R. C. Patel Educational Trust's

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Affiliated to: K. B. C. North Maharashtra University, Jalgaon-425001

Self Study Report (SSR): 2024 (4th Cycle)

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Declaration

This is to declare that, the information, reports, true copies of the supporting documents, numerical data etc. submitted in these files is verified by Internal Quality Assurance Cell (IQAC) and it is correct as per the office record.

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Place: Shirpur

Date: 15/06/2024

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Impact Of Superstations On Mental Health Among Female Teachers In Shirpur City

- Dr. Bachute Milind Bhagwanrao
R.C. Patel Arts, Commerce & Science College
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I. Introduction

Jahoda (1969) The superstition and luck are one of the factors that affect behaviors and actions of individuals and is considered a domain-specific concept of sport, academic performance, gambling, wedding etc. Most of the positive superstation's are carrying a charm,crossing fingers, touching wood in order to gain good luck and negative superstitions on the other hand effects the individual behaviorsin a different way, such as Hindus believe that cutting nails and hair on Saturdays brings bad luck, Sweeping floors in the evening drives away Laxmi from the home,breaking of mirror, The former ones constitute an external reinforcement for individual actions addressed toward the attainment of desired goals and successes functional to personal growth, while the later ones are out of personal control reinforcement of behaviors directed toward the avoiding of the bad luck and harmful significances for the individual.

Sedgwick (1973); Nsereko, (2014) past trends in mental health have pointed out that every culture has labeled its people's mental problems with its own explanation to reflect its general, social and logical concerns. Among these are the Greeks, the Egyptians, medieval England and the present-day states. African societies likewise have also described people suffering from psychological disorders in their own views which were closely associated with their environment and philosophy of life

Many people think of mental disease when they hear the term 'mental health'. But mental health is not only an absence of a mental illness; mental health is something all of us want for ourselves.

II. Literature Review

Kaur M (2005) study on mental health as related to teacher adjustment and found that there is a significant relationship between mental health and adjustment of the teacher.

Gupta (1999): study on superstition in comparison to professional students. There was no significant difference in the superstition behaviors of medical and engineering students: male and female professional graduates in.Hosteller was found to be more superstition than day scholars.

III. Methodology

3.1 Objective

* To study and associatesuperstitions in married and unmarried female teachers in shirpur city.
* To study and associate mental health of married and unmarried female teacher in shirpur city.
* To find out the associationamong the superstitions and mental health of femaleteachers in shirpur city.
* To find out the associationbetween the superstitions and mental health of married female teachers in shirpur city.
* To find out the relationship between thesuperstitions and mental health of unmarried female teachers in shirpur city.

3.2 Hypothesis

* There is no significant difference in superstitions of married and unmarried female teachers in shirpur city.
* There is no significant difference in thementtal health of married and unmarried female teachers in shirpur city.
* There is no significant relationship between the superstitions and mental health of female teachers in shirpur city.
* There is no significant relationship between the superstitions and mental health of married female teachers in shirpur city.
* There is no significant relationship between the superstitions and mental health of unmarried female teachers in shirpur city.

3.3 Variable

* **Independent Variable:** Unmarried female Teachers
  Married female Teacher
* **Dependent Variable:** Superstation Mental Health

3.4 Population: the population comprised of married and unmarriedfemale teacher in shirpur city.

3.5 Sample size: sample size consisted of 60 femaleteachers in shirpur city.

Sr. No.	Sample	N
1	Married female teacher	30
2	Unmarried female teacher	30
	Total	60

3.6. Tools:

- Superstation scale by Dr.Dixit and Dr.Dube.
- Mental health checklist-by PramodKumar.

IV. Result

Table No.1. Shows mean score of superstition among married and unmarried female teacher in shirpur city.

Superstitious	N	M	SD	t	Level of Significance
Married female teachers	30	64.29	10.34	2.51	0.05
Unmarried female	30	60.30	12.16		

The table no 1. above here shows mean scores of superstitions among married female teachers are 64.29 S.D. scores are 10.34 respectively, and unmarried femaleteacher mean score is 60.30 S.D., are12.16 respectively. Obtained t-value is 2.51more than the table value is significant at 0.05 level. This indicates superstation of married and unmarried female teachers differ significantly. Therefore hypothesisone is rejected.

Table No.2: Shows the mean scores of mental health of married and unmarried female teacher in shirpur city.

Mental Health	N	M	SD	t	Level of Significance
Married female teachers	30	24.53	5.08		0.05
Unmarried female teachers	30	22.62	5.48	2.57	

Table no. 2 above shows the mean scores of mental health of married female teacher are 24.53 and S.D. are 5.08 respectively. Unmarried femaleteachers mean score is 22.62 and standard deviation are 5.48 respectively. Obtained t value is 2.57 is less than table value significant at 0.05 level. This indicates that married and unmarried female teachers have no significant difference in the mental health in shirpur city. Therefore this hypothesis is rejected.

Table: 3: Represents the coefficient of correlation between the superstitious and mental health of married and unmarried female teachers in Shirpur city

Section No.	Variable	N	r	
a	Superstitious	60	-0.136	
	Mental health	60		
b	Superstitious is married female teachers	30	0.133	
	Mental health is married female teachers	30		
c	Superstitious is unmarried female teachers	30	0.21	
	Mental health is unmarried female teachers	30		

Table No. 3 above Section 3a represents the coefficient of Correlation between superstitions and mental health of female teacher in shirpur city. The rvalue is -0.136 present's a significant but negative relationship between superstitions and mental health of female teachers in shirpur city. Therefore hypothesis3 has no significant relationship between superstitions and mental health of female teachers in shirpur city so the hypothesis is rejected.

Table No.3 section 3b represents thecoefficient of Correlationconcerning superstitions and mental health of married female teachers. The 'r'value is -0.133 shows a significantbut negative relationship between superstitions and mental health of marriedfemale teachers in shirpur city. Therefore hypothesis 5has no significant relationship betweensuperstitions and mental health of marriedfemale teacher in shirpur city, so the hypothesis is rejected.

Table No.3 Section 3cCorrelation betweensuperstitions and mental health of unmarried female teacher'sr-value is -0.21present's significantof negative correlation. Therefore 5 hypothesis is rejected.

V. Conclusion

- There are differences between married and unmarried female teacher'ssuperstitious belief.The married teachershave more superstitions than unmarried femaleteachers in shirpur city.

- It is different between Married and unmarried femaleteacher, they differ significantly on thescore of mental health. The married teacherhas been found to have poor mental health than anunmarried female teacher in theshirpur city.

- It is significant buthas an inverse relationship between superstitions and mental health of female teacher in shirpur city. Score I of superstitions adversely affect the score of mental health.

- It is significant buthas an inverse relationship

between superstitions and mental health of married female teacher's in shirpur city.

* It is significant buthas an inverse relationship between superstition and mental health of unmarried teacher's in shirpur city.

Reference

1. Jahoda, G. (1969). The Psychology of Superstition. Harmons worth, England: Penguin

2. Jaskiran, Manjot (2015) impact of superstation attitude on mental health of female teacher

3. Nsereko, D.N. & Musisi, S. (2014). USPPDT (University student psychosocial problems development theory). Psychology Research, 4, 259-264.

4. Nsereko, D.N. (2014). Evaluating psychosocial problems among university students in Uganda: Scale development and validation. Unpublished doctoral thesis, Nkumba University, Entebbe.

5. Nsereko, D.N., Musisi, S. & Holtzman, S. (2014). Evaluation of psychosocial problems among African university students in Uganda: Development and validation of a screening instrument. Psychology Research, 2, 112-131.

6. Nsereko, D.N., Musisi, S., Nakigudde, J., & Holtzman, S. (2014). Prevalence, types, distribution, and associations of psychosocial problems among university students in Uganda. International Journal of Research Studies in Psychology, 3, 3-16.

7. Nsereko, D.N., Musisi, S., Nakigudde, J., & Ssekiwu, D. (2014). Psychosocial problems and development of psychopathology among Ugandan university students. International Journal of Research Studies in Psychology, 3, 3-16

8. Sedgwick, P. (1973). Illness: Mental and Otherwise. The Hastings Center studies.

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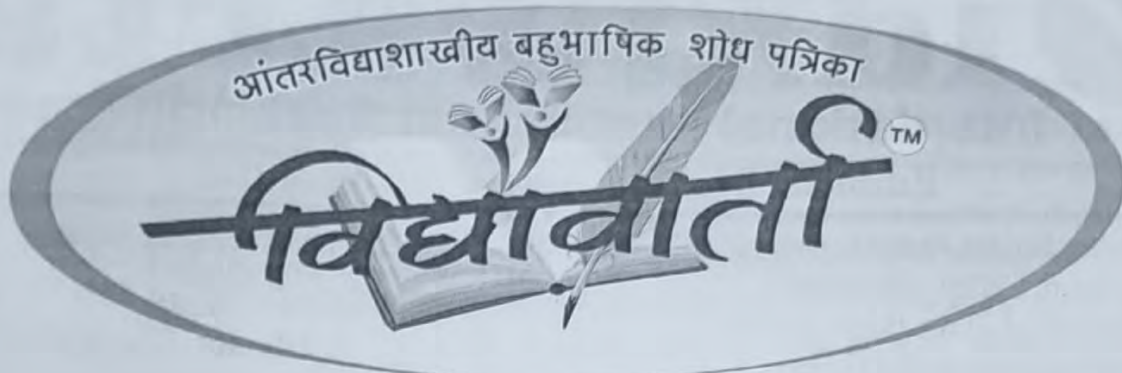
आंतरविद्याशाखीय बहुभाषिक शोध पत्रिका

विद्यावार्ता ™

विद्येविना मति गेली, मतीविना नीति गेली
नीतिविना गति गेली, गतिविना वित्त गेले
वित्तविना शूद्र खचले, इतके अनर्थ एका अविद्येने केले

-महात्मा ज्योतीराव फुले

❖ **विद्यावार्ता** या आंतरविद्याशाखीय बहुभाषिक त्रैमासिकात व्यक्त झालेल्या मतांशी मालक, प्रकाशक, मुद्रक, संपादक सहमत असतीलच असे नाही. **न्यायक्षेत्र:बीड**

५. नोकम्यात अहिल्याबाई होळकर (गौरवग्रंथ) – प्रा. इनंकय बेहरे, विद्याभारती प्रकाशन, लातूर पृ. १६२

६. किता. पृ. १६३

७. किता. पृ. १७३ व १७४.

८. दै. लोकसत्ता – अंग में २०१६ पृ. १८

९. अहिल्यानाव साप्ताहिक गोपा. सता वाकले पृ. १८

१०. नोकम्यात अहिल्याबाई होळकर (गौरवग्रंथ) – संपादक डॉ. महेंद्र शिंदे, स्नेहवर्धन प्रकाशन पुणे २०१४ पृ. १९२

११. किता. १९३

१२. अहिल्याबाई होळकर – विनया खडपेकर, राजहंस प्रकाशन, पुणें पृ. १९५

१३. नोकम्यात अहिल्याबाई होळकर (गौरवग्रंथ) – संपादक डॉ. महेंद्र शिंदे, स्नेहवर्धन प्रकाशन पुणें २०१४ पृ. १२

□□□

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स्वातंत्र्य युद्धातील खानदेशातील आदिवासी योद्धा व संदर्भ

प्रा. डॉ. आर. एल. पवार
संरक्षणशास्त्र विभाग प्रमुख,
आर.सी. पटेल महाविद्यालय शिरपूर जि. धुळे

☆☆☆☆☆☆☆☆☆☆

प्रस्तावना :-

१९४७ ला भारताला स्वातंत्र्य मिळाले ते केवळ स्वातंत्र्य लढा देऊनच. इंग्रजांना चले जाव चा नारा केवळ पंढरपणा स्वातंत्र्य सेनानींनी दिला असे नव्हे तर खानदेशात काळकोप्याात आपले जीवन व्यथित करून त्यांनी आपली संस्कृती व सामाजिक मान आणि राष्ट्रप्रेमाची जाण जोपासली होती. त्यांच्यातल्या स्वामीमानी स्वभावमुळे त्यांनी इंग्रजी सत्तेच्या विरोधात बंडाचे निशान उभारले. ब्रिटिश सत्तेविरुद्ध शस्त्र उगारण्याचे पहिले कार्य महान आदिवासी योद्धांनी केले. हिन्दुस्थानवर ज्या ज्या देशी आक्रमणे झालीत त्यांना प्रतिकार करण्याची क्षमता केवळ आदिवासी वीरांमध्ये होती. त्यांचे अतुलनीय कामगिरीचा इतिहास दुर्लक्षित झालेला दिसतो. तसेच त्यांच्या कर्तृत्वाचा इतिहासावर फारसा प्रकाश टाकलेला दिसत नाही. भारतीय स्वातंत्र्य चळवळीच्या इतिहासात आदिवासी जनतेचे योगदान महत्वपूर्ण आहे. प्रस्तुत शोध निबंधात महान आदिवासी योद्ध्यांचा व त्यांच्या प्रमुख लढ्यांचा इतिहास मांडण्याचा प्रयत्न केलेला आहे.

उद्देश :-

१. स्वातंत्र्य संग्रामातील आदिवासी महान योद्धांचे इंग्रजांविरुद्ध उठावातील योगदानाचा अभ्यास करणे.

२. स्वातंत्र्य संग्रामातील प्रमुख आदिवासी महान योद्धांचा परिचयाचा प्रचार करणे.

३. स्वातंत्र्य लढ्यातील खानदेशातील प्रमुख लढ्यांचा अभ्यास करणे.

४. इंग्रजांविरुद्ध आदिवासी लढ्ई लढ्याचा अभ्यास करणे.

संशोधन पद्धत :-

प्रस्तुत शोध निबंधात प्राथमिक व दुय्यम साधनांचे संदर्भ

घेतला असून ऐतिहासिक ग्रंथ, संशोधनपत्रिका यातून माहिती संकलन करून प्रस्तुत शोध निबंध अभ्यासपूर्ण विश्लेषणात्मक मांडण्याचा प्रयत्न केला आहे.

विषय विवेचन :-

१८१८ साली पेशवाईचा शेवट होऊन खानदेशसह महाराष्ट्रात इंग्रजी सत्ता प्रस्थापित झाली. भारतीय स्वातंत्र्याच्या चळवळीचे पर्व विलक्षण तेजस्वी आहे, देशावर प्रेम आणि आत्मसमर्पण करणा-यांचे योगदान फार मोठे आहे. महाराष्ट्रात जे आदिवासी बंडखोर होते त्यात खानदेशातील भिल्ल प्रमुख होते. इंग्रजी राजवट विरुध्द १८१८ ते १८५७ च्या स्वातंत्र्य युध्दात भिल्लांनी ब्रिटीशांच्या अन्यायी राजवटीविरुध्द उठाव केला. उत्तरेला सातपुड्या पर्यंत दक्षिणेस सातमाळा, चांदोर, अजिंठा पर्वतरांगेपर्यंत पसरलेला प्रदेश म्हणजे खानदेश होय. खानदेशातील जमातीत भिल्लांची संख्या मोठी होती. त्यांचे अधिष्ठान रानात, डोंगरकपारीत असून सह्याद्री ते सातपुडा पर्वतांची साखळीचे दुवे आदिवासी भिल्ल होय. इंग्रजांचा सततचा होणाऱ्या अन्यायामुळे भिल्ल जमात फारच हवालदिल झाली. अन्याय करणा-या गो-यांना इंगा दाखविण्याचे त्यांनी ठरविले. यासाठी सातपुडा, सातमाळा आणि अजिंठ्याच्या कुशीत वावरणारे सर्व आदिवासी भिल्ल एकत्र झाले. तलवारी आणि बनाट्या घेऊन स्वातंत्र्य युध्दात अन्यायाविरुध्द उठावात सहभागी झाले.

खानदेशातील स्वातंत्र्याचा लढा :-

पेशव्यांचा प्रदेश चार विभागात विभागून प्रत्येक विभागावर स्वतंत्र इंग्रज अधिकारी नेमले. अहमदनगर, पुणे, धारवड, व खानदेश. खानदेश विभागावर कॅप्टन ब्रिग्ज यांची नेमणुक केली. त्यावेळी खानदेशात आदिवासींनी धुमाकूळ घातला होता. इंग्रजी सत्तेविरुध्द त्यांनी बंड पुकारले होते. खानदेशात आदिवासी भिल्लांची संख्या फार मोठी होती.

आदिवासींचा भूप्रदेश खानदेश :-

महाराष्ट्राच्या उत्तरेला सातपुडा पर्वत, दक्षिणेस सातमाळा, चांदोर, अजिंठा पर्वत रांगेपर्यंत पूर्वेस हाती टेकड्या व पश्चिमेस सह्याद्री डोंगराच्या रांगापर्यंत पसरलेला हा भूप्रदेश होता. चिंचोली पट्टीचा तो प्रदेश खानदेश म्हणून ओळखला जातो. ब्रिटीश साम्राज्यकालात जळगाव व धुळे मिळून खानदेश एकच जिल्हा होता. पुढे पूर्व खानदेश व पश्चिम खानदेश असे दोन भाग करण्यात आले. खानदेश या नावाचे मूळ शोधण्याचा आजवर बराच प्रयत्न झाला. खांडनवन, कन्हदेश, स्कंददेश, खाणदेश, खानाचा देश अशी विविध नावांची उत्पत्ती संशोधकांनी केली. इ.स.१३ व्या शतकापासून या भूप्रदेशावर मोगलांची सत्ता रूढ झाली. गुजराथच्या राजाने या

भूप्रदेशावर प्रभुत्व असणा-या फारूखी घराण्यातील खान ही संज्ञा दिली. तेव्हापासून या भूप्रदेशाला खानदेश हे नाव प्राप्त झाले. याच खानदेशात वास्तव करणाज्या आदिवासी जमातींचा उल्लेख स्वातंत्र्य लढ्यातील त्यांचे योगदान महत्वपूर्ण आहे.

खानदेशातील प्रमुख आदिवासी जमाती :-

महाराष्ट्रात जे आदिवासी बंडखोर होते त्यात खानदेशातील भिल्ल, पुणे सातारा जिल्ह्यातील रामोशी ही मुख्य जमात होती. इंग्रजांनी खानदेशावर इ.स.१८१८ मध्ये ताबा मिळविला तेव्हा भिल्लांनी उठाव करण्यास सुरूवात केली. त्यांचे लढाईचे तंत्र गनिमी कावा सारखे होते. सपाटीवरच्या प्रदेशावर येऊन लुटालुट करणे, सक्तीने पैसा वसूल करणे, गुरे पळवून नेणे, प्रवाश्यांना लुटणे व पसार होणे असे लढाईचे तंत्र अवलंबिले. ब-याचदा इंग्रजांनी त्यांच्याशी सलोखा करण्याचा प्रयत्न केला. परंतु अन्याय व अत्याचार विरुध्द आदिवासींनी आपले बंड सुरूच ठेवले. १८५७ च्या स्वातंत्र्य युध्दात भिल्लांनी खानदेश, नाशिक व अंबापाणी अशा अनेक ठिकाणी इंग्रजांशी संघर्ष केला.

स्वातंत्र्य लढ्यातील खानदेशाचे महान योध्दे व त्यांचे उठाव :-

सातपुड्याच्या कुशित राहणा-या आदिवासींचे जीवन अतिशय साधे व आनंदीत होते. जंगल हा त्यांचा पोटाचा मुख्य आधार होता आणि तेच त्यांच्याकडून हिरावून घेण्याचा प्रयत्न केला. १८१९ मध्ये सर्व आदिवासी भिल्लांनी सर्व बाजूंनी उठाव केला. डोंगरी भागातील ठाणी आदिवासी बंडखोरांनी काबीज केली व आपल्या सोबतींना पठारावर पाठवून लुट करणे हे तंत्र त्यांनी वापरले. या विरोधात इंग्रजांनी कडक पावले उचलली. काही ठाणी इंग्रजांनी ताब्यात घेतल्या. बज्याच शूर आदिवासींना फाशी देण्यात आली. परिणामी आदिवासी भिल्ल अधिक क्रोधीत झाले. परिसरातील सर्व एकत्रित येऊन इंग्रजांचा अंमल असलेल्या खेड्यात लुटमार, दरोडे, खुन अशी दहशत निर्माण केली. स्वतंत्र टोळ्या इंग्रज राजवटीविरुध्द उभ्या राहिल्यात. अमळनेर उपविभागातील पारोळा गावातील उठाव कॅप्टन ब्रिग्ज च्या हत्येचा प्रयत्न झाला. यात दशरथ बांड, शेख दुल्ला यांनी सहकार्य केले. इंग्रजाविरुध्द या स्वातंत्र्य लढ्यात नेतृत्व करणारे टोळ्यांचे प्रमुख हिऱ्या नाईक, हरिया भिल्ल, गुमानसिंग, भिमा नाईक, उमेड वसवा, झुंझार नाईक, भागोजी नाईक, देवाजी नाईक, तंट्या भिल्ल, बिरसा मुंडा, तानका भिल्ल, खा-या नाईक इत्यादी प्रमुख आदिवासी योध्दे होते.

महान योध्दा उमाजी नाईक :-

उमाजी नाईक याची स्वातंत्र्य लढ्यात महत्वपूर्ण भूमिका मानली जाते. इंग्रज सत्तेला हैराण करून सोडणा-या उमाजी नाईकचा बंदोबस्त करण्यासाठी इंग्रजच नाही तर इंग्रजांच्या गुलामगिरीत पंत, सचिव, निंबाळकर, पटवर्धन, जहागिरदार, सावकार, पाटील आणि

इंग्रजांनी खास पुना हॉर्सची स्थापना करून उमाजी नाईकला पकडण्याचा जाहिरनामा रॉबर्टसनने काढला. त्या जाहिरनाम्याविरुध्द उमाजीने स्वत:ला राजा घोषित इंग्रजांना शह दिला. जाहिरनाम्याप्रमाणे खानदेशवासीयांनी त्यांना साथ दिली असती तर स्वातंत्र्य आधीच मिळाले असते.

महान योध्दा भागोजी नाईक :-

भागोजी नाईकाचा जन्म भिल्ल या आदिवासी जमातीत झाला. शेळ्यामेंढ्या चारणे हा त्यांचा मुख्य व्यवसाय होता. १८५७ च्या स्वातंत्र्य लढ्यात त्यांची महत्वाची भूमिका होती. इंग्रजांची खास नजर त्यांच्यावर होती. कारण इंग्रज सत्तेला हादरा देणारे व सळो की पळो करणारे भागोजी नाईक यांचे लढण्याचे तंत्र फारच निराळे होते. जंगलाची माहिती असल्याने उठाव करून ते पसार होत असत. १८ फेब्रुवारी १८५८ रोजी येवला येथील किल्ल्यात भागोजी नाईकाच्या टोळीवर मेजर पेंटिजर व कॅप्टन नस्सल यांनी अचानक हल्ला केला. या लढाईत भागोजींनी चाळीस इंग्रजांना ठार करून स्वत:ची सुटका करून घेतली. पुढे आपले संघटन वाढवत इंग्रजांना विरोध करीत राहिले.

महान योध्दा तंट्या भिल :-

स्वातंत्र्य लढ्यातील महान योध्दा म्हणून तंट्या भिल यांचे नाव घेतले जाते. तंट्या भिल जातीने गुन्हेगार मानला जात असे परंतु माणूस म्हणून आदर्श पुरुष होता. लहानपणापासूनच भाला फेकणे, धनुष्य बाण चालविणे, कुश्ती या गोष्टी शिकत होता. संरजामशाहीत तंट्याचे शेत गेल्याने संरजामशाहीविरुध्द सतत लढत राहिला.

महान योध्दा बिरसा मुंडा :-

बिरसा मुंडा यांनी कायदेभंगाची चळवळ उभारून आदिवासी समाज शोषण मुक्त करण्याचा प्रयत्न केला. राजकीय आंदोलन चालवून आदिवासींचे पारंपरिक हक्क, सांस्कृतिक अधिकार या विरुध्द उठाव केला. १८९५ मध्ये शेतसारा न भरण्याचे व कायदेभंगाचे आव्हान केले, त्यात त्यांना २० वर्षांचा तुरूंगवास झाला. पुढे इंग्रजांनी त्यांना मुक्त केले, जून १९०० मध्ये त्यांचा मृत्यू झाला.

महान योध्दा खा-या नाईक :-

खानदेशात खा-या नाईक यांनी इंग्रजी सत्तेला मोठे आव्हान केले होते. त्या काळात त्यांचे नाव घेण्यासही लोक घाबरत. त्यांचा जोडीदार भिमा नाईक या दोघांनी मिळून १५०० भिल्लांची फौज उभी केली. नोव्हेंबर १८५७ मध्ये कलेक्टर साहेबांचा मुक्काम होता. त्यांच्या शेजारील गावे लुटून कलेक्टरला शह दिला. खा-या व भिमा नाईक यांनी इंदोरहून मुंबईकडे इंग्रजांचा बैलगाडीतून चाललेला खजिना मोठ्या हिमतीने लुटला. इंग्रजांविरुध्द या दोन महान योध्दांनी स्वातंत्र्यासाठी शौर्य दाखविले.

महान योध्दा हरिया भिल :-

आदिवासींच्या उठावांपैकी अत्यंत परिणामकारक संघर्ष म्हणजे १८२२ मध्ये हरिया भिल्ल याने खानदेशात ब्रिटीशांविरूध्द बंड केले. त्याच्या विरोधात कॅप्टन रॉबिनसन यांची नियुक्ती करण्यात आली. हरिया भिल्ल याला शोधण्याचा इंग्रजांनी खुप प्रयत्न केला परंतु हरिया इंग्रजांच्या हाती लागला नाही. सातपुड्याच्या पर्वतरांगामध्ये पसार होवून गुप्तपणे नेतृत्व करीत राहिला.

महान योध्दा गुमान नाईक :-

१८२४ मध्ये गुमानसिंग नाईक हा थाळनेर परिसरातील सातपुड्याच्या पर्वतरांगामध्ये लुटमार करीत होता. त्याचा उपद्रव कमी व्हावा यासाठी ले. ऑड्रान, ले. लिग्वीस्टन यांची नियुक्ती करण्यात आली. थाळनेर परिसरात जवळपास ३५ घरे जाळून टाकली. चार पुरूष दोन स्त्रिया ठार झाल्या याचा परिणाम इंग्रज सरकारवर झाला. शांतता प्रस्थापित करण्यासाठी इंग्रजांनी बराच प्रयत्न केला. परंतु त्याचा फारसा परिणाम झाला नाही.

११ एप्रिल १८५७ चा खा-या नाईक व इंग्रज संघर्ष :-

आदिवासी भिल्लांचा उटावाचे स्वरूप दिवसेंदिवस वाढत होते. इंग्रज पलटणी हैराण झाल्यात. भिल्ल त्यांना पूरन उरलेत. खानदेशातील शिरपूर पासून २४ कि.मी. अंतरावर असलेल्या अंबापाणी येथे असलेल्या भिल्ल व ब्रिटीश सैन्यात भिषण लढाई झाली. आदिवासींचे नेतृत्व खा-या नाईक करीत होता. सोबत दौलतसिंग, महादेव नाईक, भिमा नाईक, हनुमंतराव नाईक हे मुख्य होते. अक्राणीमहाल भागात ब्रिटीशांविरुध्द असलेला काळूबाबा खा-या नाईकला येवून मिळाला. ११ एप्रिल १८५७ रोजी मेजर इव्हासन्स कॅप्टन बर्च, ले. वेसवी यांनी भिल्लांवर हल्ला केला. त्यात ६५ भिल्ल शहिद झाले, १७० जखमी झाले. कॅप्टन बर्च, ले.वेसवी जखमी झालेत. या लढाईत एक ब्रिटीश अधिकारी मारला गेला. या लढाईनंतर ड्रम ट्रायल खटला होवून ६२ आरोपींपैकी ५७ आरोपींना गोळ्या घालून ठार मारण्यात आले. या घटनेचा बदला नगरच्या भिल्लांनी घेतला. नांदगावच्या आसपास ते एकत्रित झाले ही बातमी ले.स्टुअर्टला कळताच ३०० सैनिकांची पलटण ४०० भिल्ल सैनिक अशी भिडत झाली. भिल्लांनी नदी किना-याने लगतच्या दाट झाडीचा आश्रय घेतला. दोघी बाजूंनी हल्ला सुरू झाला. भिल्लांनी इंग्रजांवर अक्षरश: आग ओकायला सुरूवात केली. त्यांच्या आगीच्या मा-याने कॅप्टन मॉर्टेगोमेरी जखमी झाला. कॅप्टन स्टुअर्ट मरण पावला. ५० इंग्रज सैनिक जखमी झाले. त्यात कॅप्टन चेंबरलेस, कॅप्टन डॉक्सीन यांचा समावेश होता. या लढाईत २५ भिल्ल शहिद झाले. या लढाईत इंग्रजांना विजय मिळाला असला तरी आदिवासी भिल्लांचा उटाव, संघर्ष सुरूच होता.

१७ नोव्हेंबर १८५७ ची खजिना लूट :-

१७ नोव्हेंबर १८५७ पर्यंत खा-या नाईक व भिमा नाईक यांनी १५०० लोकांची टोळी तयार केली. त्यावेळच्या खानदेशच्या हद्दीपासून ३० मैलांवर उत्तरेस होळकरांच्या हद्दीतील जामली चौकीजवळ इंदोरहून मुंबईकडे जाणारा सात लाखाचा खजिना बैलगाड्यातून जात होता तो त्यांनी लुटला. या घटनेचा इंग्रज सत्तेला जबरदस्त आघात झाला. त्यानंतर संधवा घाटात टेलीफोनच्या तारा तोडल्या, पोस्ट ऑफिस लुटले, अफुने भरलेली सात बैलगाड्या लुटल्या. २९ ऑक्टोबर १८५७ रोजी शिरपूरवर हल्ला केला. ही घटना म्हणजे इंग्रज सत्तेच्या विरूध्द मोठे बंडच होते. कारण कॅप्टन बर्च हे या विभागाचे नेतृत्व करीत होते.

झुंझार नाईक व इंगज संघर्ष :-

खानदेशात चिखली नावाची दोन संस्थाने होती. एक गंगथा व दुसरी शहादा चिखली. झुंझार नाईक हा शहादा चिखलीच्या जहांगिरदारात एक बलाढ्य सरदार होता. तुकोजी होळकरांपासून चिखलीच्या जहांगिरदारचे होळकरांबरोबर संबंध होते. होळकरांबरोबर मोहिमेवर जात असतांना राणा भिकाजीने झुंझार नाईकचा वध केला त्याचा मुलगा देवाजी नाईक याने आपल्या पित्याचा बदला घेण्यासाठी स्वतंत्र टोळी जमविली व अक्राणीवर हल्ला केला. अक्राणी किल्ल्यावर लुटालुट करून जाळपोळ केली. आपल्या पित्याचा वध करणा-या भिकाजीचा त्याने वध केला. पुढे पेशवाई जावून इंग्रज सत्तेवर आले. कॅप्टन ब्रिग्ज यांनी देवाजी नाईकची पराक्रमी वृत्तीचा दखल घेत चिखली संस्थानची जहांगिरी त्याला दिली व आपल्या सैन्यात 'क' श्रेणीच्या लष्करी सेवेत सामावून घेतले. पुढे १८१८ च्या सुमारास जहांगिरदारच्या सनदांचा तपास करण्यासाठी पाडळदा येथे ब्रिटीश अधिकारी आले. देवाजी नाईकची सनदची मागणी करताच ही माझी सनद आहे म्हणून ब्रिटीश अधिका-यावर तलवार उगारली. पुढे इंग्रजांनी पकडून धुळे येथील तुरूंगात डांबले.

निष्कर्ष :-

१. खानदेशातील आदिवासी भिल्ल जमात मुळातच पराक्रमी व स्वाभिमानी तसेच राष्ट्रप्रेमी होती. त्यांनी इंग्रज जुलमी सत्तेचा विरोध केला. ठिकठिकाणी बंड करून इंग्रजांना हैराण केले.

२. स्वातंत्र्य लढ्यात केवळ खानदेशातील नव्हे तर महाराष्ट्रभर आदिवासीची संघटना होती. त्यांनी ठिकठिकाणी टोळ्या टोळ्यांनी इंग्रजांविरूध्द उठाव करून संघर्ष केला.

३. सातपुडा पर्वत रांगेत वास्तव्य करणारे व ज्यांची पोट त्या वन्य जंगलावर आधारित होती. अशा जंगलावर अमंल बसवून ते नष्ट करण्याचा प्रयत्न स्थानिक सावकार, जमिनदार, व्यापारी यांना इंग्रजांनी संरक्षण देवून त्यांच्या विरोधात कार्यवाही केल्यात. त्याचा बदला म्हणून येथील आदिवासी भिल्लांनी स्थानिक जमिनदार व इंग्रजांविरूध्द बंड पुकारले. लुटमार करणे, खुन करणे, टोळ्या

टोळ्यांनी संघर्ष करणे आदिवासी भिल्लांना पर्याय नव्हता.

४. आदिवासी भिल्ल जमातीचा लढा केवळ इंग्रज सत्तेविरूध्द होता. स्थानिक जनतेला त्यांनी त्रास दिला नाही.

सारांश :-

इंग्रज सत्तेत आल्यावर खानदेशातील आदिवासींच्या जंगल जमीन या मुख्य उदरनिर्वाहाच्या साधनावर कडक नियम व कायदे लावले त्यांना जंगलातून हाकलण्याचा प्रयत्न केला, म्हणून आदिवासींनी इंग्रजांविरूध्द बंड पुकारले. खानदेशचा भूप्रदेश आणि तेथील आदिवासी जमात मुळातच लढाऊवृत्तीची असल्याने इंग्रजांना त्यांच्या विरूध्द फार कौशल्य पणाला लावावे लागले. स्वातंत्र्य युध्दात आदिवासीची मोलाची कामगिरी दिसते. त्यांनी इंग्रजांना हैराण करून सोडले. त्यांच्या या बलिदानाची नोंद इतिहासात फार कमी आढळते. याचे मुख्य कारण या आदिवासी जमातीत शिक्षणाचा अभाव होता. शिक्षणाची गंगा त्यांच्याकडे जाई पर्यंत उशिर झाला. परंतु त्यांच्या बलिदानाची, त्यागाची व लढाऊ बाण्याची या खानदेशातील सातपुड्याच्या पर्वतरांगेत सदैव गुंजत आहे. त्यांच्या शौर्यगाथा उभा खानदेश कधीही विसरू शकणार नाही.

संदर्भ :-

१. Kayande, Shyam - Popular Resistance To British Rule In North Maharastra (१८१८-१८८५), Kasab Prakashan, Jalgaon, १९९८

२. पाडवी विरसिंग - आदिवासी जीवन संघर्ष, प्रकाशक रेखा पाडवी, संतकृपा प्रेस नंदुरबार

३. कुलकर्णी अ.रा. - कंपनी सरकार, राजहंस प्रकाशन पुणे, २००४

४. शाह जी.बी. - धुळे व नंदुरबार जिल्ह्याचे स्वातंत्र्य चळवळीतील योगदान, प्रथमेश प्रकाशन, २००४

५. महाजन टी.टी. - खानदेशचा राजकीय व सांस्कृतिक इतिहास, कॉन्टिनेन्टल प्रकाशन पुणे, १९९८

६. गोरे गोविंद - सातपुड्यातील भिल्ल, कॉन्टिनेन्टल प्रकाशन पुणे

७. पाटील मधुकर- कंपनी सरकारकालीन खानदेश, शिवम प्रकाशन, नंदुरबार, २००७

८. देसाई संभाजी - आदिवासी समाज, देवरे डी.बी., प्रशांत पब्लिकेशन जळगांव, २०१५

९. देसाई संभाजी - आदिवासी समाज, पवार आर.एस., प्रशांत पब्लिकेशन जळगांव, २०१५

१०. गायकवाड दिपक - आदिवासी चळवळ स्वरूप व दिशा, सुगावा प्रकाशन पुणे, २००५

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In vitro Hmg-Coa Reductase Inhibitory Effect and Kinetic Properties of *Terminalia arjuna* (Roxb.) Wight & Arn.

MOHINI P. PATIL, SAMADHAN G. PATIL, BHUSHAN S. BHADANE
AND RAVINDRA H. PATIL*

ABSTRACT

Hypercholesterolemia is the leading cause of development of coronary artery diseases (CADs) and atherosclerosis. HMG-CoA reductase (HMGR) is the key enzyme in the cholesterol biosynthesis pathway and therefore it is considered as an ideal target for controlling the endogenous cholesterol biosynthesis. Several anti-hypercholesterolemic drugs have been developed which can selectively inhibit this enzyme. However, the associated side effects and the cost of these drugs have been the main constrain for their clinical use. In the present study, Terminalia arjuna (Roxb.) Wight & Arn. bark extract was investigated as an inhibitor of HMGR and its kinetic parameters were studied in an attempt to explain its hypolipidemic activity. The bioassay guided fractionation of the crude extract afforded a colorless semisolid compound that showed highest inhibition in comparison with a standard inhibitor, Atorvastatin. In the presence of purified fraction, the value of apparent K_m (K_{mapp}) was found to be increased whereas apparent V_{max} (V_{maxapp}) remained unchanged. Inhibition constant (K_i) of purified fraction was found to be significantly lower than the positive control (atorvastatin). The kinetic data revealed that the purified fraction was able to inhibit HMGR competitively.

Key words: HMG Co-A reductase, *Terminalia arjuna*, Atorvastatin, Inhibition constant, V_{max}

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INTRODUCTION

Use of medicinal plants for the treatment of human illness is as old as human civilization. India has a vast treasure of medicinal plants and thousands of species of Indian medicinal plants as well as plant derived products are known for their ethnomedicinal potential. Plant bioactive metabolites have various physiological and metabolic effects. Moreover, plant derived medicine has no adverse effects as compared to their synthetic counterparts.

From last two decades, plant-derived medicine is used all over the world for the management of life style related disorders such as type 2 diabetes, cardiovascular disease and stroke. Hypercholesterolemia is one of the major contributing factors leading to heart diseases (Dallas, 2001; Patil *et al.*, 2010). Cholesterol is the important component of the membranes and it acts the precursor for the synthesis vitamin D and several steroidal hormones. It is derived from diet as well synthesized by indigenous biosynthesis. Since, more than two third of the total body cholesterol is obtained through indigenous biosynthesis, inhibiting the cholesterol biosynthesis is considered as an attractive target for controlling the serum cholesterol level. 3-hydroxyl-3-methylglutaryl coenzyme-A reductase (HMGR, *EC* 1.1.1.88), is the key enzyme in cholesterol biosynthesis pathway which carry out conversion of HMG-CoA to mevalonate (Endo *et al.*, 1976). Statins- the fungal secondary metabolites competitively inhibit HMGR and they have widely been used as potent anti-hypercholesterolemic drugs. Lovastatin was the first highly potent inhibitor of HMGR and hence approved by FDA as a cholesterol lowering drug (Endo, 1979). Success of lovastatin followed discovery of many synthetic derivatives of statins and their clinical use has resulted in decrease in the episodes of cardiovascular events and number of deaths all over the world (Scandinavian Simvastatin Survival Study, 1994). Despite the potential anti-hypercholesterolemic effects of statins, some reports demonstrated increase in cancer risk and alteration in glucose metabolism (Peto *et al.*, 2008). Moreover, Statins are known to produce significant toxic effects such as liver focal hypoplasia, cataracts, muscle toxicity and degeneration of central nervous system (Maron *et al.*, 2000). Presence of HMGR inhibitors is also reported in some natural sources such as red yeast rice, several chines herbs, vegetables and fruit (Shoichet, 2004; Daidone *et al.*, 2012). The present study aimed to evaluate the *in vitro* HMGR inhibitory activity of bark extract of *Terminalia arjuna*, to discover anti-hypercholesterolemic drug candidate which is cheaper and safer than the synthetic drugs. The HMGR inhibitor is purified from the bark extract by activity guided fractionation and the inhibition kinetics is studied.

MATERIAL AND METHODS

Plant Material and Extraction

The bark of *Terminalia arjuna* was collected from the region of Toranmal hill station area (MS, India). The plant material was identified and authenticated by expert taxonomist during the flowering and fruiting condition. Authentication bark and other plant parts were done at Department of Botany R.C. Patel Arts, Commerce, and Science College, Shirpur (MS, India) and the voucher specimen was deposited (RCP-02/2016) in the same department. The bark of plant was thoroughly washed with tap water, shade dried, and powdered. Shade dried bark powder was subjected to the solvent extraction with methanol in Soxhlet extractor for 74 hat 65°C. After extraction, the extract were concentrated using rotary vacuum evaporator under high pressure to obtain dry residue and stored in refrigerator until further use.

Bioassay Guided Fractionation

The crude extract of bark of *T. arjuna* was subjected for bioactivity guided fractionation using silica gel (60-120 mesh size) column chromatography. The dried crude extract (~ 50 g) was dissolved in methanol and adsorbed onto the silica gel and the resulting slurry was air dried, and applied on packed column (30 cm × 5 cm) which was pre-conditioned with petroleum ether. The column was eluted with 100% petroleum ether. The polarity of mobile phase was then gradually increased using petroleum ether and chloroform with proportion of 9:1, 8:2, 6:4, 1:1, 2:8 (v/v) and finally with the chloroform and methanol [8:2, 1:1, 2:8 (v/v)]. Various fractions were collected with size of 5 mL and matched by TLC for homogeneity using different mobile phases. The fractions having the similar R_f values were mixed together and re-crystallized for further characterization. The tentative identification of fractions is confirmed by the preliminary phytochemical screening according to the Wagner and Balt (1996).

In vitro HMGR Inhibition Assay

The activity of HMGR (EC 1.1.1.88) was measured by the method described in the protocol provided by the manufacturer of HMGR assay kit (Sigma Aldrich, Saint Louis, MO, USA). Eluted fractions by column chromatography of *T. arjuna* extract were screened for *in vitro* inhibition of HMGR. The assay was based on spectrophotometric measurement of the decrease in absorbance at 340 nm, which represent the oxidation of NADPH by the catalytic subunit of HMGR in the presence of substrate HMG-CoA. Briefly, the reaction mixture containing, 910 µL assay buffer (1x), 20 µL NADPH, 60 µL HMG-CoA and 5 µL HMGR (0.6 mg U/mL). Atorvastatin was used as standard inhibitor.The solution was mixed immediately and assayed for

decrease in absorbance at 340 nm at the interval of 20 second up to 10 min using a Bio-Cell adapter placed in microplate reader carrier (Biotek, Winooski, VT, USA). The inhibition of HMGR was recorded with and without fractions. The HMGR activity was expressed as U/mg protein which converts 1 μ mole of NADPH to NADP+ per one min at 37°C and pH 7. The enzyme activity was calculated using following formula-

$$\text{Enzyme Units/mL} = \frac{(\Delta A_{340nm}/\text{min Test} - \Delta A_{340nm}/\text{min Blank}) \times (1)}{(12.44)\,(0.005)}$$

Where, 1= Total volume (in mL) of reaction mixture, 12.44 = Micro molar extinction coefficient of NADPH at 340 nm, 0.005 = volume (in mL) of enzyme used in an assay. All experiments were conducted in triplicate and the data were analyzed by using Simultaneous Nonlinear Regression (SNLR) method.

Kinetics of HMGR and Its Inhibitors

The initial rate of enzyme catalyzed reaction was calculated by Michaelis-Menten equation. K_m and V_{max} were obtained from Linewaver-Burk double reciprocal plot. Other kinetic parameters *viz*; inhibition constant (K_i) of crude extract of endophytic fungi and Orlistat standard were determined using Dixon plot (1/v versus [I]) plot. Turnover number (K_{cat}) was calculated as V_{max}/E_t. The specificity constant was expressed as K_{cat}/K_m.

Statistical Analyses

All the kinetic parameters of enzyme HMGR and its inhibitors were obtained by simultaneous non-linear regression analysis using the Sigma plot 12 software (Bangalore, India). Each point in the graphs represents the mean ± standard errors of three separate experiments.

RESULTS AND DISCUSSION

The fractions obtained by activity guided fractionation were evaluated for inhibition of HMGR. The kinetic parameters were studies using a single substrate-single inhibitor approach, whereas, the mode of inhibition was studied by Lineweaver-Burk double reciprocal plot and Dixon plot. The HMGR followed Michaelis-Menten kinetics when HMG-CoA is used as a substrate (Fig. 1A). However, in presence of inhibitor, a dose dependent decrease was observed in initial velocity (Fig. 1B).

The Lineweaver-Burk shows no change in the intercept of axis of 1/v as function of increase in inhibitor concentration (Fig. 2A). The inhibition constant (K_i) of the purified fraction of *T. arjuna* bark extract and atorvastatin standard was found to be 6.19 ± 0.71 μg/ml and 6.95 ± 0.98 (nM), respectively. (Fig. 2B, Table 1).
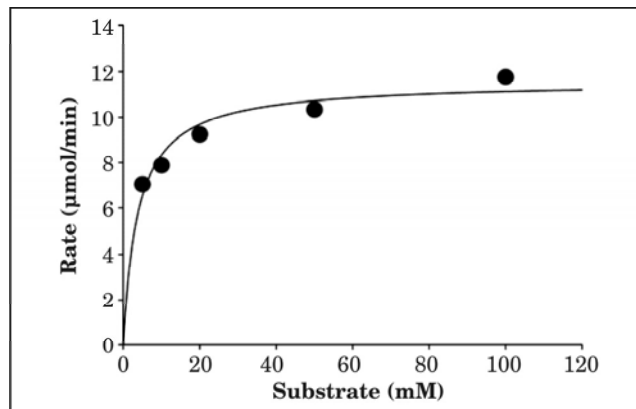
Fig. 1: Substrate-Velocity (Michaelis-Menten) curve of enzyme HMGR in the absence of inhibitor (A) and in the presence of inhibitor (B).
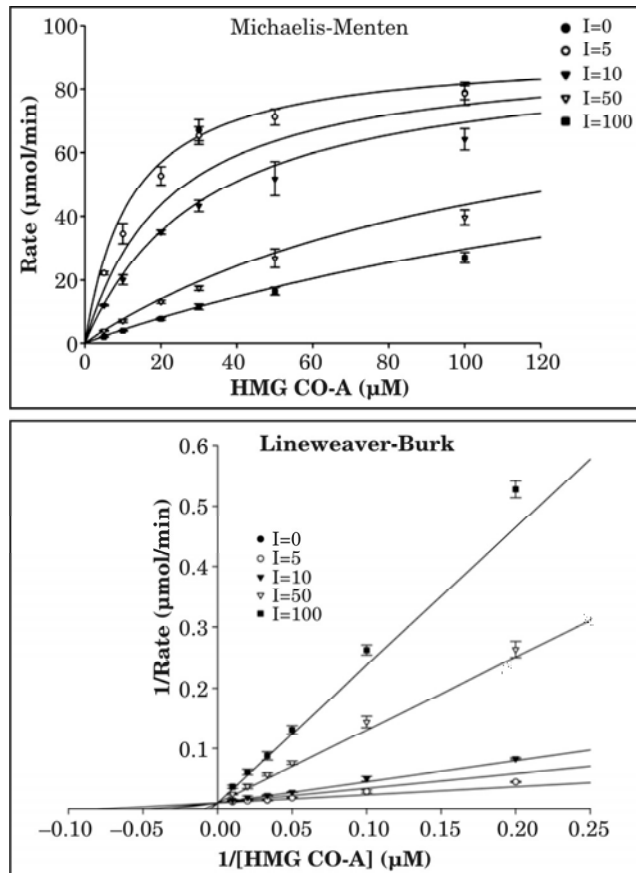
Fig. 2: Competitive inhibition of HMGR by *T. arjuna* fraction. (A) Lineweaver-Burk and (B) Dixon plot.

The fractionated compound as well as atorvastatin standard showed increase in apparent K_m while apparent V_{max} remained unchanged. The specificity constant (K_{cat}/K_m) for purified fraction and atorvastatin standard was found to be 0.43 and 4.2×10^{-3}, respectively (Figs. 3A and B, Table 1).
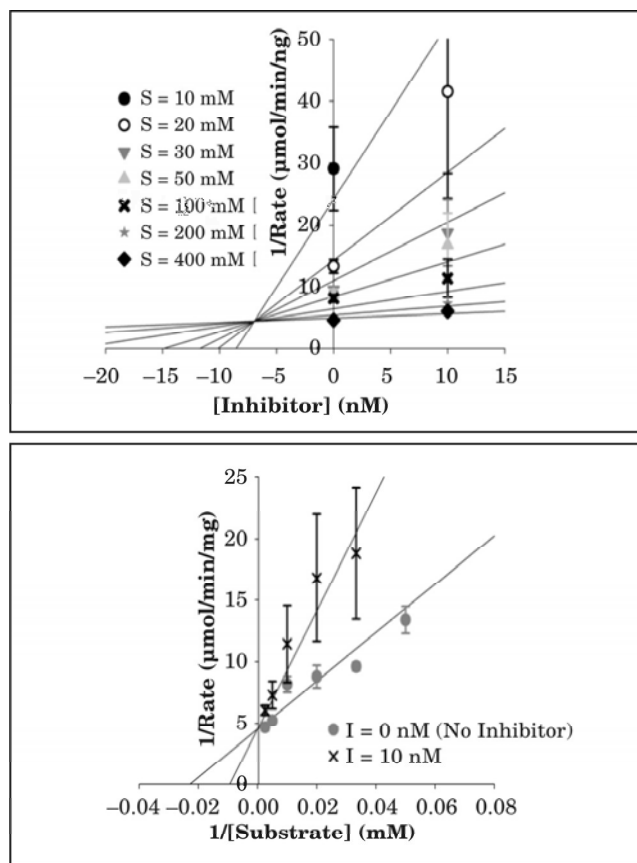
Fig. 3: Competitive inhibition of HMGR by atorvastatin standard. (A) Lineweaver-Burk and (B) Dixon plot.

Table 1: Kinetic parameters of HMG Co-A reductase in the presence and absence of inhibitors

Parameters	*No inhibitor*	*T. arjuna fraction*	*Atorvastatin*
k_m (μM)	12.15 ± 1.34	n/a	n/a
V_{max} (μmole/min)	91.56 ± 2.81	n/a	n/a
K_{mapp} ($_m$M)	n/a	16.3	77.99
V_{maxapp} (μmole/min)	n/a	92.85	0.199
K_i (μg/ml)	n/a	6.19 ± 0.71	6.95 ± 0.98 (nM)
K_{cat} s-1	9.32 ± 0.42	$7.16 \pm 0.0.46$	0.333 ± 0.01
$K_{cat}/K_{m\ (min-1\ mM-1)}$	0.74	0.43	4.2×10-3
type of inhibition	n/a	competitive	Competitive

All tested concentration of fractionated compound and atorvastatin (standard) inhibited HMGR in a dose dependent manner. The enzyme activity in presence of purified compound was found significantly lower (P <0.05) than control (without inhibitor). Moreover, the IC_{50} of fractionated compound was found comparable with atorvastatin (data not shown). The kinetic study revealed that the fractionated compound from the methanol extract of *T. arjuna* bark inhibited the HMGR in a competitive way.

Increased level of serum cholesterol increases the risk of CHDs several fold. Statins are widely prescribed for controlling the hypercholesterolemia but use of statins has several undesirable side effects (Peto *et al.*, 2008). They are known to produce significant toxicity. The toxic effects include increases in hepatic transaminases, atypical focal hyperplasia of the liver, cataracts, vascular lesions in the central nervous system (CNS) and skeletal muscle toxicity (Maron *et al.*, 2000). Moreover, inhibition of HMGR using other inhibitors affects synthesis of other nonsterol isoprenoids which play important role for normal function of the cell (Endo, 1992). Use of medicinal plants and plant derived products for health management is the imperative part of our tribal culture. A number of natural products have been screened as HMGR inhibitors and their efficiency was validated *in vitro* as well as *in vivo*. Lin *et al.* (2015) demonstrated the HMGR inhibitory effect of curcumin and salvianolic acid C with an IC_{50} values comparable to the standard. Long-chain primary alcohols such as policosanols, is shown to decrease serum cholesterol in animals and in humans (Singh *et al.*, 2006). Various parts of *T. arjuna* such as the bark, leaves and fruits have been used in indigenous system for curing a number of ailments (Warrier *et al.*, 1996). The bark is said have aphrodisiac, expectorant, tonic, styptic, antidysenteric, purgative and laxative and cardioprotective effects (Gupta *et al.*, 2001; Patil *et al.*, 2010). Traditionally, an alcoholic decoction of its bark was widely prescribed (Nadkarni and Nadkarni, 1954; Warrier *et al.*, 1996). It has hypolipidemic activity, as well as it is used as a cure for congestive heart failure, CHDs, myocardial necrosis, angina, atherosclerosis and ischemia-reperfusion injury. (Dwivedi and Agarwal, 1994; Gauthaman *et al.*, 2001). The terpene glycosides of the bark extract such as arjunin, and a lactone, arjunetin (Honda *et al.*, 1976) and flavonoids like arjunolone, flavones, bicalein and quercetin have been characterized for various biological activities (Sharma *et al.*, 1982). However, to the best of our knowledge, this is the first report on HMGR inhibitory activity of *T. arjuna*.

CONCLUSION

Management of hypercholesterolemia through new potent inhibitors is of high priority among researchers worldwide. However, the life style-related diseases such as CHDs and atherosclerosis are preventable. Medicinal plants serve as potential source of bioactive metabolites for the treatment of CHDs. However, their structural characterization, standardization and mode of

action are necessary for their clinical use. High-throughput *in vitro* and *in vivo* screening of natural products can be an efficient strategy to discover new specific inhibitors of HMGR that can lead to develop a drug candidate for hypercholesterolemia. Also, there is a renowned interest among the people for plant derived medicine all over the world. Thus, the therapeutic benefits of plant based metabolites should be the focus of our current drug discovery efforts studies (Stravic, 1994; Corson, 2007).

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REFERENCES

Corson, T.W. and Crews, C.M. (2007). Molecular understanding and modern appli-cation of traditional medicines: Triumphs and trials. *Cell,* 130: 769–774.

Daidone, F., Montioli, R., Paiardini, A. *et al.* (2012). Identification by virtual screening and *in vitro* testing of human DOPA decarboxylase inhibitors. *PLoS One,* 7: 31610.

Dallas, T.X. (2001). Heart and stroke statistical Update. American heart association, New York. 16: 250–350.

Dwivedi, S. and Agarwal, M.P. (1994). Antianginal and cardioprotective effects of *Terminalia arjuna*, an indigenous drug in coronary artery disease. *J. Asso. Physi. Ind.*, 42: 287–289.

Endo, A. (1979). A new hypocholesterolemic agent produced by *Monascus* species. *Tokyo Journal of Antibiotics*, 32: 852–856.

Endo, A. (1992). The discovery and development of HMG-CoA reductase inhibi-tors. *J. Lipid Res.*, 33: 1569–1582.

Endo, A., Kuroda, M. and Tasujita, Y.J. (1976). ML-236 A, ML-236 B and ML- 236 C, new inhibitors of cholestrogenesis produced by *Penicillium citrinum*. *Journal of Antibiotics,* 29: 1346–1354.

Gauthaman, K., Banerjee, S.K., Dinda, A.X., Ghosh, C.C. and Maulik, S.K. (2005). *Terminalia arjuna* (Roxb.) protects rabbit heart against ischemic-reperfusion injury: Role of antioxidant enzymes and heat shock protein. *J. Ethnopharmacol.*, 96: 403–409.

Gauthaman, K., Maulik, M., Kumari, R., Manchanda, S.C., Dinda, A.K. and Maulik, S.K. (2001). Effect of chronic treatment with bark of *Terminalia arjuna*: A study on the isolated ischemic-reperfused rat heart. *J. Ethnopha.*, 75: 197–201.

Gupta, R., Singh, S., Goyle, A. and Sharma, V.N. (2001). Antioxidant and hypocholesterolemic effect of *T. arjuna* tree bark: A randomized placebo controlled trial. *J. Assoc. Physi. Ind.*, 49: 231–235.

Honda, T., Murae, T., Tsuyuki, T. and Takahashi, T. (1976). The structure of arjungen: A new sapogenin from *Terminalia arjuna*. *Chemi. Pharma. Bulle.*, 24: 178–180.

Lin, S.H., Huang, K.J., Weng, C.F. and Shiuan, D. (2015). Exploration of natural product ingredients as inhibitors of human HMG-CoA reductase through structure-based virtual screening. *Drug Design, Development and Therapy*, 9: 3313–3324.

Maron, D.J., Fazio, S. and Linton, M.F. (2000). Current perspective on statins. *Circulation.*, 101: 207–213.

Nadkarni, A.K. and Nadkarni K.M. (1954). Indian Materia Medica, 1st ed. Popular Book Depot, Bombay India. 1198.

Patil, R.H., Krishnan, P. and Maheshwari, V.L. (2011). Production of Lovastatin by Wild Strains of *Aspergillus terreus*. *Natural Product Communications*, 6(2): 181–186.

Peto, R., Emberson, J., Landray, M., Baigent, C., Collins, R., Clare, R. *et al.* (2008). Analyses of cancer data from three ezetimibe trials. *N. Engl. J. Med.*, 359: 1357–1366.

Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: The Scandinavian Simvastatin Survival Study (4S). *Lancet*, 1994, 344(8934): 1383–9.

Sharma, P.N., Shoeb, P.N., Kapil, R.S. and Popli, S.P. (1982). Arjunolone - a new flavone from stem bark of *Terminalia arjuna*. *Ind. J. Chem.*, 21B: 263–264.

Shoichet, B.K. (2004). Virtual screening of chemical libraries. *Nature*, 432: 862–865.

Singh, D.K., Li, L. and Porter, T.D. (2006). Policosanol inhibits cholesterol synthesis in hepatoma cells by activation of AMP-kinase. *J. Pharmacol. Exp. Ther.*, 318: 1020–1026.

Stravic, B. (1994). Antimutagens and anticarcinogens in foods. *Food Chem. Toxicol.*, 32: 79–90.

Wagner, H. and Bladt, S. (1996). Plant Drug Analysis. A Thin Layer Chromatography Atlas. Springer-verlag, Berlin, Heidelberg.

Warrier, P.K., Nambiar, V.P.K. and Ramankutty, C. (1996). *Terminalia arjuna*. *In*: Warrier, P.K., Nambiar, V.P.K. and Ramankutty, C. (*eds.*), Indian Medicinal Plants- A Compendium of 500 Species, vol. 5, 1st ed. Orient Longman Limited, Madras, India. pp. 253–257.
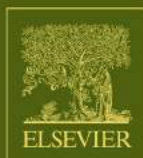
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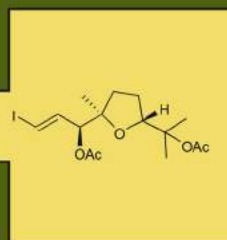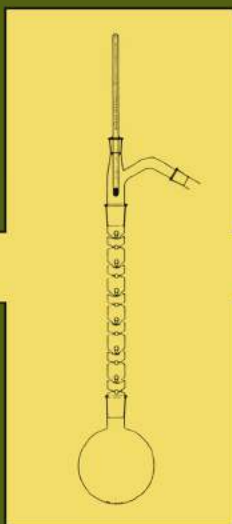
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Chapter 6

Protease Inhibitors and Their Applications: An Overview

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Chapter Outline

INTRODUCTION

Biochemical reactions in living systems are catalyzed by a series of enzymes and are tightly controlled by specific protein and nonprotein enzyme inhibitors. Enzyme inhibitors bind to an enzyme and arrest its catalytic action [1], which make them useful tools in the study of enzyme structures and reaction mechanisms and their applications as therapeutics in medicine and biocontrol agents in agriculture [2–6]. Proteases play a major role in the posttranslational processing of proteins, protein catabolism, and various pathological processes, and therefore, they become a natural target for protease inhibitors (PIs). Several natural, specific, and selective PIs are now known as major regulating proteins to control proteolytic activity in all life forms [7]. PIs find diverse applications in diagnostics and therapeutics, to treat various microbial

[hepatitis, herpes, AIDS, aspergillosis], mortal (arthritis, muscular dystrophy, malaria, cancer, obesity), neurodegenerative, and cardiovascular diseases [8]. In addition, they are indispensable tools to use to (1) study enzyme structure; (2) control herbivorous pests and fungal, postharvest microbial infections [9–11]; (3) stabilize proteases in commercial products [12]; (4) prevent undesired proteolysis during heterologous expression of protein extraction; and (5) prolong the shelf life of many proteinaceous types of seafood [13]. The discovery of PIs in plants displaying specific inhibitory activities against digestive enzymes of insects drew attention to controlling phytophagous insect pests and pathogen (fungal) invasion through antinutritional interactions and losses in crop yield and quality [14]. The proven biocontrol activity of PIs against plant pathogens and herbivorous pests [11] may help to curtail extensive chemical pesticide use, eventually reduce heavy losses in crop yield, and improve the quality of agricultural produce [15]. At present, there are several small PIs for each mechanistic class of proteases [serine, cysteine, aspartyl, and matrix metalloproteases (MMPs)] identified from plants, animals [16,17], and microbial sources [18–20]. The majority of PIs come from plants, and a few have animal origins; they (1) exhibit limited specificity, (2) inhibit only proteases (trypsin) belonging to a single mechanistic class, (3) bind and block access to the active site of target proteases and do not bind in a strictly substrate-like manner, (4) insensitive to the pH range 2–10 with varying thermostability [21], (5) show poor structural stability in a variety of environmental conditions, (6) accumulate at high concentrations in tissue in response to wounds (10% of the total proteins) [22], (7) function as defense agents to protect plants from invading pests [23], (8) exhibit competitive inhibition, and (9) require more space, time, and cost to obtain in a pure form because a long duration is required for the cultivation/growth of plants and animals.

The application of PIs from bench to business for agriculture/biotechnology purposes depends on (1) structural stability under a range of environmental conditions, including pH and high affinity for various digestive proteases of pests [16,22]; (2) rapid binding to their target protease(s) to form a tight complex with an association rate constant (K_{ass}) of $>10^5$ per M and a binding constant K_i of $<10^{-9}$ M [24]; (3) broad specificity toward the major mechanistic classes of proteases; (4) the capacity to function even in low concentrations; and (5) economical production. Microorganisms are a low-cost source of PIs due to their rapid growth and mass production by simple-medium engineering, greater diversity in inhospitable environments, amenability for genetic modification for overproduction or overexpression in transgenic plants, and resistance to proteolytic cleavage [19,25,26].

Many microbes from a variety of types of ecological habitat, such as terrestrial, marine, and soil, have been reported for a number of low-molecular-weight protein and nonprotein inhibitors [27]. The periplasmic space in *Escherichia coli* contains ecotin, which inhibits trypsin, elastase, and chymotrypsin [28]. The majority of extracellular protein inhibitors of alkaline proteases have been

produced by the genus *Streptomyces* [29]. The first *Streptomyces* subtilisin inhibitor (SSI) was reported as being derived from *Streptomyces albogriseolus;* thereafter, various *Streptomyces* species have been reported to produce similar SSI-like proteins, which are now classified as being in the SSI family [29]. In addition to being a potent low molecular weight plasmin inhibitor, plasminostreptin from *Streptomyces antifibrinolyticus* [30], trypsin inhibitors from *Streptomyces lividans* and *Streptomyces longisporus* [31], transglutaminase-activating metalloprotease inhibitors (MPIs) from *Streptomyces* spp. [32], and kexstatin from *Streptomyces platensis* [33] have been isolated. These PIs in microbes probably have evolved as a protective mechanism in all habitats, including inhospitable ones. Microbes represent a preferred source of natural PIs to understand inhibitor-enzyme interactions for applications in agriculture, therapeutics, food industry, and other environments. The current fermentative production of PIs using microbes suffers from lower yields, cost-intensive processes, and difficulties in recovery, thereby preventing its wide use for bench-to-business scale-up. Various statistical tools for media optimization can be meaningfully utilized for yield enhancement of PIs from microbial sources. Marathe et al. [5] reported a >30% increase in yield with a PI by optimizing various culture conditions through Plackett–Burman design (PBD) and the response surface method (RSM) using a central composite design (CCD) by *Streptomyces* sp. isolated from soda lake Lonar. Alternatively, large-scale production of PIs using recombinant techniques is possible, but target PI accumulates and precipitates in host cells as inclusion bodies, resulting in low recovery.

PROTEASES, THEIR OCCURRENCE, AND THEIR SIGNIFICANCE

Proteolytic enzymes are the largest functional group of proteins (there are >560) that play crucial functions in all plants, animals, and microbes, as well as archaea [34,35], and they constitute 1%–5% of the gene content [35]. There are about 100 protease genes in bacteria and archaeal genomes, while there are 400–700 protease genes in plant and mammalian genomes, suggesting the complexity in their biological functions [36]. Proteases require a water molecule for limited and unlimited proteolytic cleavage, and hence they are classed as *hydrolases*. Proteases are indispensable for the survival of all life forms because of their involvement in many complex physiological and pathological processes [37].

Serine proteases represent one-third of the total proteases, followed by metallo, cysteine, aspartic, and threonine proteases. The information on proteases is furnished in several databases, such as MEROPS (Release 9.5, July 2011), a database of proteolytic enzymes; (2) Degradome [38]; and (3) Proteolysis map (PMAP) [39]. Each class of proteases shows a different type of catalytic mechanism based on its members' active site configuration. The classification and properties of some proteases, according to the International Union of Biochemistry and Molecular Biology (IUBMB), are summarized in Table 6.1.

TABLE 6.1 Properties of Proteases Categorized on the Basis of Catalytic Mechanisms (IUBMB)

Sr. No.	Type	Source	MW (kDa)	pH	Temperature (°C)	Catalytic Residues	References
Serine protease (EC 3.4.21)							
1.	Chymotrypsin	*Manduca sexta*	23.6	10.5–11	40	Ser195, His57, Asp102	Polgar [40]
2.	Trypsin	*Streptomyces griseus*	22.8	2–10	37	Arg, Lys	Read et al. [41]
3.	Plasmin	*Homo sapiens*	75.4	4–5	65	Lys, Arg	Robbins et al. [42]
Cysteine/thiol protease (EC 3.4.22)							
1.	Papain	*Carica papaya*	23.8	6.5–7.5	20	Cys25, His159, and Gln19	Domsalla et al. [43]
2.	Cathepsin B	*Homo sapiens*	24.5	7.5	42	Cys25/29, His159/199, and Asn175/219	Fabra et al. [44]
Aspartyl protease (EC 3.4.23) or acid protease							
1.	HIV 1 protease	*HIV 1*	10.87	3.4–7	60	Asp	Bandaranayake et al. [45]
2.	Pepsin A	*Aspergillus oryzae*	39.4	3–6	55	Asp32, Asp 215	Davidson et al. [46]

Metalloprotease (EC 3.4.24)							
1.	Deuterolysin	*Penicillium roqueforti, P. caseicolum*	20.0	5	37	Asn3, Gln, and Gly8	Gripon et al. [47]
2.	Thermolysin (Zinc protease)	*B. stearothermophiles*	34.6	7	65	Ile, Pro	Titani et al. [48]
Glutamic acid protease (EC 3.4.23)							
1.	Glutamyl protease	*Stylidium lignicola*	21.00	4.5	37	Ala-Ile-His	Fujinaga et al. [49] Oda et al. [50]
2.	Glutamyl endopeptidase II	*Streptomyces griseus*	22.0	8.8	—	Glu, Asp	Yoshida et al. [51]
Threonine protease (EC 2.3.1.35)							
1.	Ornithine acetyltransferase	*Saccharomyces cerevisiae*	31.0	7.5	20–65	Ser-His-Asp	Sankaranarayanan et al. [52]
2.	Threonine protease	*Archaebacteria*	—	—	—	Ser195	Baird et al. [53]

The requirement of proteases for cellular and physiological processes in each life form is unavoidable. They have been detected in plants, such as papain, bromelain, ficin, and keratinase; in animals, such as trypsin, chymotrypsin, pepsin, and rennin; and in microbial systems, such as bacterial proteases, fungal proteases, actinomycetal proteases, and viral proteases [34]. The proteases in each life form contribute significantly to cellular physiological processes (namely, tissue differentiation, tissue arrangement, morphogenesis in development, cell growth and migration, blood clotting, controlled cell death); proteolytic activity during tumor growth and metastasis; and tumor invasion or invasion processes of pathogens and viruses. Additionally, proteases are involved in the release of hormones, activation of enzymes by limited proteolysis, transport of secretory proteins across cellular membrane, and protein metabolism. Thus, proteases are crucial in several metabolic processes of all life forms to control the synthesis, turnover, and functions of proteins [54]. Because uncontrolled protease activity can lead to serious malfunctions, it must be precisely regulated. Proteases in biological systems are generally regulated either by degradation or by binding with inhibitor molecules [19].

PROTEASE INHIBITORS

Protein PIs are a class of low molecular weight polypeptides that act as natural antagonists of proteolytic enzymes and are responsible, either directly or indirectly, for all functions, including cell growth, apoptosis, protein turnover, and cell migration, in all life forms [55,56]. PIs were first reported by Fermi and Pernossi [57], and since then, they have remained key molecules on several fronts [58]. Most PIs are small molecules (5–25 kDa) and contain many disulfide bonds [59]. The majority of these substances produced by *Streptomyces* spp. are serine protease inhibitors (SPIs), such as leupeptin, antipain, chymostatin, and elasnin [7]. PIs interact with protease active sites by contact and form stable complexes by mimicking the structure of the tetrahedral intermediates in enzyme-catalyzed reactions [60,61]. The specific inhibition potential of PIs enables them to unravel enzyme structures and pathways of enzyme catalysis, indicate the nature of active site-functional groups and their contribution to the stabilization of active site configuration, and establish enzyme substrate specificity, as well as their reported applications in the management of pests and human diseases and food processing and other allied industries, as mentioned in the section "Introduction".

CLASSIFICATION OF PIs

Natural PIs are ubiquitous, and many of them have been isolated from a wide variety of animals, plants, and microbes [62]. They are grouped based on the kind of protease that they inhibit. Accordingly, there are six types of PIs: MPIs, SPIs, cysteinyl protease inhibitors (CPIs), aspartyl protease inhibitors (APIs),

glutamate protease inhibitor (GPIs), and threonine protease inhibitors (TPIs). These PIs are either emergency or regulatory inhibitors [61]. Emergency physiological inhibitors block any protease activity [63], while regulatory ones are colocalized with protease and perform specific actions. The latter are further grouped into four types: threshold inhibitors, buffer-type inhibitors, delayed-type inhibitors, and proinhibitors. PIs are also classified based on their mechanism of action, such as suicide inhibitors, transition state inhibitors, and protein protease inhibitors and chelating agents [64]. At present, PIs are grouped into 71 families based on 17,451 inhibitor sequences [65], each having a different molecular weight and mechanism of inhibition. Each family is further grouped into 39 clans based on their tertiary structures. The family is identified by the letter *I* followed by a number, and clans by two letters (namely, *I* or *J* followed by another letter) [65]. About 634 protein PIs have been reported from viruses to animals [14–39,54–66]. Of the 71 families, 27 include PIs from microbes and fungi, 7 (I10, I16, I36, I38, I57, I58, and I69) have PIs exclusively of bacterial origin, and 5 (I34, I48, I66, I79, and I85) have PIs of fungal origin [65].

Serine Protease Inhibitors

SPIs represent the largest family of PIs that bind to target proteases by covalent bonding [67]. Of the 71 families of PIs, 16 are of SPIs based on the sequence similarity, topological similarity, and binding mechanism [55]. The greater proportion of SPIs among the total PIs may be attributed to the fact that there are >26,000 serine proteases belonging to 13 clans and 40 families [68]. Several SPI families are isolated from plants, animals, and microorganisms [69], of which serpins and the Kunitz type represent the largest families. The majority of SPIs display the standard mechanism of inhibition and bind to protease to form a typical Michaelis complex. However, the K_{cat} and K_m levels for the inhibitors are lower than those for normal substrates, indicating slow hydrolysis of the reactive site's peptide bond. Hence, SPIs mostly display biopesticidal [14,16,70] and antibacterial activities (e.g., beta lactam [71] and anticarcinogenic) in various in vivo and in vitro systems [72].

The SSI of *Streptomyces* strongly inhibits both subtilisin and trypsin. It exists as a dimer of two identical subunits of 11.50-kDa proteins [73] and is stable under edaphic conditions [74]. Each subunit has one Trp, three Tyr, and two intrachain disulfide linkages. SSIs occur at high frequency, and about 14 of them have been characterized to date from various *Streptomyces* spp. [75]. The prevalence of SSIs in significant numbers suggest that they might be involved in important physiological functions. The reactive site of an SSI contains methionine (Met73) and valine (Val74), but tyrosine, tryptophan, and lysine were not found to be involved in inhibition [76]. SSIs bind to subtilisin and form a typical Michaelis complex [77]. In a recent study, arginine was found to be crucial for this activity, as PIs isolated from a *Streptomyces* sp., lost almost all their activity in the presence of chemicals that specifically

modify it [4]. The presence of arginine at the active site is a characteristic feature of the *Streptomyces* trypsin inhibitor and the trypsin inhibitor family [31,78].

Cystatin Superfamily

The members of the cystatin family were first isolated from egg white and the leaves or seeds of rice, corn, soybean, cowpea, and Chinese cabbage [79,80]. They also are found in animals and microorganisms [81]. The cystatin PIs have been suggested as part of a plant's defense mechanism against insect attack [80]. Most cystatins are small proteins of molecular mass ranging from 11–16kDa [82]. The four families of cystatin are family-1 cystatins (stefin family), family-2 cystatins (cystatin family), family-3 cystatins (kininogen family), and family-4 cystatins (phytocystatins) [83].

Aspartyl Protease Inhibitors

The APIs are relatively uncommon and include cathepsin D. They have a molecular mass in the range of 20–22kDa and contain up to two disulfide (S–S) bonds [84]. An low molecular weight pepstatin isolated from various species of *Streptomyces* spp. is a specific inhibitor of pepsin [8]. Pepstatins, pepstanones, and hydroxypepstatins perform identical activities against pepsin, cathepsin D, and rennin. In contrast, pepstatin inhibits the growth of *Plasmodium berghei* and murine sarcoma virus [85].

SOURCES OF PIs

The specific inhibition and control over unwanted proteolysis enable PIs to play key roles in the physiological regulation of plants, animals, microbes, and archaea [86]. To date, many PIs have been purified from a variety of plant, animal, and microbial sources.

Plant PIs

Plant PIs are abundant in the seeds of monocots, dicots, angiosperms, and gymnosperms, and comprise 5%–10% of total proteins. They are found in low quantities in the aerial parts of the plants, such as leaves, flowers, and roots [21,87–89]. The PlantPI database reported about 495 inhibitors, identified from about 129 plant families [62]. Plant PIs constitute a major part of the plant's defense system against phytophagous insects and phytopathogens. This property prevents the proteolysis of the proteases present in insect guts or secreted by pathogenic microbes, which leads to scarcity of amino acids or other nutrients essential for insect or phytopathogen growth [62,90].

The inhibitors from soybean represent two families—namely, the Kunitz soybean trypsin inhibitor (STI) and the Bowman–Birk trypsin and chymotrypsin inhibitor (BBI). There have been reports on the purification and characterization of PIs from the Gramineae (Poaceae), Leguminosae (Fabaceae), and Solanaceae families [17,91–93]. The legume seeds contain the Bowman–Birk type, Kunitz type, potato type I/II, squash, barley α-antitrypsin, and thumatine-like PIs [94]. Simple inhibitors consist of a single domain, but complex inhibitors contain more than two domains. Out of 48 families, 11 are complex, having 2–15 inhibitory domains [83]. Kuhar et al. [95] reported a Bowman–Birk protease inhibitor with antifeedant and antifungal activity from *Dolichos biflorus*. Some plant PIs are synthesized as zymogen [96] in response to various stress conditions [97]. Table 6.2 summarizes the protein PIs from various plant sources. The plant PIs have potential applications as biopesticides in agriculture, while potato PIs have been used to formulate minidrinks to affect food intake in humans [135].

Animal PIs

PIs of animal origin are localized in tissues and organs as secretory proteins that block the activity of endogenous proteases and prevent unwanted proteolysis. There are trypsin inhibitors present in blood plasma, milk colostrum, seminal plasma, cervical mucus, mucous membranes of the respiratory passages, synovial fluids, and submandibular glands [136–138]. PIs from invertebrate animals, such as ascarides, sea anemones, leeches, snake venoms, and snail slimes, show specificity toward mammalian serine proteases [139]. PIs from mammalian plasma include β_2-macroglobulin, α_1-antitrypsin, $\alpha1$-antichymotrypsin, and intertrypsin inhibitors [140]. These PIs are thought to protect the host from pathogen attack, participate in embryogenesis, and regulate embryonic growth. Two PIs with molecular weights of 67 and 18 kDa, characterized to be members of the family I cystatin group, have been reported as being derived from glassfish eggs. The smaller of the two inhibited cathepsin, a cysteine protease, more effectively than egg-white PIs [141]. Similarly, a potent PI isolated from *Bombyx mori* was reported to inhibit the CDEP-1 protease of *Beauveria bassiana* and subtilisin A from *Bacillus licheniformis* [142]. Some PIs reported from animal sources are summarized in Table 6.2.

Microbial PIs

Microbes represent an inexpensive source of PIs; they display extensive structural versatility, specific broad inhibitory profiles, resistance to proteolytic cleavage, stability in edaphic conditions, and different patterns of inhibition [11]. These attributes make them suitable for an array of applications in medicine, agriculture, and biotechnology [11]. Kantyka et al. [143] suggested that

TABLE 6.2 Protease Inhibitors From Various Plant and Animal Sources

Source	Protease Inhibitor	Molecular Mass (kDa)	Target Enzymes	Reference(s)
Plant source				
Kunitz (plant) family				
Inga laurina (SW.)	Kunitz type trypsin inhibitor ILTI	20	Trypsin	Macedo et al. [98]
Glycine max	Kunitz type trypsin inhibitor	20.0	Trypsin	Gillman et al. [99]
P. tetragonolobus	Winged-bean chymotrypsin inhibitor	20	α-Chymotrypsin	Roy et al. [100]
Hordeum vulgare	Barley subtilisin inhibitor	19.2	Subtilisin, α-amylase	Vallee et al. [101]
S. tuberosum	Kunitz cysteine peptidase inhibitor	20	Cysteine proteases	Gruden et al. [102]
Cereal				
H. vulgare	Barley trypsin/factor XIIa inhibitor	—	α-Amylase trypsin	Lazaro et al. [103]
Triticum aestivum	Wheat trypsin/alpha amylase inhibitor	12–16	α-Amylase, trypsin	Shewry et al. [104]
Zea mays	Maize trypsin/factor XIIa inhibitor factor	12.028	Mammalian trypsin	Mahoney et al. [105]
E. coracana	Ragi seed trypsin/amylase inhibitor	3.268	α-Amylase	Hojima et al. [106]
Squash family				
Momordica cochinchinensis	Macrocyclic squash trypsin inhibitor	3.453, 3.480	Trypsin	Hernandez et al. [107]

Momordica charantia	Trypsin inhibitor MCTI-II	2.8	Trypsin	Huang et al. [108]
Cucumis sativus	Trypsin inhibitor CSTI-IV	3.4	Trypsin	Wieczorek et al. [109]
Potato type I				
Solanum tuberosum	Protease inhibitor	23.0	Trypsin	Fischer et al. [110]
Hordeum vulgare	Wheat subtilisin/chymotrypsin-inhibitor	—	Subtilisin, chymotrypsin	Gregg et al. [111]
Momordica charantia	Glutamyl peptidase II, subtilisin	7.419	Subtilisin	Ogata et al. [112]
Solanum tuberosum	Chymotrypsin inhibitor I inhibitor	—	Chymotrypsin, trypsin	Richardson [113]
Mustard				
Brassica hirta	Mustard trypsin inhibitor-2	—	α-Chymotrypsin, bovine β trypsin	Ceci et al. [114]
Sinapis alba	Mustard trypsin inhibitor	7.0	Beta-trypsin	Menegatti et al. [115]
Cystatin				
Oryza sativa	Oryzacystatin II	—	Cysteine proteinases	Ohtsubo et al. [116]
Onchocerca volvulus	Onchocystatin	—	Cysteine proteinase	Lustigman et al. [117]
Gallus gallus	Ovocystatin pr	—	Thiol proteases	Laber et al. [118]
Kininogen				
Oryza sativa	Oryzacystatin II	—	Cysteine proteinases	Ohtsubo et al. [116]
Onchocerca volvulus	Onchocystatin	—	Cysteine proteinase	Lustigman et al. [117]

TABLE 6.2 Protease Inhibitors From Various Plant and Animal Sources—Cont'd

Source	Protease Inhibitor	Molecular Mass (kDa)	Target Enzymes	Reference(s)
Gallus gallus	Ovocystatin pr	—	Thiol proteases	Laber et al. [118]
Bothrops jararaca	Metalloprotease inhibitor	—	Atrolysin C	Cornwall et al. [119]
Sarcophaga peregrina	Sarcocystatin	12.7	Cysteine proteinase	Saito et al. [120]
Bowman–Birk				
Maclura pomifera	Bowman–Birk	7.37	Trypsin	Indarte et al. [121]
Glycine max	Bowman–Birk	8.22	Trypsin	Gu et al. [122]
Dolichos biflorus	Bowman–Birk	16.0	Trypsin, chymotrypsin	Kuhar et al. [95]
Helianthus anus	Bowman–Birk I12	—	Trypsin, cathepsin G, elastase, chymotrypsin	Mulvenna et al. [123]
Arachis hypogea	Bowman–Birk trypsin/chymotrypsin inhibitor		Trypsin, chymotrypsin	Suzuki et al. [124]
Triticum aestivum	Bowman–Birk plant trypsin inhibitor	14.0 and 7.0	Trypsin, chymotrypsin	Odani et al. [125]
Potato type II				
Solanum tuberosum	Proteinase inhibitor II (Kunitz type)	5.6	Trypsin, chymotrypsin, papain	Kim et al. [22]
Solanum lycopersicum	Tomato peptidase inhibitor II inhibitor unit 2	—	Trypsin, chymotrypsin	Barrette et al. [126]

Solanum tuberosum	Potato peptidase inhibitor II inhibitor unit 1	—	Trypsin, chymotrypsin	Keil et al. [127]
Solanum lycopersicum	Tomato peptidase inhibitor II inhibitor		Trypsin, chymotrypsin	Graham et al. [96]
Solanum lycopersicum	Tomato peptidase inhibitor II inhibitor unit 2	5.6	Trypsin, chymotrypsin	Bishop et al. [128]
Unknown family protease inhibitors				
Sapindus trifoliatus L.	SNTI	29	Trypsin	Gandreddi et al. [129]
Animal sources				
Onchocerca volvulus	Ov-SPI-l	—	Trypsin	Ford et al. [130]
Glass fish egg	Cystatin	68	Cysteine proteases	Ustadi et al. [131]
Duck egg white	Cystatin	9.3	Cysteine proteases	Warwas et al. [132]
Anisakis simplex	*Anisakis simplex* inhibitor	—	Trypsin	Stephen and Ju [133]
Bombyx mori	SCI-II	7.0	Chymotrypsin	Sasaki and Kobayashi [134]

prokaryotic domains may express PIs for very specialized functions depending on the cellular metabolism and ecological environment. The study of microbial PIs has contributed enormously to identify enzyme structure and reaction mechanisms and develop management strategies against pests and pathogens in agriculture [131]. Naturally occurring PIs are either nonproteinaceous low molecular weight or proteinaceous. Several microbes constitute a major source of low molecular weight nonprotein inhibitors, and a very small number secrete proteinaceous PIs [144]. Of these, ecotins of *E. coli* competitively inhibit trypsin, chymotrypsin, and elastase [28]; marinostatins from marine bacteria inhibit serine proteases [144]; and thermostable protease inhibitors of fungal proteases with a molecular weight of 32–33 kDa from *Physarum polycephalum* [145] and celpins from the fungus of anaerobic genus *Piromyces* spp. arrest cellulosomal serine proteinases [146]. Fungal PIs are active in acidic reaction conditions, which restrict their possible applications at neutral or alkaline pH conditions [147]. A potent peptidic inhibitor of HIV-1 protease, ATBI, is reported to be derived from extremophilic *Bacillus* spp. [148,149]. Of the prokaryotic domain, actinomycetes represent a major source of enzyme inhibitors because of extensive diversity in all ecological habitats and the presence of a large number of enzymes [3]. Imada [150] reported different types of enzyme inhibitors of α-amylase, β-glucosidase, glucosaminidase, and pyroglutamine peptidase from actinobacteria. Of these, the *Streptomyces* species represent a major source of microbial enzyme inhibitors [3,7], which can be expressed in *E. coli* with no constraints.

Actinomycetes are filamentous soil bacteria with a morphologically complex life cycle. They are common in soil but widely distributed in all habitats, including soil [151], sediments of deep sea [152], marine samples [153], soda lake [154], and hydrothermal vents [155]. Actinomycetes are prolific producers of a variety of antibiotics or bioactives, as well as secreting extracellular hydrolytic enzymes to obtain nutrients for their growth and morphological differentiation [3,156]. Actinomycetes have been reported as potential sources of different types of PIs [7,150]. The inhibitors of bacterial serine alkaline protease (subtilisin) were characterized as proteinaceous inhibitors from actinomycetes [157]. Most proteinaceous PIs of *Streptomyces* are serine alkaline PIs (subtilisin) [158] and are members of the SSI family [29]. Later, several related *Streptomyces* subtilisin-like inhibitors (SIL) of *Streptomyces* origin have been reported, such as (i) TI of *Streptomyces antiplasminolyticus* as plasmin inhibitors [159]; (ii) inhibitors of subtilisin, chymotrypsin, and pronose E from *Streptomyces fradia*; (iii) alkaline protease inhibitor (API-2c) from *Streptomyces griseoincarnatus* [22,124]; (iv) *Streptomyces* trypsin inhibitor 2 from *Streptomyces longisporus* [31]; (v) kexstatin, a proteinaceous Kex 2 proteinase and subtilisin inhibitor of *Streptomyces platensis* [33]; (vi) a double-headed proteinaceous inhibitor of serine and metalloprotease identified in *Streptomyces* spp. [160]; (vii) inhibitors of trypsin, chymotrypsin,

and proteinase K from *Streptomyces* spp. LK3 [8]; and (viii) trypsin inhibitor (SMT1) from *Streptomyces misionensis* UMS1 [161]. The *Streptomyces* PIs are secretory proteins and exist as stable dimers with two identical subunits of 110 residues each [161]. Further, an extracellular SPI of *Phytophthora infestans* was found to inhibit tomato pathogenesis-related (PR) proteases [162]. PIs reported from different microbial sources have been listed, along with their properties, in Table 6.3. The prevalence of PIs in various microbes is believed to impart protection against proteolysis of endogenous proteins [181]. PIs from extreme habitats, like soda lake, may display unique inhibitory profiles, be resistant to proteolytic cleavage, and have broad pH and high thermal stability, which may expand their uses and applications [4].

FUNCTIONAL STUDIES OF PIs

Mechanism of Inhibition

The inhibition of protease by a protein moiety appears to be paradoxical because of structural diversity of proteases and their inhibitor complex. The extensive structural diversity in PIs indicates a different mechanism and a specific inhibition pattern for each one. Structurally, PIs have α-helical coils, β-sheets, or other folds of small, disulfide-rich proteins [65,182]. Most PIs display two types of inhibition: irreversible trapping and reversible tight binding. Accordingly, three types of inhibitors—namely, canonical (standard mechanism, Laskowski, or trapping), noncanonical, and serpins—have been reported [69]. In the canonical mode, PIs exhibit a canonical conformation of a binding loop and insert a reactive loop into the active site of protease, which is complementary to it and resembles the typical substrate binding to an active site of enzyme [69,183]. The PI and enzyme active site interaction resemble the hydrolysis of a peptide bond during proteolysis [55]. Although the standard mechanism is mostly adopted for efficient inhibition of serine proteases, a few inhibitors of metalloprotease, thermolysine, and cysteine proteases such as *Streptomyces* metalloprotease inhibitor (SMPI) and staphostatin B also bind in a substrate-like manner [178]. There are around 18 inhibitor families recognized as canonical inhibitors [182]. A standard mechanism is prominently seen in serpins, α_2-macroglobulin, and viral caspase inhibitors, in addition to kazal, kunitz and Bowman–Birk family of inhibitors [61]. In the noncanonical type of inhibitor, the initial slow-binding step occurs at the secondary binding site, followed by the N-terminus locking at the active site of protease. The PIs bind to the catalytic site of protease, but not in a substrate-like fashion [184]. The cystatins, inhibitors of papain like cysteine proteases, are typical noncanonical inhibitors that insert N-terminus and two hairpin loops into V-shaped active site [61,185]. The noncanonical approach is also seen in the case of recognition of thrombin by hirudin [186]. Serpins interact with proteases in a substrate-like

TABLE 6.3 Microbial Protease Inhibitors With Their Sources and Properties

Microbial Source	PIs	Molecular Mass (kDa)	Target Proteases	Family	Reference(s)
Serine protease inhibitor					
Streptomyces spp. VL J2	PI	38.0	Trypsin, chymotrypsin	—	Marathe et al. [5]
Streptomyces spp. LK3	PI	0.568	Trypsin, chymotrypsin and proteinase K	—	Karthik et al. [8]
Streptomyces chromofuscus 34	PISC-2000		Protease	—	Angelova et al. [163]
Phytophthora infestan	EPI 1	—	Subtilisin	I1	Tian et al. [162]
Streptomyces hiroshimensis	S-ALP	14.2	Trypsin, subtilisin	I16	Nitta et al. [164]
Streptomyces caespitosus	ScNPI	11.857	Subtilisin, trypsin, metalloproteases	I16	Hiraga et al. [32]
Streptomyces albogriseolous	S-SI	11.5	Trypsin	I16	Taguchi et al. [75]
E. coil	Ecotin	—	Trypsin, chymotrypsin, elastase	I11	Yang et al. [28]
Streptomyces platensis	Kexstatin	13.0	Kex2 proteinases, subtilisin	I16	Oda et al. [33]
Streptomyces cacaoi	SIL1	—	Subtilisin, chymotrypsin	I16	Kojima et al. [165]
Streptomyces lavendulae	SIL-4	—	Subtilisin, trypsin	I16	Taguchi et al. [166]
Streptomyces fradiae	SIL-5		Subtilisin, trypsin	I16	Terabe et al. [167]

Streptomyces ambofaciens	SIL-7	—	Subtilisin, trypsin	I16	Terabe et al. [167,168]
Streptomyces thermotolerance	SIL-10	—	Subtilisin, trypsin	I16	Terabe et al. [167,168]
Streptomyces hygroscopicus	SIL-12	—	Subtilisin, trypsin	I16	Terabe et al. [167,168]
Streptomyces galbus	SIL-13	—	Subtilisin, trypsin	I16	Terabe et al. [167,168]
Streptomyces azureus	SIL-14	—	Subtilisin, trypsin	I16	Terabe et al. [167,168]
Streptomyces flavopersicus	SIL-V1	12.5	Subtilisin, trypsin	I16	Taguchi et al. [166]
Streptomyces orinoci	SIL-V2	11.5	Subtilisin, trypsin	I16	Taguchi et al. [166]
Streptomyces eurocidicus	SIL-V3	12.5	Subtilisin, trypsin	I16	Taguchi et al. [166]
Streptomyces parvulus	SIL-2	—	Subtilisin, trypsin	I16	Taguchi et al. [29]
Streptomyces coelicolor	SIL-3	—	Subtilisin, trypsin	I16	Taguchi et al. [29]
Streptomyces lividans	*Streptomyces* trypsin inhibitor 1	10.0	Trypsin	I16	Strickler et al. [31]
Streptomyces longisporus	*Streptomyces* trypsin inhibitor 2	10.0	Trypsin	I16	Strickler et al. [31]
Bacillus brevis HPD 31	Bbr PI-a	22.0	Trypsin chymotrypsin, subtilisin	I16	Shiga et al. [169]
Streptomyces spp. *23*	TI-23	13.0	Trypsin	—	Kourteva [170]
Alteromonas spp.	Marinostatin	16.431	Chymotrypsin	I10	Imada et al. [171]

TABLE 6.3 Microbial Protease Inhibitors With Their Sources and Properties—Cont'd

Microbial Source	PIs	Molecular Mass (kDa)	Target Proteases	Family	Reference(s)
Streptomyces antifibrinolyticus	Plasminostreptin	11.7	Plasmin, trypsin, subtilisin	I16	Kakinuma et al. [30]
Streptomyces spp. WT-27	MAPI	—	Subtilisin, chymotrypsin	I16	Murao and Watanabe [172]
Streptomyces albogriseolous	S-SI	11.5	Trypsin	I16	Sato and Murao [157]
Cysteine protease inhibitor					
Chlorella spp.	ECPI	284.0	Papain, ficin, bromelain	I25	Ishihara et al. [173]
Aspergillus oryzae	Kojistatin	—	Cathepsin D and B	I25	Yamada et al. [174]
Alteromonas spp.	Monastatin	20.0	Papain, cysteine proteases	I10	Imada et al. [144]
Aspartic protease inhibitor					
Streptomyces spp. MBR04	Aspartic protease inhibitor	—	Pepsin	—	Menon and Rao [175]
Bacillus spp.	PI	Low molecular weight	Pepsin, rennin	—	Dash and Rao [148]
Aspergillus oryzae	Kojistatin	—	Cathepsin D and B	I25	Yamada et al. [174]
Metalloprotease inhibitor					
Photorhabdus luminescence	Protease inhibitor	51.8	Zn Metalloproteases	I38	Chang et al. [175]
Pseudomonas aeruginosa	API	11.5	Metalloprotease	I38	Feltzer et al. [176]

Photorhabdus luminescence	Protease inhibitor	14.8	Zn Metalloproteases	—	Valens et al. [177]
Streptomyces caespitosus	ScNPI	11.857	Metalloproteases inhibitor	I16	Hiraga et al. [160]
Streptomyces nigrescens STK 23	SMPI		Thymolysine		Seeram et al. [178]
Transglutaminase activating protease inhibitor					
Streptomyces hygroscopicus	TGase activating inhibitor		Transglutamine		Zang et al. [179]
Other					
Streptomyces spp. NRC-35	Lactamase inhibitor	—	β-Lactamase	—	Awad et al. [180]

manner, but cleavage of peptide bond in binding loop occurs through structural modification [182]. A diagrammatic representation of canonical and noncanonical type of modes of inhibition of PIs is shown in Fig. 6.1.

Recently, a heterodimeric PI specific against serine proteases, based on detailed kinetic studies, was found to inhibit trypsin noncompetitively. The K_i value of PI, 3.32 µg/mL was found to be equivalent to 9.4×10^{-9} M (based on the molecular weight of the PI)—a subnano molar range that suggests high affinity of the inhibitor for the enzyme [4]. Similar results have been reported for a novel chymotrypsin-trypsin inhibitor—LsCTI from the seeds of *Lonchocarpus sericeus* [187]. In contrast, BTPI-301, a trypsin PI from marine *Pseudomonas* sp. was found to be a competitive inhibitor of enzymes with a K_i of 3.5×10^{-10} M [188]. A few other PIs inhibit proteases competitively, with a secondary binding site outside the active site (exosite). The ecotin of *E. coli* has a primary site as well as secondary binding sites and thereby compensate for suboptimal binding at the primary site, which broadens its specificity against
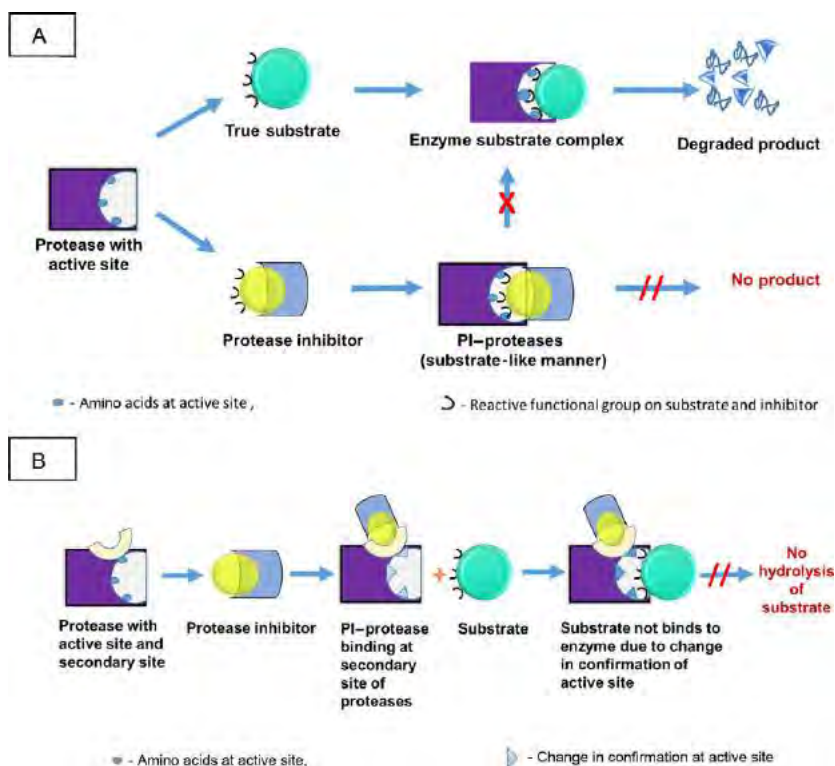
FIG. 6.1 A diagrammatic representation of mode of inhibition of PIs (A) canonical type and (B) noncanonical type.

several host proteases [185]. In some cases, PIs lead to irreversible covalent modification of proteases or release charged groups and act as suicide substrates. Serpins and α-2 microglobulin have a large reactive loop that triggers a conformational change and allows covalent attachment to serine proteases [67]. Serpin inhibition is completely irreversible and protects the cells from unwanted proteolysis [184,185].

PURIFICATION AND CHARACTERIZATION OF PIs

PIs exist in all life forms, and purification of proteinaceous PIs to homogeneity is essential to unravel their physiological functions. The process of purification involved strategies like salt/solvent precipitation and chromatography, based on the increase in inhibitory activity after separation. Most proteinaceous PIs, including serpins, have molecular masses ranging from 3–80 kDa. Initial simple fractionation with ammonium sulfate, organic solvent, or polyethylene glycol is followed by separation with ion exchange, gel filtration, or reversed phase HPL chromatography and electrophoresis. The efficiency of each separation approach is ensured by an increase in the specific activity of PI. Of the chromatographic purification strategies, affinity, ion exchange, and reverse phase chromatography are commonly preferred [189,190]. Affinity chromatography on a column containing immobilized protease is a rapid process for purification of PIs from various sources. Affinity chromatography constitutes the last step in the purification strategy. The most preferred affinity ligand includes chymotrypsin-sepharose, trypsin sepharose, trypsin agarose, and S-carboxymethyl-papain sepharose [161,191].

The purified PIs are characterized further as select stable PIs that are functional under a variety of conditions for determining the possible applications. The functional stability of PIs in a range of pH, temperatures, and reducing agents is the most crucial factor for biotechnological applications. It is usually governed by the presence of intramolecular, disulfide bonds [192]. Most of these PIs were insensitive to pH (2–10) and thermostable even up to 70°C [21]. The pH stability implies that they potentially can be used as biocontrol agents because of their ability to inhibit various proteases of the digestive tract of insect pests [16]. In the case of serpins, thermostability may not allow temperature-dependent changes in the primary structure, resulting in the formation of inactive polymeric assemblies. The formation of these structures in serpens in vivo has been reported to form the molecular basis of several diseases [193]. The alkaline PI (API) of *Streptomyces* spp. was stable over a wide range of pH and temperature, which suggests its direct application as a biocontrol agent against fungal pathogens [192]. Another PI-BTPI-301, isolated from a marine *Pseudomonas mendocina,* showed high pH and thermal stability suitable for it to be used as a biopreservative [194]. Similarly, LsCTI, a chymotrypsin-trypsin inhibitor derived from the seeds of a plant, showed remarkably high thermal stability at temperatures as high as 100°C for 180 min [187].

The presence of certain divalent ions is required to attain critical conformation for maintaining the structural integrity of PIs. An SPI from *Streptomyces* sp. showed increased activity in the presence of both Ca^{++} and Mg^{++} [5]. Similarly, a cysteine PI of pearl millet required Zn^{++} for inhibitory and antifungal activities [16]. Also, exposure of PI to oxidants generally lowers the biological activity [188]. Each PI contains methionine residues, which upon oxidation to its sulfoxides cause loss of inhibitory activity. On the contrary, loss of inhibitory activity of PIs from *Moringa oleifera* was observed with H_2O_2 and DMSO [13].

The covalent linkage of cysteine residues by disulfide bonding is vital for the conformational stability of PIs in prokaryotes [195]. Low concentration of dithiothreitol (DTT) has no effect on a Kunitz-type trypsin inhibitor from *Polychaos dubium* and *Erythrina caffra* [21], but it led to unfolding of the mutant leech carboxypeptidase inhibitor [196].

Detergents are widely preferred for solubilizing proteins from membrane lipids. PIs are routinely used with detergents, especially in cell lysis buffers, to inhibit unwanted proteolysis. Ionic detergents bind to proteins, which causes them to unfold [197]. Marathe et al. [4] reported the complete abolition of activity of a PI isolated from *Streptomyces* sp. in the presence of both sodium dodecyl sulfate (SDS) and triton X-100. Most likely, SDS inactivated the PI because it is an anionic detergent that exerted unfavorable electrostatic interactions that might have caused unfolding and/or disruption of trypsin binding [197]. In contrast, Bijina et al. [17] showed an increase in the inhibitory activity of PI from *M. oleifera* in the presence of SDS. Naturally occurring osmolytes have been reported to confer protection to PI proteins against thermal inactivation by stabilizing the temperature-mediated unfolding. Along with natural osmolytes such as amino acids and polyols, SDS and Tween 80 were found to confer 60% and 45% protection, respectively, against temperature-mediated instability in API I isolated from actinomycetes [22].

APPLICATIONS OF PIs

PIs and Crop Protection

The use of PIs for insect pest management has gained a fresh impetus because of increasing pest-mediated economic losses in agriculture fields and storage places. Of the PIs, Bowman–Birk and Kunitz STIs retard the larval growth of *Tribolium confusum*, *Tribolium castaneum*, and *Heliothis virescens* [14,198] while cysteine PI and oryzacystatin exerted a stable suppressor effect against *Diabrotica undeciumpunctata* larvae [199]. The heterologous inhibitors in transgenic plants have been shown to reduce the growth rates of several insect larvae [200–202]. Broadway and Duffey [203] found that ingestion of STIs and potato inhibitor II inhibited growth and development in the noctuid caterpillars *Spodoptera exigua* and *Helicoverpa zea*. Recently, a novel

Kunitz-type inhibitor from the seeds of *Platypodium elegans* has been shown to be active against *Spodoptera frugiperda* [204]. The PIs targeting different groups of proteases have also shown various antinutritional effects when fed to insect pests. Only a few microbial PIs are used as insecticidal agents for crop protection, such as aminopeptidase inhibitors of actinomycetes (amstatin and bestatin) for *T. castaneum* [205]; pepstatin A from actinomycetes against cowpea bruchid (*Callosobruchus maculatus*) [206]; leupeptin from actinomycetes for the Western corn rootworm (*Diabrotica virgifera*) [207], (iv) cysteine PI E-64 from *Aspergillus japonicus* against Colorado potato beetle [208] and (v) a heterodimeric PI, a member of serpin family from *Streptomyces* spp. VLJ2, against *Helicoverpa armigera*, fungal pathogens, and *Callosobruchus chinensis* [4,5].

PIs and Therapeutic Medicine

The fungal strain *Aspergillus fumigatus* is the most common human pathogen causing invasive aspergillosis. It secretes a protease belonging to the subtilisin family that is involved in pathogenesis; therefore, its specific inhibitors are potential prophylactic agents against aspergillosis. SSI is known to inhibit microbial alkaline proteases, and so its potency was tested against the fungal protease. The broad-range microbial inhibitors of serine, cysteine, and threonine proteases (i.e., leupeptin and antipain), were also found to inhibit malignant transformation [209]. MMPs are reported to destroy the inflammatory tissues, leading to chronic inflammatory diseases [210]. Also, angiogenesis, metastasis, and growth of tumors may be inhibited by MMP inhibition. During carcinogenesis and angiogenesis, gelatinases, MMP-2, and MMP-9 are expressed, which can likely arrest the tumor growth and metastasis when inhibited by PIs [211].

Several PIs acting against HIV I protease, a homodimeric aspartic protease, have been used to treat HIV I infection (e.g., ATBIs from extremophilic *Bacillus* spp.) [148]. The inhibitor of metalloprotease angiotensin-converting enzymes was used for the first time to treat hypertension and cardiovascular and renal diseases in humans [212]. A few PIs, such as antipain, leupeptin, and pepstatin, also have been tested for treatment of muscular dystrophy. Lactacystine, a proteosome inhibitor of *Streptomyces lactacystinaeus,* is reported to inhibit the replication of several viruses, including influenza, herpes simplex type 1, and paramyxovirus [213]. A recombinant *Streptomyces* trypsin inhibitor from *S. levendulae* showed promising activity against Coxsackievirus B3 (CVB3), one of the major causative agents of chronic and acute myocarditis and pancreatitis [214]. Similarly, aspartate proteases (omptins) found in the cell walls of several pathogenic species, such as *E. coil*, *Shigella flexneri*, *Shigella dysenterae*, and *Salmonella enterica*, are inhibited by SPIs [215,216]. Recently, a few reports have shown remarkable antimalarial vector (*Aedes aegypti*) [187,217] and antiparasitic (*Plasmodium falciparum*) [218] activities of PIs obtained from various sources.

PIs and Biotechnology Research

Small molecular weight PIs (pepstatin of aspartic proteases and chymostatin of serine proteases) are incorporated as buffer additives in protein extracts during purification to prevent proteolytic degradation [11]. In the case of recombinant proteins, PIs are added during the expression process as a fusion partner to the culture medium for preventing proteolytic degradation [219]. Similarly, refolding of reduced and denatured *Streptomyces griseous trypsin* (SGT) was also achieved by SSI [220]. Generally, subtilisin gets denatured during refolding, SSI enhances the thermal stability of subtilisin, thus preventing its denaturation [221]. In basic research, PIs (i.e., SSI) and their enzymes have been excellent model systems to study protein–protein interactions [222]. Additionally, PIs are used as legends in affinity chromatography for protein purification. In this context, pepstatin A has been tested for purification of aspartyl proteases from several sources, including plants and fungi [11].

CONCLUSION

Continuous efforts in the field of structure, functions, mode of action, and biophysical characterization of PIs from various sources explore the wide range of opportunities in the pharmaceutical, biotechnology and agriculture sectors. Several human diseases like malaria, cancer, and AIDS, are caused by an imbalance of proteolytic events and incorrect protease signaling pathways. Moreover, there is increasing evidence of protease involvement in many other diseases. Hence, PIs from microbial sources have renewed the interest and efforts of the scientific community to develop PI-based drugs. Similarly, pests and pathogens are the major bottleneck in the growth and development of crops, affecting their yields both qualitatively and quantitatively and causing economic losses. PIs have emerged as potential candidates in the quest for safer human- and environmentally friendly alternative strategies for their control. They have been mainly investigated from plant sources, but studies on PIs of microbial origin are also gaining momentum, primarily because of vast diversity and ease of cultivation. An added inherent advantage of PIs from *Streptomyces* spp. in transgenic research is relatively higher GC content in their genes, which is a critical factor in their expression in the host plants. There is ample scope for further research on structure elucidation and protein engineering of PIs employing bioinformatic tools, which in turn would facilitate their use in a wider range of applications.

ACKNOWLEDGMENTS

ABBREVIATIONS

API	aspartate/aspartyl protease inhibitor
BBI	Bowman–Birk trypsin and chymotrypsin inhibitor
CCD	central composite design
CPI	cysteine/cysteinyl protease inhibitor
GPI	glutamate/glutamyl protease inhibitor
IUBMB	International Union of Biochemistry and Molecular Biology
K_{cat}	turn over number
kDa	kilodalton
K_i	inhibitor constant
K_m	michaelis constant
MEROPS	database of proteolytic enzymes
Met	methionine
MMP	matrix metalloprotease
MPI	metalloprotease inhibitor
PBD	Plackett–Burman design
PIs	protease inhibitors
RSM	response surface method
SDS	sodium dodecyl sulfate
SIL	Subtilisin like inhibitor
SPI	serine protease inhibitor
Spp.	species
SMPI	*Streptomyces* metalloprotease inhibitor
SSI	*Streptomyces* subtilisin inhibitor
STI	soybean trypsin inhibitor
TI	plasminostreptin
TPI	threonine protease inhibitor
Trp	tryptophan
Tyr	tyrosine
Val	valine

REFERENCES

[1] F.A. Fitzpatrick, Curr. Pharm. Des. 10 (2004) 577–588.

[2] J.E. Ahn Salzman, S.C. Braunagel Koiwa, K. Zhu-Salzman, Insect Mol. Biol. 13 (2004) 649–657.

[3] P. Manivasagan, P. Sivasankar, J. Venkatesan, K. Senthilkumar, K. Sivakumar, S.K. Kim, Int. J. Biol. Macromol. 59 (2013) 29–38.

[4] K.R. Marathe, S. Kasar, A.B. Chaudhari, V.L. Maheshwari, Process Biochem. 51 (2016) 1650–1663.

[5] K. Marathe, A. Chaudhari, K. Kamalaja, V. Maheshwari, Biocatal. Agric. Biotechnol. 5 (2016) 58–68.

[6] S. Kasar, K. Marathe, A. Bhide, A. Herwadea, A. Giri, V. Maheshwari, P. Pawar, Pest Manag. Sci. 73 (2016) 1382–1390.

[7] H. Umezawa, Annu. Rev. Microbiol. 36 (1982) 75–99.

[8] L. Karthik, G. Kumar, T. Keswani, A. Bhattacharyya, S.S. Chandar, K.V. Bhaskara Rao, PLoS One 9 (2014) 1–13.

[9] T.C. Baird-Parker, B.M. Lund, T.C. Baird-Parker, G.W. Gould (Eds.), The Microbiological Safety and Quality of Food, Aspen Publishers Inc., Gaithersburg, 2003, pp. 3–18

[10] K. Dunse, J. Stevens, F. Lay, Y. Gaspar, R. Heath, M. Anderson, Proc. Natl. Acad. Sci. U.S.A. 107 (2010) 15011–15015.

[11] J. Sabotic, J. Kos, Appl. Microbiol. Biotechnol. 93 (2012) 1351–1375.

[12] P.J. Ganz, M.D. Bauer, Y. Sun, A.M. Fieno, R.A. Grant, P.E. Correa, M. Laskowski, C.W. Saunder, Protein Eng. Des. Sel. 17 (2004) 333–339.

[13] B. Bijina, S. Chellappan, J. Krishna, S. Basheer, K. Elyas, A. Bahkali, M. Chandrasekaran, Saudi J. Biol. Sci. 18 (2011) 273–281.

[14] C.A. Ryan, Annu. Rev. Phytopathol. 28 (1990) 425–449.

[15] F.D. Leo, R. Gallerani, Insect Biochem. Mol. Biol. 32 (2002) 489–496.

[16] B. Joshi, M. Sainani, K. Bastawade, V. Deshpande, V. Gupta, P. Ranjekar, Eur. J. Biochem. 265 (1999) 556–563.

[17] B. Bijina, S. Chellappan, S. Basheer, K. Elyas, A. Bahkali, M. Chandrasekaran, Process Biochem. 46 (2011) 2291–2300.

[18] J. Anderson, C. Schiffer, S. K. Lee, R. Swanstrom. in: G.H. Krausslich, R. Bartenschlager (Eds.), Antiviral Strategies, Springer, Berlin, Heidelberg, 2009, pp. 85–110.

[19] N. Rawlings, A. Barrett, A. Batemanm, J. Biol. Chem. 286 (2011) 38321–38328.

[20] F. Zeng, R. Xue, H. Zhang, T. Jiang, Pest Manag. Sci. 68 (2012) 1345–1351.

[21] L.R. Macedo, G.M. Freire, E.C. Cabrini, M.H. Toyama, J.C. Novello, S. Marangoni, Biochim. Biophys. Acta. 1621 (2003) 170–182.

[22] J. Pandhare, K. Jog, V. Deshpande, Bioresour. Technol. 84 (2002) 165–169.

[23] M.H. Kim, S.C. Park, J.Y. Kim, S.Y. Lee, H.T. Lim, H. Cheong, K.S. Hahm, Y. Park, Biochem. Biophys. Res. Commun. 346 (2005) 681–686.

[24] N. Hideaki, S.S. Guy, B. Robert, S.B. Judith (Eds.), A Practical Approach, Oxford University Press, New York, 2001, pp. 131–146.

[25] B. Rao, M. Tanksale, S. Ghatge, V. Deshpande, Microbiol. Mol. Biol. Rev. 62 (1998) 597–635.

[26] J. Pandhare, PhD Thesis, (2002) NCL, Pune.

[27] E. Bitoun, S. Chavanas, A.D. Irvine, L. Lonie, C. Bodemer, M. Paradisi, D. Hamel-Teillac, S.I. Ansai, Y. Mitsuhashi, A. Taïeb, Y. Prost, J. Investig. Dermatol. 118 (2002) 352–361.

[28] S.Q. Yang, C.I. Wang, S.A. Gillmor, R.J. Fletterick, C.S. Craik, J. Mol. Biol. 279 (1998) 945–957.

[29] S. Taguchi, H. Kikuchi, M. Suzuki, S. Kojima, M. Terabe, K. Miura, T. Nakase, H. Momose, Appl. Environ. Microbiol. 59 (1993) 4338–4341.

[30] I. Kakinuma, U. Sugino, O. Moriya, O. Isono, J. Biol. Chem. 253 (1978) 1529–1537.

[31] J.E. Strickler, T.R. Berk, J. Gorniak, J. Fornwald, R. Keys, J.J. Rowland, M. Rosenberg, D.P. Taylor, J. Biol. Chem. 267 (1992) 3236–3241.

[32] S. Schmidt, F. Adolf, H.L. Fuchsbauer, FEBS Lett. 582 (2008) 3132–3138.

[33] K. Oda, S. Takahashi, N. Kikuchi, Y. Shibano, Biosci. Biotechnol. Biochem. 60 (1996) 1388–1389.

[34] A.J. Kenny, E.E. Sterchi, W. Stocker (Eds.), Proteolytic Enzymes, Tools and Targets, Springer-Verlag, Berlin, 1999, pp. 1–8.

[35] A.J. Barrette, N.D. Rawlings, E.A. Brien, J. Struct. Biol. 14 (2001) 95–102.

[36] N.D. Rawlings, F.R. Morton, A.J. Barrett, Nucleic Acids Res. 34 (2006) D270–D272.

[37] R.C. Chambers, G.J. Laurent, Biochem. Soc. Trans. 30 (2002) 194–200.

[38] V. Quesada, G.R. Ordóñez, L.M. Sánchez, X.S. Puente, C. López-Otín, Nucleic Acids Res. 37 (2009) D239–D243.

[39] Y. Igarashi, E. Heureux, K.S. Doctor, P. Talwar, S. Gramatikova, K. Gramatikoff, Y. Zhang, M. Blinov, S.S. Ibragimova, S. Boyd, B. Ratnikov, Nucleic Acids Res. 37 (2009) D611–D618.

[40] L. Polgar (Ed.), Mechanisms of Protease Action, CRC Press, Boca Raton, Florida, 1987, pp. 87–113.

[41] R.J. Read, G.D. Brayer, L. Jurasek, M.N. James, Biochemistry 23 (1984) 6570–6575.

[42] K. C. Robbins, L. Summaria, R. C. Wohl. in: L. Lorand (Ed.), Methods in Enzymology, vol. 80. Academic Press, New York, 1981, pp. 379–387.

[43] A. Domsalla, M.F. Melzig, Planta Med. 74 (2008) 699.

[44] M. Fabra, J. Cerdà, Mol. Reprod. Dev. 67 (2004) 282–294.

[45] R.M. Bandaranayake, M. Prabu-Jeyabalan, J. Kakizawa, W. Sugiura, C.A. Schiffer, J. Virol. 82 (2008) 6762–6766.

[46] R. Davidson, A. Gertler, T. Hofmann, Biochem. J. 147 (1975) 45–53.

[47] M. Fujinaga, M. Cherney, H. Oyama, K. Oda, N. James, Proc. Natl. Acad. Sci. U.S.A. 101 (2004) 3364–3369.

[48] K. Oda, S. Murao, T. Oka, K. Morihara, Agric. Biol. Chem. 39 (1975) 477–484.

[49] N. Yoshida, S. Tsuruyama, K. Nagata, K. Hirayama, K. Noda, S. Makisumi, J. Biochem. 104 (1988) 451–456.

[50] J.C. Gripon, B. Auberger, J. Lenoir, Int. J. Biochem. 12 (1980) 451–455.

[51] K. Titani, M.A. Hermodson, L.H. Ericsson, K.A. Walsh, H. Neurath, Biochemistry 11 (1972) 2427–2435.

[52] R. Sankaranarayanan, M.M. Cherney, C. Garen, G. Garen, C. Niu, M. Yuan, M.N. James, J. Mol. Biol. 397 (2010) 979–990.

[53] T.T. Baird, W.D. Wright, C.S. Craik, Protein Sci. 15 (2006) 1229–1238.

[54] V. Turk, in: V. Turk (Ed.), Proteases: New Perspectives, Springer Science & Business Media, BrikhauserVerlag, Basel, 1999, pp. 1–224.

[55] M.J. Laskowaski, I. Kato, Annu. Rev. Biochem. 49 (1980) 593–626.

[56] H. Fritz, in: K. von der Helm, B.D. Korant, J.C. Cheronis (Eds.), Proteases as Targets for Therapy, Springer-Verlag, Berlin, 2000 (V–VI).

[57] C. Fermi, L. Pernossi, Z. Hyg. Infektionskr. 18 (1894) 83e9.

[58] C.J. Scott, C.C. Taggart, Biochimie 92 (2010) 1681–1688.

[59] R.R. Singh, A.A. Rao, Biochim. Biophys. Acta. 1597 (2002) 280–291.

[60] G. Norton, in: J.P. D'Mello, C.M. Duffus, J.H. Duffus (Eds.), Toxic Substances in Crop Plants, Royal Society of Chemistry, 1991, pp. 68–106.

[61] W. Bode, R. Huber, Biochim. Biophys. Acta Protein Struct. Mol. Enzymol. 1477 (2000) 241–252.

[62] F. De Leo, M.A. Bonade-Bottino, L.R. Ceci, R. Gallerani, L. Jouanin, Nucleic Acids Res. 30 (2002) 347–348.

[63] B. Turk, D. Turk, G.S. Salvesen, Curr. Pharm. Des. 8 (2002) 1623–1637.

[64] A. Kulkarni. PhD Thesis. (2007). National Chemical Laboratory, Pune.

[65] N. Rawlings, Biochimie 92 (2010) 1463–1483.

[66] B. Turk, Nat. Rev. Drug Discov. 5 (2006) 785–799.

[67] P.G. Gettins, Chem. Rev. 102 (2002) 4751–4804.

[68] M.J. Page, E. Di Cera, Cell. Mol. Life Sci. 65 (2008) 1220–1236.

[69] J. Otlewski, D. Krowarsch, W. Apostoluk, Acta Biochim. Pol. 46 (1998) 531–565.

[70] A.K. Nath, R. Kumari, S. Sharma, H. Sharma, Indian J. Exp. Biol. 53 (2015) 594–599.

[71] M. Saravanan, B. Ramachandran, H. Barabadi, Microb. Pathog. 114 (2018) 180–192.

[72] J. Gills, J.J. Lopiccolo, J. Tsurutani, et al., Clin. Cancer Res. 13 (2007) 5183–5194.

[73] K. Takahashi, H. Fukada, Biochemistry 24 (1985) 297–300.

[74] K. Akasaka, H. Aoshima, H. Hatano, S. Sato, S. Murao, Biochim. Biophys. Acta 412 (1975) 120–126.

[75] S. Taguchi, S. Yamada, S. Kojima, H. Momose, J. Biochem. 124 (1998) 804–810.

[76] T. Ikenaka, S. Odani, M. Sakai, Y. Nabeshima, S. Sato, S. Murao, J. Biochem. 76 (1974) 1191–1209.

[77] T. Nonaka, T. Suzuki, N. Tanaka, S. Saito, T. Senda, K. Miura, Y. Mitsui, in: R. Bott, C. Betzel (Eds.), Subtilisin Enzymes, Springer, USA, 1996, pp. 21–27.

[78] S. Kojima, Y. Nishiyama, I. Kumagai, K.I. Miura, J. Biochem. 109 (1991) 377–382.

[79] R. Colella, Y. Sakaguchi, H. Nagase, J.C. Bird, J. Biol. Chem. 264 (1989) 17117–17164.

[80] T. Jacinto, K.V. Fernandes, O.L. Machado, C.L. Siqueira-Júnior, Plant Sci. 138 (1998) 35–42.

[81] A.S. Oliveira, J.X. Filho, M.P. Sales, Braz. Arch. Biol. Technol. 46 (2003) 91–104.

[82] A.J. Barrette, Trends Biochem. Sci. 12 (1987) 193–196.

[83] H. Habib, M.H. Khalid, Microbiol. Mol. Biol. Rev. 2 (2007) 068–085.

[84] Y. Park, B.H. Choi, J.S. Kwak, C.W. Kang, H.T. Lim, H.S. Cheong, K.S. Hahm, J. Agric. Food Chem. 53 (2005) 6491–6496.

[85] Y. Yuasa, H. Shimojo, T. Ayogi, H. Umezawa, J. Natl. Cancer Inst. 54 (1975) 1255–1256.

[86] G.A. Silverman, J. Whisstock, S.P. Bottomley, J.A. Huntington, D. Kaiserman, C.J. Luke, S.C. Pak, J.M. Reichhart, P.I. Bird, J. Biol. Chem. 285 (2010) 24299–24305.

[87] A. Mutlu, S. Gal, Physiol. Plant. 105 (1999) 569–576.

[88] Z.F. Xu, W.Q. Qi, X.Z. Ouyang, E. Yeung, M.L. Chye, Plant Mol. Biol. 47 (2001) 727–738.

[89] S.F. Sin, M.L. Chye, Planta 219 (2004) 1010–1022.

[90] Z.Y. Chen, R.L. Brown, A.R. Lax, T.E. Clevel, J.S. Russin, Appl. Environ. Microbiol. 65 (1999) 1320–1324.

[91] S.K. Haq, R.H. Khan, J. Protein Chem. 22 (2003) 543–554.

[92] S.K. Haq, S.M. Atif, R.H. Khan, Arch. Biochem. Biophys. 431 (2004) 145–159.

[93] G.C. Mello, M.L.V. Oliva, J.T. Sumikava, O.L.T. Machado, S. Marangoni, D.G.G. Matos, J. Protein Chem. 20 (2002) 625–632.

[94] M. Richardson, Methods in Plant Biochemistry, vol. 5 Academic Press, New York, 1991, pp. 295–305.

[95] K. Kuhar, R. Kansal, B. Subrahmanyam, K. Koundal, K. Miglan, V. Gupta, Acta Physiol. Plant. 35 (2013) 1887–1903.

[96] J.S. Graham, G. Pearce, J. Merryweather, K. Titani, L.H. Ericsson, C.A. Ryan, J. Biol. Chem. 260 (1985) 6555–6560.

[97] H. Koiwa, R.A. Bressan, P.M. Hasegawa, Trends Plant Sci. 2 (1997) 379–384.

[98] L.R. Macedo, S.F. Ribeiro, G.B. Taveira, V.M. Gomes, K.M. Barros, S. Maria-Neto, Curr. Microbiol. 72 (2016) 1–7.

[99] J.D. Gillman, W.S. Kim, H.B. Krishnan, J. Agric. Food Chem. 63 (2015) 1352–1359.

[100] S. Roy, S.K. Dutta, Am. J. Biochem. Biotechnol. 5 (2009) 142–146.

[101] F. Vallée, A. Kadziola, Y. Bourne, M. Juy, K.W. Rodenburg, B. Svensson, R. Haser, Structure 6 (1998) 649–659.

[102] K. Gruden, B. Štrukelj, M. Ravnikar, M. Poljšak-Prijatelj, I. Mavrič, J. Brzin, I. Kregar, Plant Mol. Biol. 34 (1997) 317–323.

[103] A. Lázaro, P. Rodriguez-Palenzuela, C. Maraña, P. Carbonero, F. Garcia-Olmedo, FEBS Lett. 239 (1988) 147–150.

[104] P.R. Shewry, L. Domenico, S. Gabriel, A. Cipriano, G. Francisco, J.L. Ellen, D.D. Mary, D.K. Donald, FEBS Lett. 175 (1984) 359–363.

[105] W.C. Mahoney, M.A. Hermodson, B. Jones, D.D. Powers, R.S. Corfman, G.R. Reeck, J. Biol. Chem. 259 (1984) 8412–8416.

[106] Y. Hojima, J.V. Pierce, J.J. Pisano, Thromb. Res. 20 (1980) 149–162.

[107] J.F. Hernandez, J. Gagnon, L. Chiche, T.M. Nguyen, J.P. Andrieu, A. Heitz, D. Le Nguyen, Biochemist 39 (2000) 5722–5730.

[108] Q. Huang, S. Liu, Y. Tang, F. Zeng, R. Qian, FEBS Lett. 297 (1992) 143–146.

[109] M. Wieczorek, J. Otlewski, J. Cook, K. Parks, J. Leluk, A. Wilimowska-Pelc, M. Laskowski, Biochem. Biophys. Res. Commun. 126 (1985) 646–652.

[110] M. Fischer, M. Kuckenberg, R. Kastilan, J. Muth, C. Gebhardt, Mol. Genet. Genomics. 290 (2015) 387–398.

[111] M.A. Gregg, A.B. Brauer, R.J. Leatherbarrow, Biochim. Biophys. Acta 1222 (1994) 179–186.

[112] F. Ogata, T. Miyata, N. Fujii, N. Yoshida, K. Noda, S. Makisumi, A. Ito, J. Biol. Chem. 266 (1991) 16715–16721.

[113] M. Richardson, Biochem. J. 137 (1974) 101–112.

[114] L.R. Ceci, N. Spoto, M. De Virgilio, R. Gallerani, FEBS Lett. 364 (1995) 179–181.

[115] E. Menegatti, G. Tedeschi, S. Ronchi, F. Bortolotti, P. Ascenzi, R.M. Thomas, M. Bolognesi, S. Palmieri, FEBS Lett. 301 (1992) 10–14.

[116] S. Ohtsubo, H. Kobayashi, W. Noro, M. Taniguchi, E. Saitoh, J. Agric. Food. Chem. 53 (2005) 5218–5224.

[117] S. Lustigman, B. Brotman, T. Huima, A.M. Prince, J.H. McKerrow, J. Biol. Chem. 267 (1992) 17339–17346.

[118] B. Laber, K. Krieglstein, A. Henschen, J. Kos, V. Turk, R. Huber, W. Bode, FEBS Lett. 248 (1989) 162–168.

[119] G.A. Cornwall, A. Cameron, I. Lindberg, D.M. Hardy, N. Cormier, N. Hsia, Endocrinology 144 (2003) 901–908.

[120] H. Saito, T. Suzuki, K. Ueno, T. Kubo, S. Natori, Biochemistry 28 (1989) 1749–1755.

[121] M. Indarte, C.M. Lazza, D. Assis, N.O. Caffini, M.A. Juliano, F.X. Avilés, … S.A. Trejo, Planta 245 (2017) 343–353.

[122] C. Gu, X. Song, L. Zhao, S. Pan, G. Qin, Food Nutr. Res. 2 (2014) 546–550.

[123] J.P. Mulvenna, F.M. Fole, D.J. Crai, J. Biol. Chem. 280 (2005) 32245–32253.

[124] A. Suzuki, Y. Tsunogae, I. Tanaka, T. Yamane, T. Ashida, S. Norioka, H.A.R.A. Saburo, T. Ikenaka, J. Biochem. 101 (1987) 267–274.

[125] S. Odani, T. Koide, T. Ono, J. Biol. Chem. 100 (1986) 975–983.

[126] I.H. Barrette-Ng, K.K.S. Ng, M.M. Cherney, G. Pearce, C.A. Ryan, M.N. James, Biol. Chem. 278 (2003) 24062–24071.

[127] M. Keil, J. Sanchez-Serrano, J. Schell, L. Willmitzer, Nucleic Acids Res. 14 (1986) 5641–5650.

[128] P.D. Bishop, G. Pearce, J.E. Bryant, C.A. Ryan, J. Biol. Chem. 259 (1984) 13172–13177.

[129] S. Gandreddi, V.R. Kappala, K. Zaveri, K. Patnala, BMC Biochem. 16 (2015) 23–29.

[130] L. Ford, D.B. Guiliano, Y. Oksov, A.K. Debnath, J. Liu, S.A. Williams, M.L. Blaxter, S. Lustigman, J. Biol. Chem. 280 (2005) 40845–40856.

[131] T. Terashita, M. Kono, S. Murao, Trans. Mycol. Soc. Jpn. 21 (1980) 137–140.

[132] M. Warwas, J. Gburek, J. Osada, K. Gołab, Acta Biochim. Pol. 42 (1994) 351–356.

[133] R.M. Stephen, A.S. Judy, J. Biochem. 269 (1994) 27650–27656.

[134] T. Sasaki, K. Kobayashi, J. Biochem. 95 (1984) 1009–1017.

[135] H.P.F. Peters, M. Foltz, E.M.R. Kovacs, D.J. Mela, E.A.H. Schuring, S.A. Wiseman, Int. J. Obes. 3 (2011) 244–250.

[136] J.J. Lee, S.S. Tzeng, S.T. Jiang, J. Food Sci. 65 (2000) 81–86.

[137] S. Rawdkeun, S. Benjakul, W. Visessenguan, T.C. Lainet, J. Food Biochem. 29 (2005) 486–503.

[138] J.L. Xian, H.L. Deng, Z. Zhenlin, H. Qingfeng, Y. Chen, J. Hanguo, Z. Xing, P. Lifei, Parasitol. Res. 108 (2011) 287–295.

[139] R. Vogel, I. Trautschold, E. Werle (Eds.), Natural Proteinases Inhibitors, Academic Press, New York, NY, 1968, pp. 1–174.

[140] R. S. Kent, W. N. Drohan. US patent, 6 (2001)193: 891.

[141] K. Ustadi, Y. Kim, S.M. Kim, J. Agric. Food Chem. 53 (2005) 7667–7672.

[142] Y. Li, P. Zhao, S. Liu, Z. Dong, J. Chen, Z. Xiang, Q. Xia, Insect Biochem. Mol. Biol. 42 (2012) 766–775.

[143] T. Kantyka, N.D. Rawlings, J. Potempa, Biochimie 92 (2010) 1644–1656.

[144] C. Imada, U. Simidu, N. Taga, Bull. Jpn. Soc. Sci. Fish. 51 (1985) 799–809.

[145] D.A. Davies, N.A. Kalinina, L.V. Samokhvalova, G.V. Malakhova, G. Scott, G. Venning, A.M. Volynskaya, V.A. Nesmeyanov, Russ. J. Bioorg. Chem. 31 (2005) 229–237.

[146] P.J. Steenbakkers, J.A. Irving, H.R. Harhangi, W.J. Swinkels, A. Akhmanova, R. Dijkerman, … H.J.O. Den Camp, Mycol. Res. 112 (2008) 999–1006.

[147] Y.E. Dunaevsky, V.V. Popova, T.A. Semenova, G.A. Beliakova, M.A. Belozersky, Biochimie 101 (2014) 10–20.

[148] C. Dash, M. Rao, J. Biol. Chem. 276 (2001) 2487–2493.

[149] V. Vathipadiekal, P.K. Umasankar, M.S. Patole, M. Rao, Peptides 31 (2010) 16–21.

[150] C. Imada, Antonie Van Leeuwenhoek 87 (2005) 59–63.

[151] E. Kuster. in: S. Gray, T. Parkinson, (Ed.), Ecology of Soil Bacteria, Liverpool University Press, Liverpool, 1968, pp. 322–336.

[152] J.A. Colquhoun, J. Mexson, M. Goodfellow, A.C. Ward, K. Horikoshi, A.T. Bull, Antonie van Leeuwenhoek 74 (1998) 27–40.

[153] W. Pathom-aree, J.E.M. Stach, A.C. Ward, K. Horikoshi, A.T. Bull, M. Goodfellow, Extremophiles 10 (2006) 181–189.

[154] K. Kharat, A. Kharat, P. Hardikar, Afr. J. Biotechnol. 8 (2009) 6645–6648.

[155] P. Murphy, R.T. Hill, Biofuture 179 (1998) 34–37.

[156] S. Kim, K. Houng, L. Hyun, J. Kye, J. Microbiol. Biotechnol. 1 (1991) 288–292.

[157] S. Sato, S. Murao, Agric. Biol. Chem. 36 (1972) 160–163.

[158] K. Tsuchiya, Y. Asami, K. Sakuta, T. Kimura, Agric. Biol. Chem. 53 (1989) 841–842.

[159] H. Sugino, A. Kakinuma, S. Iwanaga, J. Biol. Chem. 253 (1978) 1546–1555.

[160] K. Hiraga, T. Suzuki, K. Oda, J. Biol. Chem. 275 (2000) 25173–25179.

[161] J. Mohd-Yusoff, Z. Alias, K. Simarani, Appl. Biochem. Microbiol. 52 (2016) 256–262.

[162] M. Tian, E. Huitema, L.D. Cunha, T.T. Alaliba, S. Kamoun, J. Biol. Chem. 279 (2004) 26370–26377.

[163] L. Angelova, S. Danova, I. Iliev, I. Ivanova, J. Serkedjieva, Biotechnol. Biotechnol. Equip. 2 (2005) 110–114.

[164] M. Nitta, M. Goto, N. Shibuya, Y. Okawa, Biol. Pharm. Bull. 25 (2002) 833–836.

[165] S. Kojima, I. Kumagai, K.I. Miura, J. Mol. Biol. 230 (1993) 395–399.

[166] S. Taguchi, S. Kojima, M. Terabe, K.I. Miura, H. Momose, Eur. J. Biochem. 220 (1994) 911–918.

[167] M. Terabe, S. Kojima, S. Taguchi, H. Momose, K. Miura, J. Biochem. (Tokyo) 116 (1994) 1153–1163.
[168] M. Terabe, S. Kojima, S. Taguchi, H. Momose, K.I. Miura, Biochim. Biophys. Acta 1292 (1996) 233–240.
[169] Y. Shiga, I. Hasegawa, A. Tsuboi, H. Yamagata, S. Udaka, Appl. Environ. Microbiol. 58 (1992) 525–531.
[170] Y. Kourteva, Appl. Microbiol. Biotechnol. 34 (1990) 292–296.
[171] C. Imada, S. Hara, M. Maeda, U. Simidu, Bull. Jap. Soc. Sci. Fish. 52 (1986) 1455–1459.
[172] S. Murao, T. Watanabe, Agric. Biol. Chem. 41 (1977) 1313–1314.
[173] M. Ishihara, T. Shiroma, T. Taira, S. Tawata, J. Biosci. Bioeng. 101 (2006) 166–171.
[174] T. Yamada, J. Hiratake, M. Aikawa, T. Suizu, Y. Saito, A. Kawato, K. Suginami, J. Oda, Biosci. Biotechnol. Biochem. 62 (1998) 907–914.
[175] Y.T. Chang, C. Hsieh, L.C. Wu, H.C. Chang, S.S. Kao, M. Meng, F.C. Hsieh, Int. J. Mol. Sci. 14 (2012) 308–321.
[176] R.E. Feltzer, J.O. Trent, R.D. Gray, J. Biol. Chem. 278 (2003) 25952–25957.
[177] M. Valens, A.C. Broutelle, M. Lefebvre, M.A. Blight, Microbiology 148 (2002) 2427–2437.
[178] S.S. Seeram, K. Hiraga, K. Oda, J. Biochem. 122 (1997) 788–794.
[179] D. Zhang, M. Wang, G. Du, Q. Zhao, J. Wu, J. Chen, J. Agric. Food Chem. 56 (2008) 3403–3408.
[180] M.H. Awad, K.Y.I. El-Shahed, A.E.M. El-Nakkadi, World Appl. Sci. J. 7 (2009) 637–646.
[181] Y. Shiga, H. Yamagata, N. Tsukagoshi, S. Udaka, Biosci. Biotechnol. Biochem. 59 (1995) 2348–2350.
[182] D. Krowarsch, T. Cierpicki, F. Jelen, J. Otlewski, Cell. Mol. Life Sci. 60 (2003) 2427–2444.
[183] G.A. Silverman, P.I. Bird, R.W. Carrell, F.C. Church, P.B. Coughlin, P.G. Gettins, J.A. Irving, D.A. Lomas, C.J. Luke, R.W.P.A. Moyer, E. O'Donnell, R. Pemberton, G.S. Selvesen, T. James, J.C. Whisstock, J. Biol. Chem. 276 (2001) 33293–33296.
[184] C.J. Farady, C.S. Craik, ChemBioChem 11 (2010) 2341–2346.
[185] M.J. Page, E. Di Cera, J. Biol. Chem. 283 (2008) 30010–30014.
[186] M.T. Stubbs, W. Bode, Trends Biochem. Sci. 20 (1995) 23–28.
[187] L.C.A. Filho, P.M.S. Tobosa, D.C. Hissa, I.M. Vasconcelos, A.F.U. Carvalho, Pest Manag. Sci. 74 (2017) 1362–1373, https://doi.org/10.1002/ps.4812.
[188] W. Vogt, Free Radic. Biol. Med. 18 (1995) 93–105.
[189] B. Bijina. PhD Thesis, (2006). Cochin University of Science and Technology, Cochin.
[190] S. Wang, J. Lin, M. Ye, T.B. Ng, P. Rao, X. Ye, Peptides 27 (2006) 3129–3136.
[191] N. Alinda, T.M. Maria, P. Laszalo, Eur. J. Biochem. 270 (2003) 2101–2107.
[192] J. Vernekar, M. Ghatge, V. Despande, Biochem. Biophys. Res. Commun. 262 (1999) 702–707.
[193] L.N. Benning, J.C. Whisstock, J. Sun, P.I. Bird, S.P. Bottomley, Protein Sci. 13 (2004) 1859–1864.
[194] K. Sapna, P.P. Manzur Ali, K.R. Rekha Mol, S.G. Bhat, M. Chandrasekaran, K.K. Elyas, Biotechnol. Lett. 39 (2017) 1911–1916.
[195] P.J. Hogg, Trends Biochem. Sci. 28 (2003) 210–214.
[196] L. Arolas, V. Castillo, S. Bronsoms, X. Aviles, S. Ventura, J. Mol. Biol. 392 (2009) 529–546.
[197] J.E. Mogensen, P. Sehgal, D.E. Otzen, Biochemistry 44 (2005) 1719–1730.

[198] A.M.R. Gatehouse, Y. Shi, K.S. Powell, C. Brough, V.A. Hilder, W.D.O. Hamilton, C. Newell, A. Merryweather, D. Boulter, J.A. Gatehouse, Philos. Trans. R. Soc. B 342 (1993) 279–286.

[199] H.S. Edmonds, L.N. Gatehouse, V. Hilder, J.A. Gatehouse, Entomol. Exp. Appl. 78 (1996) 83–94.

[200] L.N. Gatehouse, A.L. Shannon, E.P.J. Burgess, J.T. Christeller, Insect Biochem. Mol. Biol. 27 (1997) 929–944.

[201] L. Jouanin, M. Bonade-Bottino, C. Girard, G. Morrot, M. Giband, Plant Sci. 131 (1998) 1–11.

[202] T.H. Schuler, G.M. Poppy, B.R. Kerry, Trends Biochem. Sci. 16 (1998) 168–175.

[203] R.M. Broadway, S.S. Duffey, J. Insect. Physiol. 32 (1986) 827–833.

[204] S.R. Ramalho, C.D.S. Bezerra, D.G.L. Oliveira, L.S. Lima, S.M. Neto, C.F. Ramalho, N.V. Verbisck, M.L.R. Macedo, J. Agric. Food Chem. 66 (2018) 1349–1358, https://doi.org/10.1021/acs.jafc.7bo4159.

[205] B. Oppert, T.D. Morgan, C. Culbertson, K.J. Kramer, Comp. Biochem. Physiol. 105 (1993) 379–385.

[206] B. Amirhusin, R.E. Shade, H. Koiw, M.H. Paul, R.A. Bressan, L.L. Murdock, K. Zhu-Salzman, J. Insect Physiol. 53 (2007) 734–740.

[207] J.H. Kim, C.A. Mullin, J. Chem. Ecol. 29 (2003) 795–810.

[208] C.J. Bolter, M.L. Green, Entomol. Exp. Appl. 83 (1997) 295–303.

[209] M. Vaccari, A. Argnani, W. Horn, P. Silingardi, M. Giungi, M.G. Mascolo, S. Bartoli, S. Grilli, A. Colacci, Anticancer Res. 19 (1998) 589–596.

[210] T.N. Shamsi, R. Parveen, S. Fatima, Int. J. Biol. Macromol. 91 (2016) 1120–1133.

[211] M.A. Rudek, J. Venitz, W.D. Figg, Pharmacotherapy 22 (2002) 705–720.

[212] G. Abbenante, D.P. Fairlie, J. Med. Chem. 1 (2005) 71–104.

[213] M.S. Kaspari, E. Bogner, N. Hooper, in: U. Lendeckel (Ed.), Viral Proteases and Antiviral Protease Inhibitor Therapy, Springer Media B.V, Houten, 2009, pp. 71–81.

[214] D.E. Hadedy, S.E. Mostafa, M.M. Saad, J. Chem. 2015 (2015) 963041.

[215] T.H. Yun, J.E. Cott, R.I. Tapping, J.M. Slauch, J.H. Morrissey, Blood 113 (2009) 1139–1148.

[216] M.V. Seron, J. Haiko, P. Deg, T.K. Korhonen, J.C. Meijers, J. Thromb. Haemost. 8 (2010) 2232–2240.

[217] L.P. Dias, J.T.A. Oliveira, L.C.B. Rocha, D.O.B. Sousa, H.P.S. Costa, et al., Process Biochem. 57 (2017) 228–238, https://doi.org/10.1016/j.procbio.2017.03.015.

[218] A. Bhattacharyya, E. Chetan, C.R. Chitinis, Process Biochem. 57 (2017) 207–218.

[219] A.K. Sharma, M.K. Sharma, Biotechnol. Adv. 27 (2009) 811–832.

[220] D. Nohara, H. Sugiura, H. Sakakibara, M. Matsubara, S. Kojima, K. Miura, T. Sakai, J. Biochem. 125 (1999) 343–347.

[221] T. Arakawa, K. Lazenby, C.G. Kolvenbach, T.P. Horan, M. McGinley, M.F. Rohde, O.P. Narhi, Agric. Biol. Chem. 55 (1991) 903–910.

[222] W.S.J. Valdar, J.M. Thornton, Proteins 42 (2001) l08–124.
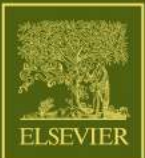
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मराठाकालीन खानदेशातील उद्योग व व्यापार : एक दृष्टिक्षेप

प्रा.डॉ. ए.जी. सोनवणे

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शिरपूर जि. धुळे.

प्रस्तावना

स्वातंत्र्यानंतरखानदेश परगणाहा महाराष्ट्र राज्याचा एक महत्वाचा भाग बनला असून आजच्या प्रगत खानदेशामध्ये विज्ञान व तंत्रज्ञानाच्या सहाय्याने वाहतुकीतील वेगवान साधनांमुळे उद्योग व व्यवसायांची महाराष्ट्राच्या अर्थव्यवस्थेत वाढ होत असून लोकांचे उत्पन्न, राहणीमान व आरोग्य सुविधेत वाढ झाल्याचे दिसून येत आहे. मात्र खूप वर्षापूर्वी १८ व्या शतकातमध्ययुगीनकाळातखानदेशची राजकीय, आर्थिक व सामाजिक स्थिती वेगळी होती. मध्ययुगीनखानदेशची अर्थव्यवस्था मुख्यत: स्वयंपूर्ण होती आणि त्यामानाने लोकांच्या गरजाकमीहोत्या. उच्चकुलीन आणि सत्ताधारी लोक मात्र लोक चैनीचे आयुष्य जगत.भारी पोशाख, मसालेदार रूचकर खाद्यपदार्थ, कलाकुसरीच्या वस्तू आणि चैनीच्या वस्तूंना या वर्गाकडून मोठी मागणी असे.ज्यात मलमल आणि रेशीमकापड, मौल्यवान रत्ने, मोती, हस्तदंत, हत्ती यांचा समावेश असे.खांडववन, कन्हदेश, स्कंददेश, सेऊणदेश, दानदेशअशा विविध नावाने प्रचलित खानदेश दख्खनच्या पठारात मोडतहोता. व अत्यंत सुपीक प्रदेश म्हणून विशेषत: कापसासाठी प्रसिध्द होता. या पीकाला पांढरेसोनेसमजले जाई. मात्र प्रमुख व्यवसाय कृषी असला तरीखानदेशच्या आर्थिक जीवनात उद्योगधंद्यांना अतिशय महत्वाचे स्थान आहे.वाढलेल्या उद्योगधंद्यांनी रयतेच्या कल्याणात भर पडली.रयतेचे जीवन प्रगत केले.या दृष्टीकोनातून प्रस्तुत शोध निबंधात संशोधकाने मराठाकालीनखानदेशातील उद्योग यावर प्रकाश टाकण्याचा प्रयत्न केला आहे.

संशोधनाचे उद्देश

१) मराठाकालीनखानदेशातील उद्योग व व्यापारावर प्रकाश टाकणे.
२) मराठाकालीनखानदेशातील उद्योग व व्यापारात कोणकोणत्या वस्तूंचा समावेश केला जात होता यावर प्रकाश टाकणे.
३) मराठाकालीनखानदेशातील उद्योग व व्यापारात कोणकोणत्या दळणवळण साधनांचा वापर केला जात होता याचा अभ्यास करणे.
४) मराठाकालीनखानदेशातील उद्योग व व्यापाराला सरकारच्या धोरणाची चिकित्साकरणे.

संशोधनाची गृहीते

१) मध्ययुगीनकाळात आजच्या सारखे प्रगत तंत्रज्ञान असलेले उद्योग व व्यवसाय अस्तित्वात नव्हते.
२) खानदेशलासमुद्र किनारा लाभला नसल्याने मध्ययुगीनकाळात व्यापारासाठी जलमार्गाच्या वापरावर मर्यादाहोती.

संशोधनाची पध्दती

प्रस्तुत शोध निबंधात दुय्यम सामग्रीचा आधार घेण्यात आला आहे.यात विविध लेखकांची पुस्तके, मासिके, वर्तमानपत्रे, लेख, इंटरनेट इत्यादी प्रकाशित सामग्रीचा अवलंब केला आहे.

खानदेशचे भौगोलिक स्थान व सीमा

खानदेशचा भूभाग हा २०.८०ते २२.७० उत्तर अक्षांशावर आणि ७३.४२०ते ७६.२८० पूर्व रेखांशाच्या दरम्यान आहे.इ.स. १८७ च्या सर्वेक्षणावरून ग्या प्रदेशाचेक्षेत्रफळ एकूण १०,४३१ चौ.कि. एवढे आहे.खानदेशच्या उत्तरेकडील सीमेवर सातपूडा पर्वताच्या रांगा पसरलेल्या आहेत.या रांगेची लांबी ४८ ते ६४ कि.मी.एवढी आहे.खानदेशच्या भूभागात मध्यभागी सुपीक असतेपीचेखोरे आणि दक्षिणेकडे व नैऋत्य दिशेकडे अजिंठा व सह्याद्रीच्या रांगा आढळतात.खानदेशचा पश्चिम भूभाग हागुजरात राज्याच्या सीमेपर्यंत पसरलेला असून १९१८ सालीखानदेशचे प्रशासकीयसोयीसाठी विभाजन करण्यात आले आणि पूर्व खानदेश व पश्चिम खानदेश अशी नावे देण्यात आली. आज खानदेशचे एकूण ३ जिल्हे आहेत. पूर्वकडील जळगाव, पश्चिमेकडे धुळे आणि नंदुरबार. मात्र मराठाकाळातखानदेशहा सुभा होता.खानदेशमध्ये मध्ये भडगाव, अमळनेर, भुसावळ, चोपडा, शहादा, शिरपूर, नंदुरबार, तळोदा, विरदेल इत्यादी परगणेहोते.

मराठाकालीनखानदेशातील उद्योगधंदे

खानदेशमध्ये अनेक प्रकारचे उद्योगधंदे प्रचलित होते. आज ज्या प्रमाणे मोठे उद्योगधंदे महाराष्ट्रात आढळताततसे मध्ययुगात नव्हते. खानदेशातील असे उद्योग पुढील प्रमाणे –

१) कापड उद्योग

मोमीन, साळी व खत्री जमातीचे लोकांची वस्ती धुळे, कासोदा, धरणगाव, एंडोल, सावदा, फैजपूर, वरणगाव, नशिराबाद, जळगाव, नशिराबाद येथे जास्त होती.खानदेशातीलकापडाला पुण्याला चांगली मागणीहोती.ब-हाणपुरचे शालू प्रसिध्द होते. थिवेने हा फ्रेंच प्रवासी १७

व्या शतकात भारतात आल्यानंतरतोखानदेशच्या कापड व्यवसायाबद्दल म्हणतो कि, ह्या प्रांतात सुती वस्त्रांची निर्मिती जेवढी विपुल प्रमाणात होते तेवढी हिंदुस्थानच्या इतर प्रांतात माझ्या मतेहोत नसली पाहिजे.

२) घोंगड्यातयारकरणे

घोंगड्यातयारकरण्यासाठीखानदेश आघाडीवर होता. घोंगड्यांसाठी लागणारे घुलन खानदेशातून मुबलक मिळत असल्यामुळेहा व्यवसाय धुळे, नशिराबाद, जामनेर, अमळनेर, सोनगीर व विरदेल येथे मोठ्या प्रमाणात तयारहोई व यात्रेच्या ठिकाणी विकला जाई.

३) साखर आणि गुळ व्यवसाय

ज्या भागात शेतीला चांगला पाणी पुरवठा होत असे त्या भागात ऊसाची लागवड करण्यात येत असे.खानदेशात ऊसापासूनगुळ आणि साखरतयारकरण्याचा व्यवसाय पेशवे काळातखुपहोता.पिंपळनेर आणि गाळणा परगण्यातसाखर आणि गुळतयारकरण्याचा प्रमुख व्यवसाय होता.

४) तेल व्यवसाय

तेलही जीवनावश्यक वस्तू असल्यानेतेलाचा व्यवसाय हा सर्वत्र विखूरलेला होता.या व्यवसायात २००० हिंदू-मुसलमान कुटुंबं गुंतलीहोती.तेलतयार झाल्यानंतरते बाजारात विक्रीसाठी घेऊन जात.तीळ, भुईमूग, खोबरे, एंरडी इत्यादी पासूनतेलतयारहोत असे.

५) पादत्राणेतयारकरणे

धुळे, एरंडोल, चोपडा, नंदुरबार येथील पादत्राणे विशेष महत्त्वाची होती.

६) बैलगाड्या तयारकरणे

बैलगाड्या तयारकरणेहाखानदेश मधील प्रमूख व्यवसाय होता.कारणबैलगाडी हे वाहतूकीचे प्रमुख साधन होते.शिवाय उत्तम आणि स्वस्त लाकूड मोठ्या प्रमाणात उपलब्ध होते.दोंडाईचा, तळोदा, नवापूर, सोनगीर, चोपडाही बैलगाडी तयारकरण्याची प्रमुखकेंद्रेहोती.

७) अलंकारतयारकरणे

सोन्या चांदीची दागिनेतयारकरण्याचा व्यवसाय खानदेश मधील बहुतेक सर्व गावातून सुरूहोता.धुळे आणि नंदुरबार हे अलंकारतयारकरण्याच्या बाबतीत विशेष प्रसिध्द होते.

८) धातुपासून भांडी तयारकरणे

तांब्या व पितळ या धातूपासून भांडी तयारकरण्याचा व्यवसाय सोनगीर व फैजपूर येथे चालत असे.

९) विट व मातीची भांडी तयारकरण्याचा व्यवसाय

कुंभार हेघागर, डेरा, फुलदाणी, माठ, जार इत्यादी वस्तू मातीपासूनतयारकरीत. सावद्याचे कुंभार हे मातीच्या भांड्यावर रंगीतकामकरीत. मातीच्या भांड्यांना खानदेशमध्ये चांगली मागणीहोती.

१०) खाण व्यवसाय

खानदेशच्या भागात कोणतीही नैसर्गिक खनिजेसापडत नाहीत्यामुळेतेथेकसल्याच प्रकारच्या खाणी नाहीत.याला अपवाद फक्त दगडांच्या खाणीचा आहे.या दगडाचा वापर ईमारती बांधण्यासाठी केला जाई. धरणगाव, चोपडा आणि धुळे येथीलकाही कुटूंबे या कामात वाकबगार मानली जात असे.

११) जंगलावर आधारीत व्यवसाय

जंगलावर आधारीत असे व्यवसाय मराठा राज्यात खानदेश सुभ्यात प्रचलित होते.महुआची फुले व फुलांपासून दारूगाळण्याचा व्यवसाय होता.जंगलातीलडिंक व रोशा गवतापासून तेलकाढळे जाई. त्यामुळे रोशा गवत गोळाकेले जाई.

१२) बंदुका तयारकरणे

खानदेशमध्ये चांगल्या प्रतीच्या बंदुकाही तयारहोतहोत्या.त्यासाठी जैनाबाद हे गाव प्रसिध्द होते.

खानदेशमधील प्रमुख व्यापार केंद्र

खानदेश सुभा जसा उद्योगधंद्यांच्या बाबतीत आघाडीवर होता तसाच तो व्यापाराच्या बाबतीतही आघाडीवर होताकारणग्रामीण भागात अनेक जीवनोपयोगी वस्तूंची निर्मितीहोत असे व त्या भागात व्यापार सुरू असे.

खानदेश सुभ्यातील बऱ्हाणपुर, नंदुरबार, मालेगाव, सोनगीर आदि काही शहरेही हमरस्त्यावर व मोक्याच्याठिकाणी वसली असल्याने या शहरात व्यापार वाढला तसेच धरणगाव, बऱ्हाणपुर, पारोळा, सोनगीर आदि शहरे उद्योगधंद्यांच्या बाबतीत प्रगत होती. या शहरात ज्या वस्तूंचे उत्पादनहोई. त्याला राज्यातून व राज्याच्या बाहेरून चांगली मागणी असे म्हणूनखानदेश सुभ्यात व्यापार वाढीस मदत झाली.काही शहरांचा इतिहास पाहता सातवाहन काळात बहाळ, प्रकाशेही प्राचीन नगरे असल्याचा उल्लेख आढळतो.ती नगरेखानदेशातील विविध भागात उत्पादित झालेल्या मालांसाठी बाजारपेठ म्हणून उपयोगीहोती. ती नगरेखानदेशात आयात होणाऱ्या मालासाठी व खानदेशातून निर्यात

होणाऱ्या मालासाठी व उद्योगधंद्यांसाठी महत्वाची केंद्रेहोती.प्रकाशेहे ठिकाण बांगड्या तयारकरण्याच्या उद्योगाचेकेंद्रहोत.प्रकाशे येथे स्त्रियांची कर्णभुषणे, अलंकार, शंख, शिंपले, यापासून कलाकुसरीच्या विविध वस्तु तयारकरणाऱ्या कारागीर वर्गाचे निवासाचे ठिकाणहोते.तर पाटणे येथे प्राण्यांच्या हाडांपासून व शंखापासून विविध अलंकार व हत्यारे बनविण्याचे उद्योगधंदे असल्याचे उत्खननावरून आढळते.पिसांपासून शोभेसाठी वस्तु बनविणे इत्यादी.

व्यापारात पुढील वस्तूंचा अंतर्भाव असल्याचे दिसून येते.:– अन्नधान्य, कापड, मसाल्याचे पदार्थ, फळफळावळे आणि इतर पदार्थ यात केली, आंबे, भाबीपाला, मध, खारीक, साखर, पेढे, चारोळी, गूळ, तंबाखू, तांबे, पितळ, लोखंड, शिसे, इत्यादी इतर वस्तूं मध्येकर्णिक, पीठ, मैदा, तेल, तूप, मेण, सूतधागा, विड्याची पाने, पशुमध्ये बैल, शेळ्या, मेंढ्या इत्यादी

व्यापारासाठी दळणवळणाचे मार्ग

व्यापार आणि उद्योगधंदे वाढीसाठी रस्तेहे महत्वाचे असतात.रस्तेहे विकासाच्या वाहिन्या असतात.राज्यात तयार झालेला माल योग्य ठिकाणी पोहोचविणे, कच्चा माल वाहून आणणे, नवीन बाजारपेठा शोधणे, अन्नधान्याची इच्छित ठिकाणी वाहतूक करणे इत्यादी अनेकगोष्टी दळणवळणाच्या मार्गावर अवलंबून असतात.खानदेशातून देशातील बहुतेक भागात दळणवळण होतहोते.खानदेशच्या पश्चिम बाजूला गुजरात जोडला जातो.उत्तर भागाला मध्यप्रदेश, दक्षिणकडे हैद्राबाद व नैऋत्य बाजूला बऱ्हाणपुर असल्यानेखानदेशची बहुतेक प्रांतात वाहतूक सुरु झालीहोती.बऱ्हाणपूर ते गोवळकोंडा हा महत्वाचा मार्ग जसा खानदेश मधून जात होता.तसा सुरतते आग्रा हा महत्वाचा मार्ग ही बऱ्हाणपूरहून जात होता.खानदेशातून नाशिक व पुणे येथे जाता येतहोते.खानदेशला जवळ असणारे महत्वाचे बंदर सुरतहोते.त्याला साक्रीहुन नवापूर सुरत असा मार्ग होता.खानदेशलासमुद्र किनारा जरी लाभला नसला तरीखानदेशमध्ये गिरणा, तापी या सारख्या मोठ्या नद्या होत्या.या नद्यांमुळे अंतर्गत जलवाहतूक बोटीच्या सहाय्यानेसुरूहोती.अशी अंतर्गत जलवाहतूक अमळनेर, भुसावळ, एंडोल, चोपडा, शहादा, शिरपूर, विरदेल, नंदुरबार, तळोदा इत्यादी ठिकाणीहोत असे.वाहतुकीला लागणाऱ्या बोटी प्रकाशे, सारंगखेडा, बऱ्हाणपूर इत्यादी सुम्यातील गावात तयारकरीत असत.वाहतूकीसाठी बैल, उंट, घोडे, गाढव, रेडा, बैलगाडी, पालखी इत्यादीचा वापर होत असे.तथापि बैल हे वाहतूकीचे प्रमुख साधन होते.कापूस वाहण्यासाठी तसेच बैलाच्या पाठीवरून मीठ, किराणा माल, कापड, सूत, गूळ, खोबरे, खारीक, भुसार माल इत्यादी अनेक प्रकारच्या वस्तू वाहून आणत.नारोगणेश यांच्या एका पत्रावरून खानदेशमध्ये सात–आठहजार बैलांचे तांडेहोते.याचा अर्थ खानदेशमध्येखूप मोठ्या प्रमाणात व्यापार चालत असे.खानदेशमध्ये मराठाकाळातकाही गावात यात्रा भरत.या यात्रा तीन दिवसापासून तीन महिन्यांपर्यत चालत असत.तात्पर्य मराठाकाळातखानदेशातून मालाची आयात निर्यात उपरोक्त पध्दतीनेहोत असे.

निष्कर्ष

मराठ्यांनंतर पेशव्यांनीही राज्यात व्यापार वाढविण्यासाठी प्रयत्न केल्याचे दिसते.सामान्यपणेखानदेश सुभ्यात कसबे व पेठहोती.उदा.रनाळे, नंदुरबार यासारखी पेठहोती.कसब्यात आठवडा बाजार भरायचा.मात्र पेठही वर्षभर व्यापारासाठी उघडी असे.व्यापार पेठेचेसंरक्षण आणि प्रगती या संबंधीची जबाबदारी व्यापारपेठेचा प्रमुख शेठेवर असायची.तात्पर्य खानदेशमध्येसमृद्धीहोती व हीसमृद्धी फक्तकृषी मुळेच नव्हती तर व्यापार आणि उद्योगधंदे यांनीही मोठा हातभार लावला होता.नानासाहेब अर्थात बाळाजी बाजीराव यांनी अनेक व्यापाऱ्यांना राज्यात येण्याचे आमंत्रण दिलेहोते. जेव्यापारी खानदेश सुभ्यात आहेत त्यांच्या अडचणी दूरकरून त्यांना अनेक प्रकारच्या सवलती दिल्या. माधवराव पेशव्यांच्या कारकिर्दीतही बऱ्हानपूरहून पळून गेलेल्या व्यापाऱ्यांना अभयदान देऊन परत बोलविले.त्यांना करातसुट दिली.त्यामुळेचखानदेशमध्ये व्यापार हा मोठ्या प्रमाणात वाढला व हजारो व्यापारी बैलावर माल वाहून खानदेशच्या कानाकोपऱ्यात पोहोचू लागले.

संदर्भ सूची :

१) डॉ.प्रताप पी.टी., 'खानदेश इतिहास', गणेश ऑफसेट जळगांव, १९९७

२) डॉ.महाजन टी.टी., 'प्राचीनखानदेशचा इतिहास आणि संस्कृती' दिलीपराज प्रकाशन पुणे, २००५

३) डॉ.शहा जी.बी. , 'मध्ययुगीनखानदेश (आर्थिक, प्रशासकीय व सांस्कृतिक)' प्रशांत पब्लिकेशन्स जळगांव, २०१५

४) चिटणीसकृ.ना., 'मध्ययुगीन भारतीय संकल्पना व संस्था, व्यापार व उद्योगधंदे' भाग-३, पुणे, १९८२

५) विविध मासिके, वर्तमान इत्यादी मधील लेख

६) www.wikipedia.

Change Detection of Land-use and Land-cover of Shirpur Tehsil: A Spatio-Temporal Analysis

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Abstract: The general land use of region is control by various factors i.e. physical, cultural, social, environmental etc. economic activities, agricultural practices and their development depend on land use and intensity of land use. The temporal changes in land use pattern of Shirpur tehsil have studied for the period of 1991 to 2011 to find out the trends of variation in general land use and to identify the reasons for the changes. Spatial variation in land use changes studied on circle level. Last three decades land satellite images have been used. These satellite images further processed and analyzed by GIS software. Total population density of Shirpur Tehsil was 405 in 1991 that increase up to 507 in 2011. The total area of Shirpur tehsil is 83307.61hectares out of that 1000.72 hectares area under built up in 1991 that increases by 1152.22 hectares in 2011. The agricultural land was 540.33 hectares in 1991 that has been decline 298.72 hectares in 2011. Forest area also decline by 3196.27 hectares in last three decades. It is concluded that in Shirpur tehsil Barren land and forest area decline and built up area, agricultural land, area under water bodies has increasing because of increasing population demands.

Keywords: Land use, density, forest area, barren, population demands etc.

I. Introduction

The general land use of region is control by various factors i.e. physical, cultural, social, environmental etc. economic activities, agricultural practices and their development depend on land use and intensity of land use. The general land use of any region experiences the changes in given period of time according to changing population number and its demands is called as temporal variation. The temporal changes in land use pattern of Shirpur tehsil have studied for the period of 1991 to 2011 to find out the trends of variation in general land use and to identify the reasons of the changes. Remote Sensing (RS) has been used to classify and map land cover and land use changes with different techniques and data sets. Landsat images in particular have served a great deal in the classification of different landscape components at a larger scale (Ozesmi and Bauer, 2002). Last three decades land satellite images have been used for this study. These satellite images further processed and analyzed by GIS softwares.

Change analysis of features of Earth's surface is essential for better understanding of interactions and relationships between human activities and natural phenomena. This understanding is necessary for improved resource management and improved decision making (Lu et al., 2004; Seif and Mokarram, 2012). Changes in land use can be categorized by the complex interaction of structural and behavioral factors associated with technological capacity, demand, and social relations that affect both environmental capacity and the demand, along with the nature of the environment of interest (Verburg et al., 2004). Change detection involves applying multi-temporal Remote Sensing information to analyze the historical effects of an occurrence quantitatively and thus helps in determining the changes associated with land cover and land use properties with reference to the multi-temporal datasets (Ahmad, 2012; Seif and Mokarram, 2012; Zoran, 2006).

The land use or land cover pattern of a region is an outcome of natural and socio – economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use / land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare (G. Sreenivasulu et al. 2013). Accurate LULC maps can be effective tools in aiding soil erosion control efforts. Such maps can play an important role in watershed management as a whole and help in deciding what sort of lands are capable of sustaining agriculture and which are not (Cihlar, 2000; Renschler and Harbor, 2002).

Agricultural & Water

Resource Practices:
A Regional Approach

Dr. B. D. Patil

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Studying clustering algorithms in Data Mining using Weka

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Abstract

Clustering techniques are utilized when class prediction is not required but breaking number of instances into usual groups. Clustering apparentlyreveal some appliance that is work in area from which instances are taken and a mechanism that causes some instances to have stronger similarity to each other than other left over instances. An unsupervised learning mechanism can be categorized into partitioning, hierarchical, density based grid based, model based and constraint based approaches. The clustering algorithms groups the data into classes and work on principle of maximizing intra class similarity and minimizing inter class similarity. This paper focuses on studying clustering algorithms k-means; hierarchical clustering, density based clustering and model based clustering.Evaluations of these algorithms arepresented using Weka.

Keywords - clustering methods, Weka tool, clustering types, discretization.

1. Introduction

Data mining is the exploration of observational datasets to find unexpected relationships and to summarize data in a innovative way that are both understandable and useful to data owner .The action of grouping set of abstract objects into classes of same objects is named as clustering. A cluster is assembly of data objects that are analogous to one another within same cluster and are different to objects in another cluster. Clustering is similar to data compression follows unsupervised learning. Various methods of cluster analysis are effective in finding different kinds of clusters.[5] Clustering algorithms will be biased towards finding different kinds of shapes from data. Clustering is a basic task in data mining. The goal of clustering methods is investigative to find data if falls into meaningful groups with small within group similarities and large between group dissimilarity. Many clustering methods are available: partitioning methods, hierarchical methods, density based methods, grid based methods, model based methods, clustering high dimensional data and constraint based methods. In this paper we focus on partitioning, hierarchical, density based and model based method for clustering. We use Weka 3.6 as aourstudy tool.

2. Weka 3.6

Weka has pool of machine learning algorithms and data preprocessing tools. Weka was designed and developed at University of Waikato in New Zealand. The system is coded in Java and distributed under general public license. Weka is open source, platform independent freely accessible. Weka starts with GUI chooser which has four controls:

Fig-1: Weka Tool

Introduction : Short Search on Threats with SQL injection attack

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Abstract

Threat is very serious issue in today's computer and network environment and real world. Here we introduced threats in SQL injection attack. Using injection attack hacker easily accessed website and other attack. SQL injection is a familiar and most vulnerable threat which may exploit the entire database of any organization irrespective whether it is a private organization or a government sector, where code is injected in a webpage. This code injection technique is used to attack data-driven web applications or applications. Many new computer and network users are unknown about threat and SQL injection attack, also they unknown about their malicious activity and harmful or damaging intentions. In this paper we describe a threat in short along with their types and injection method details, which is very useful and important information about threat for new users and after gaining information of threat and injection attack people aware of them and used preventing method in computer and network.

Keywords – Threat, Types of threat, SQL injection, SQL injection attack types, conclusion.

I. Introduction

Nowadays everybody used computer for their personal or official work and to entertainment or for other reasons. In today's environment network are grown up their popularity and most frequently used by professional user and non-professional users of network and computer. Threat is most serious issue in that network, which is harm or damage to computer and create a problem in network. Number of users have accounts on various websites or many users developed self created websites for personal and corporate used, but they easily hacked or attack attempt by SQL injection attack. So here we introduced these attack in short search along with their attack types and codes. Many users does not use their prevention technique because they unknown about threat and their types. So in this research paper we focused on threats along with SQL injection attack and introduced to people of computer, non-computer or professional, non-professional user of computer and network.

II. Threat

"A threat is a feasible danger that strength feat vulnerability to infraction security after that cause possible impair and In computer and network a threat is a feasible danger that might feat a vulnerability to infraction security and therefore cause possible impair."

Threat comes in two types either intentional or accidental. An intentional used by hackers, criminals in organizations or an individual crackers. Accidental means those problems comes as natural i.e. natural disaster (such as an earthquake, a fire, or a tornado) and possibility of computer manufacturing or otherwise a event, capability, action, or incident [1] [2].
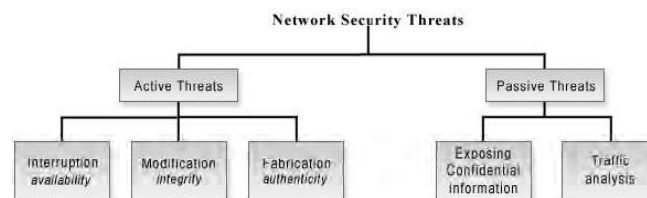

Figure 1: Types of Threat in network

Threats are categorized in two types Active and Passive threat, in active Interruption,

Brain MR Image Segmentation Methods

- Mr. S.Y. Solanki

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- Mr. B.S. Panchbhai

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Abstract

In the recent years, the most important diagnostic tool in medical applications is medical imaging. This is a group of non-invasive techniques, used for visual probing of the human body. The impressive range of sophisticated and versatile medical imaging devices, with Magnetic Resonance imaging (MRI) technique, accentuates the need for a shift from manually assessed images towards efficient, accurate and reproducible computer-based methods. These methods aim at assisting medical experts in their decisions by providing them with quantitative measures inferred from the above-mentioned imaging modalities. These are the most helpful modalities in the study of brain and its related diseases. Image segmentation plays a crucial role in many medical imaging applications by automating or facilitating the delineation of anatomical structures and other regions of interest. We present herein a critical appraisal of the current status of semi-automated and automated methods for the segmentation of anatomical medical images. Current segmentation approaches are reviewed with an emphasis placed on revealing the advantages and disadvantages of these methods for medical imaging applications.

Keywords - Segmentation; MRI; Human brain

I. Introduction

The brain is the most fascinating and least understood organ in the human body. For centuries, scientists and philosophers have pondered the relationship between behavior, emotion, memory, thought, consciousness, and the physical body. The study of the human brain has entered a new era, offering new insights into neurology, psychiatry, psychology and perhaps even contributing to the philosophical debate about the relationship between mind and brain.

The most recent technique used to study the human brain is MRI. Magnetic Resonance Imaging uses magnetization and radio waves, rather than x-rays to make very detailed, cross-sectional pictures of the brain. It has many advantages over conventional imaging techniques. Few of them are:

- High spatial resolution
- Excellent discrimination of soft tissues
- Rich information about anatomical structure

Brain development in the first 2 years after birth is extremely dynamic and likely plays an important role in neurodevelopment disorders, including autism and schizophrenia. There is a dramatic increase in overall brain size during this period; with the brain reaching 80–90% of adult volume by age 2 .Knowledge regarding this period is currently quite limited.

Image segmentation is a process to identify regions of interest from digital images. Image segmentation plays an important role in medical image processing which enables a variety of clinical applications. Although numerous efforts in recent years have advanced this technique, no single approach solves the problem of segmentation for the large variety of image modalities existing today. Consequently, brain MRI segmentation remains a challenging task

II. Brain MRI Segmentation

At the highest level, brain segmentation methods can be classified as manual methods and computer-aided semi-automated or automated methods. Manual segmentation of the brain from MR images requires a high level of expertise in neuroanatomy. The procedures are tedious, time and labor consuming, and subjective. The outcomes of manual segmentation are thus rater-dependent.

A Survey on Web Usage Mining and Its Applications

- B.S. Panchbhai
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- A.J. Maheshwari
R.C. Patel ACS College, Shirpur.

Abstract

With the fast growing of the Internet and its web users all over the world, Mining the data from the web is very difficult task. Tomine various patterns from the web is known as web mining. Nowadays, many current and up-and-coming web applications require real time monitoring and analyzing user patterns in the web.Web Usage mining is the data mining technique to mine the knowledge of usage of web data from World Wide Web. Web usage mining is a newly emerging research area concerned with analyzing the World Wide Web .Web mining is further classified as content mining, structure mining and web usage mining .Web usage mining extracts useful information from various web logs. This paper is going to explain about web usage mining and Its applications.

Keywords - Web mining, Web Structure mining, Web usage mining.

1. Introduction

Recently millions of electronic data are included on hundreds of millions data that are previously on line today. With this significant increase of existing data on the internet & because of its fast disordered growth, the WWW has evolved into a network of data with no proper organizational Structure. In addition to this heterogeneous nature of the web, web searching has become a trickyProcedure for the majority of the users. This makes the users feel confused & at times lost in overloaded data that carry on to enlarge. As a result, guessing the users interests for improving the visibility of web or so called personalization has turn out to be very crucial. We personalization can be depicted as some action that builds the web experience of a user personalized according to the user's interest.

Data Mining applied to web is called web mining. There are three types of web mining according to the usage of data.

2. Web Mining

2.1. Web Content Mining (WCM)

Web content mining performed by extracting useful information from the content of a web site. Web contentmining is the mining, extraction and combination of important data, information and particulars from Web pagecontent. An information source on the World Wide Web, such as hypertext documents, makes automated discovery and search and indexing tools of the Internet. It includes extraction of structured data from web pages, identification,and integration of semantically similar data, judgment drawing out from online sources, and concept hierarchy, information integration.

2.2. Web Structure Mining (WSM)

Web structure mining tries to find out the model basic link structures of the Web. The model isbased on the topology of the hyperlinks with or without the description of the links. This model can be used to sort out Web pages and is useful to generate information such as the similarity and relationship between differentWebsite. Web structure mining could be used to discover authority sites for the authorities and overview sites for thesubjects that point to many authorities (hubs).Two algorithms that Web structure mining used: HITS and Page Rank. Web structure mining is the process of using graph theory to analyze the node and connection.

According to the type of web structural data, it is divided into two kinds:

E-Recruitment System in Indian Country and Its Efficiency

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- B.S. Panchbhai
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Abstract

E-recruitment is integration and utilization of internet technology to improve efficiency and Provides HR and Recruiters with the tools Technology and the capacity to deliver time and cost effective resourcing. This paper deals with the importance of e-recruitment in terms of cost, time and quality efficiency in Indian current scenario. So this paper concludes with some global E-Recruitment services providers as well as it emphasizes on the need of adopting such system by Indian organization.

Introduction

Recruitment refers to the process of attraction screening and selecting qualified people for a job.

"Recruitment refers to the process of attracting people with multidimensional skills and experiences that suits the present and future organizational strategies" (Personnel and HRM, P.Subha Rao).

Recruitment is the process of creating huge pool of potential candidates. It attracts the prospective employees and simulates them to apply for job.

E-Recruitment is an online recruitment where the recruitment is done through electronic resources. It utilizes the web based tools, techniques and technologies. It is the speed that, counts in these days of changing times and technologies. When employers want to fill the slots quickly, they prefer e- recruitment to traditional recruitment. ***E- Recruitment is also known as Internet recruitment.***

The Process of e- recruitment involves the elimination of ineligible and unsuitable candidates through automatic process. There are resume scanners that filters automatically online and provide the right candidates to the employers.

E- Recruitment is a cost effective online recruitment. It is useful when there is sudden shortage of skilled manpower and also if the company bags a new contract and if it wants job seekers with specific skill set, mindset and tool set then e- recruitment is the only solution. Simply we say ***E-recruitment is the mantra for successful recruitment in this global technology world.***

"Today the growth in the e-recruitment industry has been fuelled with the adoption of technology by ***perspective employers & Internet penetration,*** Organizations has cut costs by almost 80 % over traditional recruitment modes by moving over to the online recruitment process."

Background

E- Recruitment originated in the form of independent job sites called bulletin board system in the 1980's. Initially only the U.S. Universities and military had access to internet facilities. Today more than three-fourths of the fortune 900 companies use online recruiting and approximately about 20 million people are posting their resumes on internet portals such as monster. Com. Jobstreeb.com etc.

Taylor launched monster.com in 1994(Murray, 2001) with 20 clients and 200 job openings. Monster.com pioneered e- recruitment in the U.S. and today is the leading internet recruitment portal. Since those in early days the monster of sites has multiplied and the technology has, and will continue to improve for the benefits of both recruiter and jobseeker.

A Comparative study of Cloud computing and Grid Computing

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- Bhanudas Suresh Panchbhai
R.C. Patel Arts, Comm. & Science College, Shirpur

Abstract

Cloud computing is a favourable technology of the present and future which uses the grid computing as its backbone. Cloud computing is the newest topic of information and communication technology (ICT) for implementing it for individual, groups and business. Grid computing is considered as most related ancestor technology of cloud computing. Although Cloud and Grid computing look similar but they differ at many aspects which has been explained in detail. The cloud computing and grid computing is compared side by side on the basis of features & Security issues.

Keywords - Cloud computing, Grid computing, Infrastructure, Platform, Service

I. Introduction

Cloud computing and Grid computing are two main technologies which are in use in the world for easy and portable computing. Although look similar from layman point of view but they are quite different from each other. With Cloud computing application software can be operated using internet-enabled devices [4]. Grid computing is the collection of computer resources from multiple locations to reach a common goal. The grid can be imagined as a distributed system with non-interactive workloads that involve a large number of files.

II. Cloud Computing

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [1]. Resources are pooled and offered on-demand with ubiquitous network access to rapidly configurable and elastic IT capabilities. The three types of services provided by cloud are Software as service (SaaS), Platform as service (PaaS) and Infrastructure as service (IaaS). The deployment model, service models and service attributes are as given below:
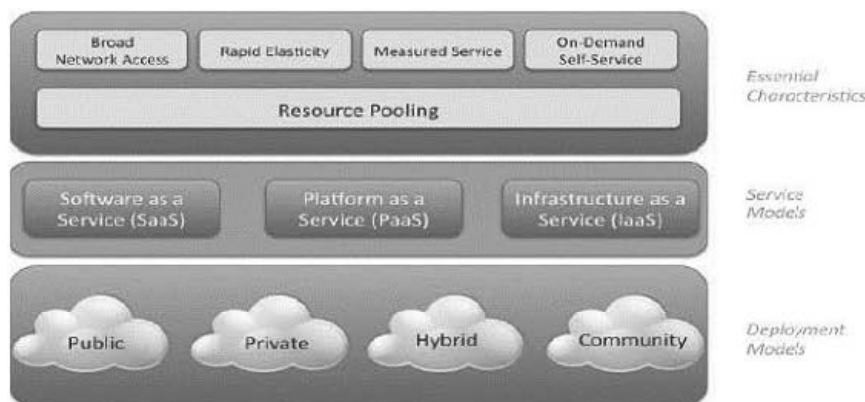

Figure 1: NIST Cloud computing [1]

The key benefits of providing computing power using Clouds are [5]:

1. Avoidance of expensive computer systems configured to cope with peak i performance.

Study of Processes and Process Management - A Review

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- Prof. A.J. Maheshwari
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Abstract

The active entities in a Linux operating system are the processes.In this paper, we study the process management in the Linux. We represent the data structure of a process and how to manage the multiple processes in Linux operating system. Process management describes a life cycle of a process can be conceptually divided into set of states and transition.

Linux is a one of multiuser and multiprocessing system. Linux has its solution to the file system resource management. The Linux kernel handles almost all issues related to all process management and provides the well-defined system programs.

Keywords - Linux, Kernel, process, schedule, interrupt preemption.

Introduction

The process is the program in execution or an abstraction of a running program, and that consistsof a pattern of bytes that interprets as machine instructions called text, data and stack. All modern computers can do several things at the same time.While running a user program, a computer can also be reading from a disk and displaying the specific result.
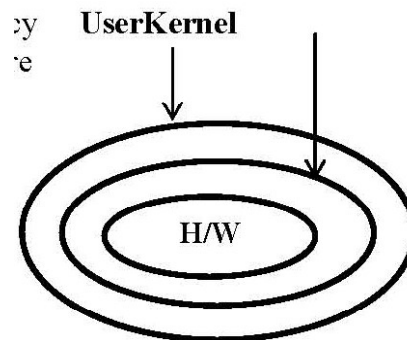
Fig. Basic architecture of kernel

Each process runs a single program and has a single thread of control. In other words, it has one program counter, which keeps the track of the next instruction to be executed. The executing program i.e. process, including the current values of the program counter, registers, and variables. Conceptually, each process has its own virtual CPU.

Linux Operating System

The computer system manages the complex tasks with such efficiency and accuracy with the help of Linux operating system. It is the operating system that uses hardware resources efficiently to perform various tasks and ultimately makes life easier. At a high level, the OS can be divided into two parts the first being the kernel And other is the utility programs.

Kernel

The Linux kernel is not an operating system, but the kernel, or heart, of the operating system that enables the applications that make the real OS able to operate. Such applications include the various shells, the compiler, the windowing software, Utilities and so on that are needed before we computer will even boot up. So the Linux kernel is not the same as the Linux OS.

Multilevel Hashing to reduce searching Time

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Introduction

Hash table is a data structure in which large amount of data can be stored. Though large amount of data is stored in hash table, hash is designed so that amount of time require to search desire record or data item is much less as compare to any other data structure.

Time require to search record isnot respect to 'n' , where 'n' is number of total record . Searching time is O(s), where 's' is bucket size. If we keep bucket size,' s' much large it may leads to increase searching time, because in a bucket records are search sequentially, on other hand if we keep bucket size much less it may leads to overhead of overflow handling technique or collision resolution technique.

In this paper I am trying to propose hash table so that when a new record will hash to bucket, instead of storing new record in hashed bucket sequentially that is in next free socket, instead a hash table will be maintain in a hashed bucket, that is each bucket of a main hash table will be a small inner hash table. So that searching time will be 's1', where let size of each bucket for outer hash table will be divide into 's1'.And searching time will be O(s1) and 's1' is a fraction of 's'.we can reduce our searching time from 's' to 's/b1', where 'b1' is number of buckets of inner hash table.

Objective

To minimize searching time, as searching time of hash table is O(s), where 's' is bucket size, we have to minimize searching time in fraction of 's'.

Data collection

Consider primary data as all students enrol them self in a university for examination. Once data is stored in multilevel hash table we can reduce searching time up to greater extend.

Proposed solution(Multilevel hashing)

Existing hash table will be as follows as shown in fig1
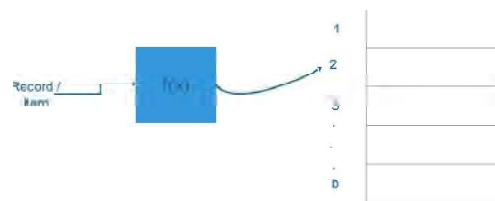
In fig. 1 we can see when a record hash to a bucket, record will be store sequentially that is next free socket of hashed bucket. In future if desire record is to be search time require to search a desire record will be O(s), where 's' is size of bucket And while search record is to be search sequentially in a bucket who size will be 's'.

Proposed multilevel hash table shall be as follows,

Information Communication Technology (ICT) for Quality Education - An Overview

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Abstract

Education is the only weapon to change the World that unlocks the door to prosperity of a Nation. It is one of the main key to develop and the improvement of mankind. Since Education is regarded as the bedrock for Nation building. The purpose of this paper aims to bring together the finding and key points from a review of significant part of the available literature associated with ICTs for Education. This review set out to identify and evaluate relevant strategies in National and International research and initiatives related to measuring and demonstrating the effective use of ICT for education with regard to the teaching learning process; Therefore, ICT works for the best quality and accessibility of education.

Keywords - Information Technology & Communication., Education, Quality, Information Technology.

Introduction

As technology comes to dominate and transform our lives more and more, as it becomes more pervasive, user-friendly and inexpensive, schools cannot be impervious to it. According to experts like Paper (1986), it will become an integral part of Education and eventually transform the entire process. Till then, the piecemeal efforts of the governments, multilateral agencies and college authorities can be seen as innovations and experiments that will lead them to discover the good practices and avoid some of the challenges. It also examines the reasons, rationales, policies, plans, challenges, strategies and limitations of technology integration in education.

Global changes put pressure on Education's studies to constantly acquire and apply new skills and techniques in teaching through adoption of relevant technologies to cope with trends of globalization. Education, with the help of ICT is at the confluence of powerful and rapidly shifting technological and political forces that will shape the structure of educational systems across the globe.

Information Communication Technology (ICT)

The term information and communication technology (ICT) is a new addition of Information technology (IT) and communication technology (CT). According to Khan et al. [5], information communication technology (ICT) refers to technologies that provide access to information through Communications and also adds information and communicates with technology. Along with this ICT is an umbrella term that includes any communication device, encompassing radio, television, cell phones, computer and network hardware, satellite systems and so on, as well as the various services and appliance with them such as video conferencing and distance learning. Information and communication technology (ICT) have been touted as potentially powerful enabling tools for educational change and reform. ICT is concern with the storage, retrieval, manipulation, transmission or receipt of digital data.

"ICTs are the computing and communication facilities and features that variously support teaching, learning and a range of activities in education."

Objectives of ICT for Quality Education

- To improve in learning achievement.
- To reduction of adult illiteracy rate, with sufficient emphasis on female literacy.
- For expansion of provisions of basic education and training in other essential skills required

Improve Quality of Education in Rural Areas through Multimedia System

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Abstract

Computer Aided learning (CAL) program are simple and fun to use which motivates children to want to use them. Multimedia and animated texts can be used to great effect to support beginners. Teachers can play main role in allowing educational innovations to scatter into the classrooms. The study of CAL for primary school children in rural area has been done to improve the quality of education by looking, into the particular learning need of children to track the progress of each child. The main aim is to increase the quality of education by exploring various tools, teaching learning methods & materials that can change the paradigm of the way children learn in these schools.

Keywords - CAL – Computer Aided Learning, Multimedia Learning System etc.

1. Introduction

Now a day's education is very speedy and difficult and there are so many competitions. So students required a technique by which they can learn more in very short Span of time. As pictures are thousands times better than words so just instead of reading books they would like to learn from pictures in which there may be animations, By which they can enjoy learning. Technology in education is the combination of various medium. These technologies may use some combinations of audio channels, video, computer code, graphics or text. These include audio and video tapes, interactive audio and video teleconferencing, various computer and Internet technologies like web-based learning and computer based Learning, and print technologies. Different technologies have contributed to different facets of educational development and effective learning: expanding access, promotingefficiency, improvingefficiency, improving the quality of learning, enhancing the quality of teaching and improving management system. Multimedia combines five basic types of media into the learning environment text, video, sound, graphics and animation, thus providing a powerful new tool foreducation. CAL (Computer Aided Learning) can be easily accepted especially for primary student's age between 6- 11 years old. The main characteristics of these students are fun at play: matched with increasing trends on technology, learning won't be boring as the conventional way of teaching.CAL is based on the integrated approach;it is used as a learning resource. We observed that students from rural area are week and shy as compared to students from urban area. There is needed to feel the gap between them. For that we have to improve the quality of education of rural area from primary level.

2. Review of literature

I reviewed some papers on topic multimedia and education that are as:

Linden L. and et al (2003) present the result of CAL; they find the program to be quite effective.

Pal J. (2005) the social and organizational factors affecting CAL.Prasad S. (2008) "Computer Aided Learning has the power to transform education in a fundamental way ".Meiting Bai (2008) describes programs to reduce the gap between city and rural education in primary schools.At the twist of the millennium An Indian Government launch universal education program known as Sarva Shikshan Abhiyan (SSA) aims to achieve relevant elementary education for all Indian children by 2010.From the literature CAL may be an effective method of teaching well defined concept concerning one aspect of the curriculum.

3. Objective

Need of Effective Concurrency Control Techniques in Distributed Databases

- Mr. Dipak E. Chavan
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Abstract

There is a growing demand for more difficult transactions and higher throughputs in transaction processing systems leading to higher degrees of transaction concurrency. The main problem in distributed databases is to maintain consistency in databases. To maintain consistency in database, accuracy criteria must be met. Many of the concurrency control methods are presented earlier, but they have problems about delay, performance, waiting time and number of message exchanges while maintaining correctness. In this paper, we have analyzed different techniques of concurrency control in distributed databases and compared their performance. Ideas that are used in the design, development, and performance of concurrency control mechanisms have been summarized. The locking, time-stamp, optimistic-based mechanisms are included.

Keyword - Distributed Database System, Time-stamp, Locking, concurrency control.

1. Introduction

When someone want to store the huge amount of data for future use, the databases are the best approach of storing the data. A distributed system can be think as a set of sites, each site consisting of a number of autonomous transactions. A distributed database is basically a database that is not limited to one system, it is spread over different sites, i.e., on multiple computers or over a network of computers. A distributed database system is located on various sited that don't share physical components. This may be required when a particular database needs to be accessed by various users globally. It needs to be managed such that for the users it looks like one single database. A database state represents the values of the database objects that represent some real- world entity. The database state is changed by the execution of a user transaction. Individual transactions running in isolation are assumed to be correct. When multiple users access multiple database objects residing on multiple sites in a distributed database system, the problem of concurrency controlarises.Database is inconsistent when transactions are in deadlock. Therefore concurrency control is needed to maintain database in consistent state.

The database system through a scheduler must monitor, examine, and control the concurrent accesses so that the overall correctness of the database is maintained. There are two criteria for defining the correctness of a database: database integrity and serializability. The database integrity is satisfied by assigning a set of constraints that must be satisfied for a database to be correct. The serializability ensures that database transitions from one state to the other are based on a serial execution of all transactions. For concurrency control serializability is the most important criterion. The serializability ensures the correctness of the database by converting conflict equivalent schedule to a serial schedule. This paper presents various concurrency control techniques that maintains both the properties.

2. Concurrency Controol

When several transactions execute concurrently in the database, the isolation property may no longer be preserved. To ensure the system must control the interaction among the concurrent transactions; this control is achieved through concurrency control schemes. Concurrency control is the procedure in DBMS for managing simultaneous operations without conflicting with each another. Concurrent access is quite easy if all users are just reading data. There is no way they can interfere with one another. Though for any practical database, would have a mix of reading and WRITE

A Review on Image Based Steganography

- Mrs. Madhavi A. Gulhane

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Abstract

Today looking at digital multimedia content has lead to it being utilized as a medium of safe and secure communication. The art of secret communication by a secret medium like images is known as steganography as the equal method of detecting the presence of embedded data in media is called steganalysis. Steganography is one of the methods used to hide information for the purpose of exchanging information and it can be defined as the study of communication that usually deals with ways of hiding the message with other medium like image, audio etc. In this review paper we have studied and analyzed the different methodologies from various researchers in their research. The main goal of image steganography is to hide the existence of the data message from illegal sources. Image steganography proposes a job to transfer the embedded secure data to the target destination without being detected through the unauthorized user. Various carrier file formats would be used, but digital images are large enough used due to the frequency and huge users on the worldwide Internet. To hide the secret data in images, there are large ranges of steganographic methodologies exist some are complex in used than others method. Every method has respective strong and weak points.

I. Introduction

Information security is a major issue of concern while exchanging a data in an open network, as internet is not only a single network it is worldwide collection of loosely network. It is not restricted by any geographical, national or international boundaries; it means anyone can access it from any part of the world. Although it is very useful for various purposes but there is a risk associated with security of the information which is transfer through the internet. Anyone can hack the information and then make misuse from that or corrupt it or we can say that anyone can destroy the information if it is not fully secured or protected. Steganography and Cryptography both plays a very important role in information security. The steganography word is derived from the Greek words stegos meaning cover and grafia meaning writing [1] defining it as covered writing. The information is hidden exclusively in images known as steganography images. Steganography is the art and science of secret communication. It is the practice of embedding secret information in a manner such that the existence of the information is invisible.

Fig 1: Steganography system

महिलांची सुरक्षितता व सशक्तीकरण अंतर्गत महिलांमध्ये करावयाची सामाजिक व कायदेविषयक जाणीव जागृती

आयोजक
चाळीसगांव एज्युकेशन सोसायटीचे
बी.पी. आर्टस्, एस.एम.ए. सायन्स, ॲन्ड के.के.सी. कॉमर्स कॉलेज
चाळीसगाव, जि. जळगाव.
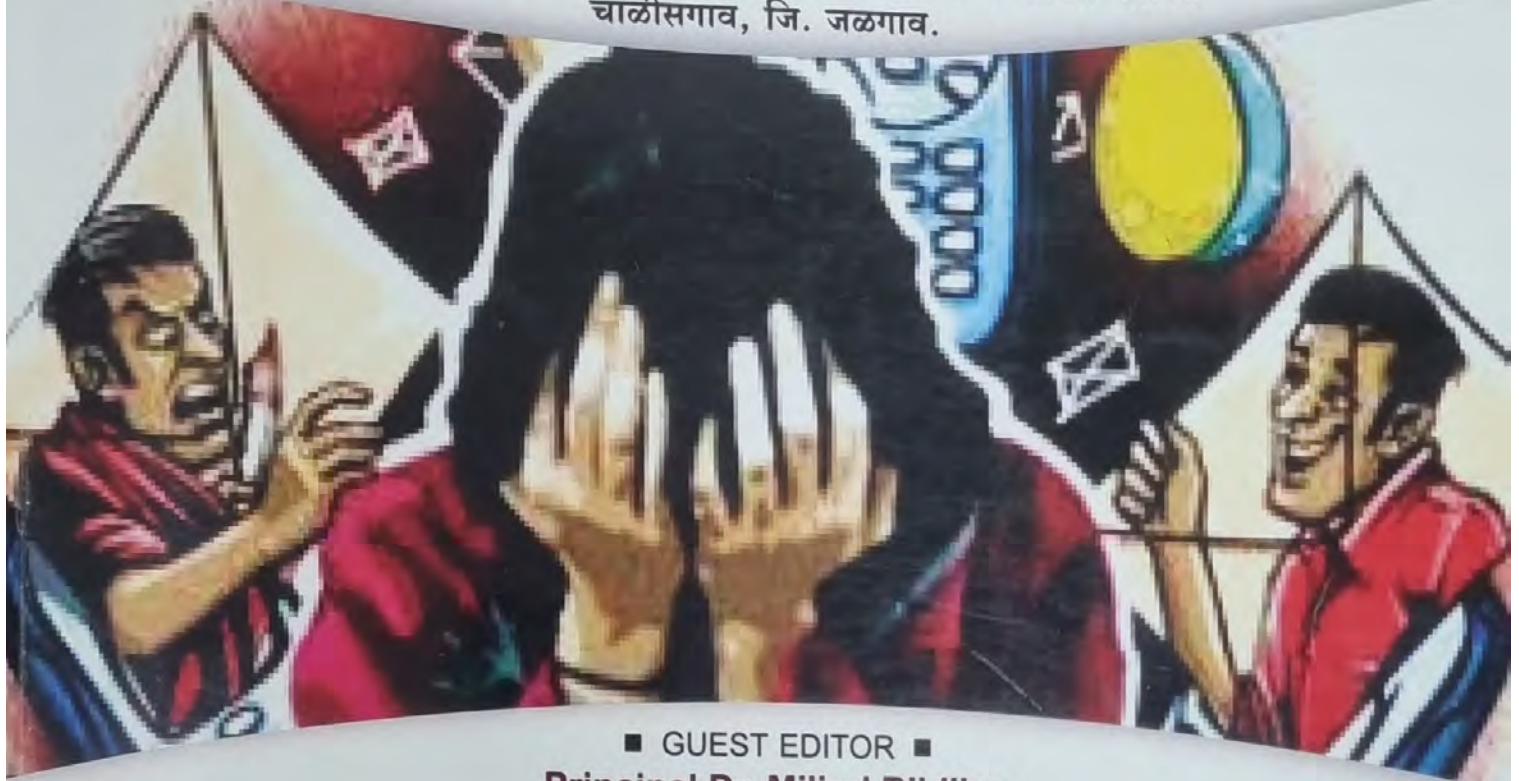
महाराष्ट्र राज्य महिला आयोग, मुंबई

यांच्या सहयोगातून

एक दिवसीय राष्ट्रीय परिषद (आंतरविद्या शाखीय)

– आयोजक –

चाळीसगांव एज्युकेशन सोसायटीचे

बी.पी. आर्टस्, एस.एम.ए. सायन्स, ऑन्ड के.के.सी. कॉमर्स कॉलेज

चाळीसगाव, जि. जळगाव.

– विषय –

महिलांची सुरक्षितता व सशक्तीकरण अंतर्गत महिलांमध्ये करावयाची सामाजिक व कायदेविषयक जाणीव जागृती

१४ फेब्रुवारी, २०१९

INDEX

भारतीय संरक्षण आणि महिलांची भूमिका

प्रा.डॉ. राजु सिताराम पवार

संरक्षणशास्त्र विभाग प्रमुख, आर.सी. पटेल कला, वाणिज्य व विज्ञान महाविद्यालय, शिरपूर, जि.धुळे.

२१ व्या शतकाच्या प्रारंभापासूनच नव्या बदलत्या काळात भारतीय महिलांचे स्थान याबर अनेक परिसंबाद, चर्चा होऊ लागल्या. भारतीय सशस्त्र सेनेत महिलांचे स्थान पुरूषांच्या बरोबरीने महिला देखील कोणत्याही क्षेत्रात कमी नाहीत हे भारतीय सेनेत आर्मी, नेव्ही आणि एअरफोर्स या तिन्ही दलात महिलांची कामगिरी उल्लेखनीय आहे. सेनेतील शिपाई पासून तर सरसेनापती पर्यंत महिलांनी जबाबदारी पार पाडली. सशस्त्र सेनेतील महिलांचे सबलीकरणास एका नव्या क्षेत्रात उत्तुंग भरारी मारण्याची क्षमता असल्याचे सिध्द झाले. बऱ्याचदा महिला सबलीकरण व जागतिकीकरणाचे जगात केवळ ज्ञान क्षेत्रातील आशा न राहता त्या एका वैशिष्ट्यपूर्ण अशा विकासवादाच्या प्रतिमानाच्या स्वरूपात चर्चिल्या जातात. यावरून महिलांचे महत्व लक्षात येते. महिला सबलीकरण म्हणजे स्त्रियांचे आध्यात्मिक, राजनैतिक, सामाजिक, लष्करातील सामर्थ्य वाढविणे ज्यात स्वतःच्या क्षमता संबंधी त्याचा आत्मविश्वास विकसित करण्याचा अधिकाराचा समावेश आहे

उद्दिष्ट्ये – १) भारतीय संरक्षण आणि महिलांच्या भूमिकेचा अभ्यास करणे. २) भारतीय सशस्त्र सेनेतील महिलांचे योगदान याबर प्रकाश टाकणे. ३) महिला सबलीकरण व सेना दलातील महिलांचे योगदान या निष्कर्ष व उपाय सुचविणे. ४) महिलांचे राष्ट्र विकासात भूमिका स्पष्ट करणे.

महिलांचे अधिकार – महिलांच्या क्षमता आणि सामर्थ्यावर समाजाचा विकास अवलंबून आहे. महिलांचे सबलीकरण हा त्याचा मुख्य घटक त्या अस्तित्वाचा आहे जो समाजाने त्यांना प्रदान केला आहे. ज्यात सामाजिक, राजकीय, आर्थिक, सार्वजनिक व राष्ट्र सुरक्षा देण्याचे रक्षण या साऱ्या जबाबदाऱ्यांचे त्यांच्या जिवनात महत्वाचे स्थान निर्माण झाले आहे. कधी काळी देशाच्या रक्षणाची जबाबदारी केवळ पुरूषांखेरीज होऊ शकत नाही. ही समीकरणे अलिकडच्या दोन दशकात महिलांनी बदलून टाकली आहे. भारतीय सेना दलात अगदी शिपाई पासून पायलट तर राष्ट्रपती म्हणजे सरसेनापती पर्यंत महिलांनी आपल्या सामर्थ्याची जाणीव जगाला करून दिली.

महिलांचे सामर्थ्य बाबत महत्वपूर्ण बाबी – १) स्वतःचा निर्णय घेण्याचे सामर्थ्य २) सामुहिक निर्णय घेतांना दृढनिश्चय घेण्याची योग्यता ३) परिवर्तन घडवून आणण्याच्या योग्यतेबाबत सकारात्मक विचारसरणी ४) योग्य निर्णय घेण्यासाठी माहिती आणि इतर साधने वापरात उपलब्ध असणे ५) सामुहिक निर्णय घेतांना माहिती आणि इतर साधने वापरात उपलब्ध असणे ६) सामुहिक निर्णय घेतांना हा दृढनिश्चय घेण्याची योग्यता व सामर्थ्यता ७) वैयक्तिक किंवा सामुहिक सामर्थ्यामध्ये सुधारणा घडविण्याचे कौशल्य आत्मसात करण्याची योग्यता असणे. ८) अखंड व स्वपुरूस्कृत विकास प्रक्रिया आणि परिवर्तन सहभाग होणे. ९) लोकशाही पध्दतीने इतरांचा दृष्टीकोन बदलण्याची योग्यता १०) स्वतःची सकारात्मक प्रतिमा तयार करणे आणि नकारात्मक गोष्टींवर ताबा मिळविणे ११) लष्कर व विज्ञान तंत्रज्ञान क्षेत्रात आपली क्षमता सिध्द करणे १२) जागतिक स्तरावर भारताची प्रतिमा सिध्द करण्याचा प्रयत्नाचा पाठपुरावा करणे.

भारतीय महिला आणि जागतिक कायदे

भारतामध्ये १९७१ मध्ये स्त्रियांच्या स्थितीबाबत अहवाल तयार करण्यासाठी एक समितीची स्थापना झाली होती. त्यांनी मेहनतीने भारतीय स्त्रियांच्या स्थितीबाबत तीन वर्ष अभ्यास करून अहवाल तयार केला. १९९५ ला संयुक्त राष्ट्र संघाने 'आंतरराष्ट्रीय महिला वर्ष' घोषित केले. पुढे लगेचच संयुक्त राष्ट्र संघाने १९७५ ते १९८५ असे आंतरराष्ट्रीय महिला दशक म्हणून घोषीत केले. आणि खऱ्या अर्थाने या घडामोडीनंतर स्त्रियांसाठी आधी कल्याणकारी व पुढे विकासात्मक त्यापुढे सहभाग व सक्षमीकरण असा प्रवास करीत स्त्रियांच्या हक्काधारित कायद्याची भारतात सुरूवात झाली. अर्थात यामध्ये विविध स्त्रीवादी चळवळी व पुढे स्त्रियांच्या संस्था-संघटना याचे योगदान मोठे आहे. आज जगभरात आणि भारतात ज्या पध्दतीने धोरणे आणि कार्यक्रम राबविले जात आहेत. त्यामध्ये केवळ शासन सहभागी नसून खाजगी कंपन्या देखील सहभागी आहेत. जागतिक बाजारपेठेच्या रेट्यामधून व जागतिक हितसंबंधाना जोपासण्यासाठी विकासात्मक कार्यक्रम सुरू झाले आहेत. त्याचाच परिणाम म्हणून भारतीय सशस्त्र सेनेतील महिलांचे योगदान महत्वपूर्ण आहे.

भारतात येत्या दशकामध्ये अजून एक कळीचा मुद्दा असणार आहे तो म्हणजे देशातील विविध भागांमध्ये सुरू असलेला सशस्त्र संघर्ष आणि शांतता प्रक्रिया जिथे असे सशस्त्र संघर्ष सुरू आहेत. तेथील मुली व स्त्रियांवर त्याचा जास्त खोल आणि वेगळा परिणाम होतो. सशस्त्र संघर्षाच्या काळात स्त्रियांवर विविध लैंगिक अत्याचार केले जातात. ते तथ्य अनेक वर्षांपासून स्थापित झालेले आहेत. जातीय दंगली, वांशिक दंगली, धार्मिक दंगे, यामध्ये देखील हेच होते हे आपण सारेच जाणतो कधी चर्चा करून तर कधी बंदूकीच्या धाकावर शांतता स्थापीत केली जाते. या सगळ्या प्रक्रिया मध्ये स्त्रियांना मात्र सामावून घेतले जात नाही. खरे पाहता अशा शांतता प्रक्रियेमध्ये स्त्रियांना निर्णयकर्त्या म्हणून सहभाग असणे खुप महत्वाचे आहे. संयुक्त राष्ट्र संघाच्या सुरक्षा परिषदेच्या स्त्रिया, शांतता आणि सुरक्षा या विषयाचा ठराव क्रमांक १३२५ ची अंमलबजावणी सुरक्षा दलांमध्ये स्त्रियांची संस्था वाढविणे असे नसून समाजातील शांतता टिकून रहावी आणि विशेषतः संघर्षमय असलेल्या राज्यांमध्ये शांतता प्रस्थापित करण्यासाठी केल्या जाणाऱ्या निर्णय प्रक्रियेमध्ये टेबलाबर महिलांना स्थान असले पाहिजे.

भारतीय संरक्षण दलातील महिलांची भूमिका

भारतीय लष्कराच्या सरसेनापती श्रीमती प्रतिभा देवीसिंह पाटील (भारताच्या माजी राष्ट्रपती) हा भारताच्या पहिल्या लष्कराच्या सरसेनापती बनल्या. त्यांनी आपल्या काळात दुर्गम अशा लष्करी छावण्यांना भेटी दिल्यात. लष्कराच्या अलौकिक राष्ट्रीय कार्याबद्दल सैन्य दलांना प्रोत्साहन दिले. पुनित अरोरा या भारताच्या पहिल्या महिला आहेत ज्यांनी भारतीय सशस्त्र दुसरी सगळ्यात मोठी रँकींग लेप्टनंट जनरलची पोस्ट सांभाळली शिवाय पुनित अरोरा भारतीय नौसेनेच्या पहिल्या व्हाईस ॲडमिरल होत्या. पद्मावती बंडोपाध्याय या भारतीय वायुसेनेच्या पहिल्या महिला एअर मार्शल होत्या. दिव्या अजित कुमार 'स्वॉर्ड ऑफ ऑनर' चा किताब मिळविणाऱ्या पहिल्या महिला कॅडेट होत्या. अवनी चतुर्वेदी, भावनाकांत आणि मोहनसिंग या भारतीय वायु सेनेच्या पहिल्या पायलट होत्या. गुंजन सक्सेना या भारतीय वायु सेनेच्या पहिल्या महिला अधिकारी होत्या. ज्या युध्द क्षेत्रात गेल्या. गुंजन सक्सेनांचा उल्लेख कारगील गर्ल म्हणूनही केला जातो.

१९४३ पासून भूदलाच्या वैद्यकिय विभागामध्ये आणि १९२७ पासून मिलिटरी नर्सिंग होम मध्ये भूदलाच्या शिक्षण विभागात स्त्रियांनी अत्यंत

महत्वाची कामगिरी केली आहे. आजच्या स्त्रीचे सक्षमीकरण आव्हानांना तोंड देण्याची तयारी पाहता भारतीय सैन्य दलात अधिक अधिक स्त्रियांची भरती होणे गरजेचे आहे. लष्कराच्या संदर्भातील देशाची सद्याची परिस्थिती पाहता सध्या तिनही दलामध्ये 'कमिशन ऑफिसर' पदावरच घेतले जाते. आज भारतीय सशस्त्र सेना दलात महिलांची भरती पुरूषांच्या तुलनेने अत्यंत नगण्य आहे. एका सेना भरतीच्या जाहिराती नुसार ५० पुरूषांमागे ४ महिला अशी सध्याची स्थिती आहे. सैन्य दलातील स्त्रियांचा सहभाग वाढविण्यासाठी एक सोपा उपाय म्हणजे स्त्रियांसाठीच्या जागा वाढविणे. अभियांत्रिकीच्या पदवीच्या शेवटच्या वर्षात शिक्षण घेणाऱ्या मुलींसाठी २००९ पासून लष्कराने विशेष सवलत देवू केली आहे. त्यानुसार युनिव्हर्सिटी एन्ट्री स्कीम द्वारे मुलींना सुध्दा इंजिनिअर, सिग्नल आणि ईएमई कोर मध्ये कमिशन करण्याची सोय करून दिली आहे. परंतु निबड झालेल्या महिला अधिकाऱ्यांना युध्दभूमीवर पाठविण्यात येत नाही. तेथे अजुनही स्त्री-पुरूष भेदभाव आहे.ह्या पाश्चात्य देशाच्या मात्रा सेनेत हेच कार्य करणाऱ्या स्त्रियांना युध्दभूमीवर पाठविले जाते. या शिवाय आणखी एक संधी म्हणजे DRDO मध्येही स्त्रियांनी भरीव योगदान दिले असुन उत्तम कामगिरी केली आहे. इथे त्या प्रयोगशाळेत आणि फॅक्टरीत महाव्यवस्थापक, वैज्ञानिक, लेझर थर्मल डिटेक्टर या क्षेत्रात राष्ट्रपती पुरस्कार सुध्दा मिळविले आहेत. लष्कराच्या तिनही दलाच्या प्रत्येक शिक्षण संस्थात NDA, IMA, WAR COLLEGES इथे प्राध्यापक त्याचप्रमाणे प्रयोग शाळेत मोठे योगदान दिले आहे. इथे त्यांची नेमणूक केंद्रिय लोकसेवा आयोगा तर्फे होते.

पॅरा मिलीटरी फोर्सेस अर्थात सुरक्षा रक्षक दल CISF म्हणजे केंद्रिय औद्योगिक सुरक्षा दल CISF सेन्ट्रल रिझर्व पोलिस फोर्स केंद्रिय राखीव पोलीस दल सीमा सुरक्षा दल, कोस्ट गार्ड, आसाम रायफल्स, इंडो-तिबेट बॉर्डर फोर्स, रेल्वे सुरक्षा दल, भारतीय पोलीस सेवा अशा गृहमंत्रालया अंतर्गत येण्याच्या सशस्त्र सेना आहेत तिथे विविध पदावर स्त्रिया कार्यरत आहेत. तसेच विमानतळ, रेल्वे स्थानके, रेल्वे गाड्या, ऑर्डनन्स फॅक्टरी अशा अनेक ठिकाणी सुरक्षितचेची जबाबदारी स्त्रिया उत्तम रित्या पार पाडत आहे. दहशतवादी हल्ले रोखणे, भुकंप, त्सुनामी, पूर अशा नैसर्गिक आणि मानव निर्मित संकट काळात समाजाला सावरण्याची महत्वपूर्ण जबाबदारी स्त्रिया पार पाडत आहे. अशा संघटनामध्ये महानिरिक्षक पदापासून शिपाई पदावर तैनात असतात. आणि उत्तम कामगिरी करतात. गृहमंत्र्यांनी केंद्रिय औद्योगिक सुरक्षा दल आणि केंद्रिय राखीव पोलीस दलामध्ये कॉन्टेबल पदासाठी ३३% राखीव जागा ठेवण्याची घोषणा केली आहे. थोडक्यात संरक्षण क्षेत्रात कार्यनीतीपासून ते युध्दनीतीपर्यंत स्त्रिया उत्तमरित्या कार्य करतील. भारताच्या संरक्षण क्षेत्राशी जोडलेल्या संस्था मध्ये स्त्रियांकरीता किती वाव आहे याची कल्पना आपल्या महिला सक्षमीकरणात येते. या शिवाय महिलांसाठी सशस्त्र दलात वरील महिलांच्या संरक्षणदलाच्या कामगिरी व्यतिरिक्त शॉर्ट सर्व्हिसेस कमिशन म्हणजे भूदल-ईएमई, सिग्नल, इंजिनिअर्स, आर्मी एज्युकेशन क्रॉर्प्स आर्मी, ऑर्डनन्स क्रॉर्प्स, आर्मी सर्व्हिसेस कॉर्प्स, इंटेलिजन अँड अॅडव्होकेट जनरल (जेएजी) नौदल - लॉजिस्टीक्स, एटीसी, एव्हीएशन केडर, नावल आर्किटेक्चर केडर, हवाईदल- फ्लाईंग, एरोनॉटिकल इंजिनियरींग, इलेक्ट्रीकल, मॅकनिकल, एज्युकेशन अॅडमिनिस्ट्रेशन, लॉजिस्ट्रीकल, अॅकाउन्ट अँड मिटिरोलजी. थोडक्यात भारतीय सेना दलात महिलांची कामगिरी पुरूषांबरोबरीची असुन कोणत्याही क्षेत्रात महिला कमी नाहीत. या उलट महिला अधिकारी असलेल्या पदावर निरपेक्षपणे कार्य केल्याची उदाहरणे आहेत. भारतात महिलांना होमगार्ड ते सरसेनापती पदावर काम सक्षम करण्याची क्षमता आहे म्हणजे या संदर्भात महिला खऱ्या अर्थाने सक्षमीकरण झाले आहे असे म्हणता येईल. भारतात राज्य आणि केंद्रिय दलात महिलांचा सहभाग जास्त वाढावा या करिता विशेष प्रशिक्षण संस्थाची निर्मिती केली आहे. १९९२ मध्ये भारतीय भूदलात प्रवेश झाला आता सैनिक दलात प्रत्येक मुकाबल्यात महिला सैनिकांची निवड करण्याची योजना लष्कराने हाती घेतली असुन केंद्राच्या परवानगी नंतर प्रथम लष्कर पोलीसात भरती केली जाणार व शांततापूर्ण वातावरण निर्मितीसाठी भारतीय सैन्यातील महिला तितकीच खंबीर आहे. जगातील काही निवडक देशातील अशा महिला लढाऊ सैनिक आहेत. भारतीय लष्करात वैद्यकीय, कायदा, शिक्षण, सिग्नल व इंजिनिअरींग विभागात महिला कार्यरत आहेत. मात्र आता प्रत्यक्ष शत्रूशी मुकाबला करणाऱ्या दलातही समाविष्ट केल्या जातील. जगात सध्या जर्मनी, ऑस्ट्रेलिया, कॅनडा, अमेरिका, डेन्मार्क, फिनलँड, फ्रान्स, नार्वे, स्वीडन, इस्लाईल या देशात महिला कॉम्बॅट दलात कार्यरत आहेत.

उपाय – १) केंद्र व राज्य सरकारने महिलांच्या सक्षमीकरणकरीता सशस्त्र दलातील बहुतेक पदावर महिलांचे आरक्षण दिले आहेत. परंतु महिलांनी विश्वास व निश्चय निर्माण करून आपणही संरक्षण दलात कार्य करू शकतो. २) महिलांनी योजनांचा योग्य तो वापर करावा. सरकारच्या विविध योजनांचा लाभ महिलांनी घेतला पाहिजे. ३) जगात बहुतेक विकसित देशात महिलांना सशस्त्र दलात प्रत्येक रणांगणावर लढण्याच्या पदावर नियुक्ती केल्याचे दिसते. परंतु भारतात अजुन काही युध्दसेनाच्या दृष्टीने महिलांना योग्य ते स्थान दिले जात नाही. ते स्थान मिळावे यासाठी प्रयत्न करायला हवेत. तसा महिला आयोग यांनी पुढाकार घेवून सशस्त्र दलात प्रत्येक क्षेत्रात स्त्रिया कार्य करू शकतात. या करिता केंद्र सरकार बरोबर चर्चा करून महिलांसाठी राखीव पदे असण्याची मागणी करता येईल.

निष्कर्ष – आज जागतिकीकरणाच्या प्रक्रियेत महिलांना मानाचे स्थान मिळाले आहे. बहुतेक पुढारलेल्या देशांमध्ये सशस्त्रदलात महिलांना संधी प्राप्त करून दिली आहे. भारतात महिलांचा भारतीय सेनेत शिपाई ते सरसेनापती पदापर्यंत उत्तम कार्यक्षमता सिध्द केली आहे. कधी काळी चूल आणि मुल या समाजाच्या बोहट चौकटीतून महिला आज पुरूषांपेक्षा मोठ्या पदावर कार्य करताना दिसत आहेत. भारतीय सेनेतील महिलांचे स्थान आणि त्यांची कार्यक्षमता महिला सबलीकरणाचे द्योतक आहे. भारतात सशस्त्र सेनेमध्ये सन्मानाने महिलांना उच्च पदावर कार्यक्षमता सिध्द करण्याचे योग्य भारतीय महिलांना मिळाले आहेत. थोडक्यात भारतीय महिला आज कोणत्याही क्षेत्रात कमी नाहीत हे त्यांच्या कार्याने पुर्नसिध्द केले आहे.

संदर्भ

१) डॉ.सांजेवार ज्योती, भारतीय समाज आणि स्त्री

२) साप्ताहिक चित्रलेखा, १२ मार्च २०१२

३) गांधी संटिता, स्त्री संघर्षाची नवी रूपे, पॉप्युलर प्रकाशन मुंबई

४) झी २४ तास न्युज, शुर महिलांनी भारताची मान उंचावली, १५ जाने. २०१८

५) सक्सेना अंजली, भारतीय सेनेतील संधी, साप्ताहिक विवेक मराठी, १८ जुलै २०१८

६) ब्रिगेडीयर जोशी सदानंद, सैन्य दलातील स्त्रियांचा सहभाग, लोकसत्ता, २० जाने. २०१६

7) www.wikipedia.org

८) भारट्राज निधी, महिला सबलीकरण, सागर पब्लिकेशन जयपूर, २०१२

९) पाटील किसन, पाटील विनय, महिलांचे सामाजिक व सांस्कृतिक योगदान, अर्थव पब्लिकेशन जळगाव

१०) गोटे शुभांगी, महिला सबलीकरण स्वरूप आणि समस्या, वरद प्रकाशन औरंगाबाद, २०१४

11) Sharma Aniket, Womens and Globalization, ESS Publication Delhi, 2008

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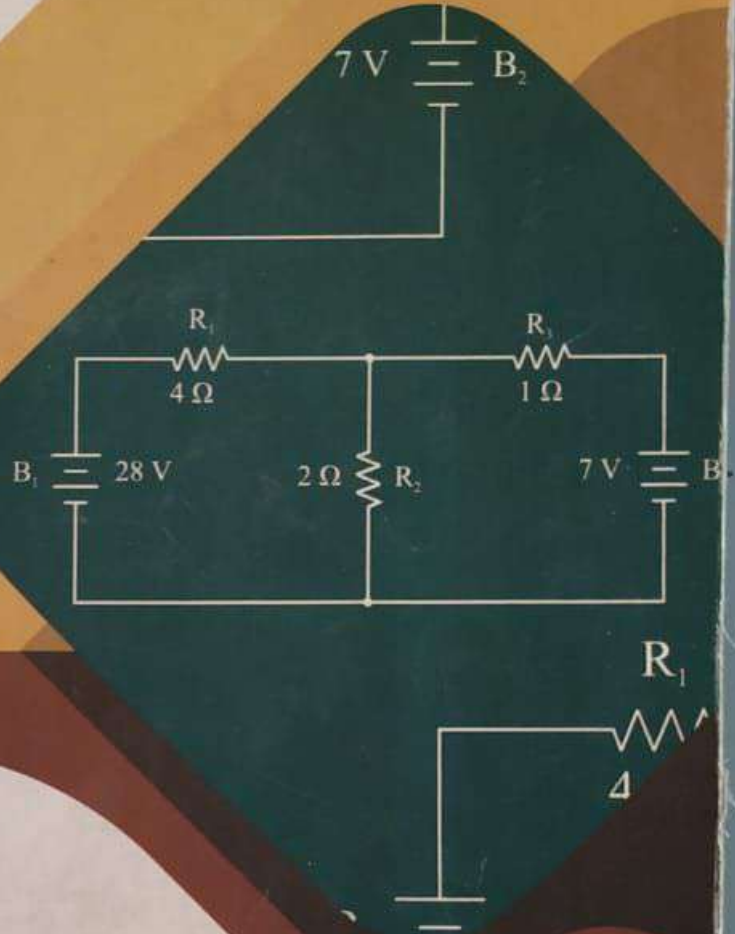
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4. Eco-Friendly Synthesis and Characterization of Graphene Oxide

K. M. Sarode

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Abstract

In present work, Graphene oxide (GO) was successfully prepared via the improved Hummers method without using $NaNO_3$ almost the same to that prepared by conventional Hummers method. Comprehensive characterizations of GO were conducted. X-ray diffraction (XRD) was selected to measure the crystal structure of GO sheet. Fourier-transform infrared spectra analyzer (FT-IR) was used to certify the presence of oxygen-containing functional groups in GO. The TGA analyzer shown that GO sheet possessed excellent thermal stability. This modification does not decrease the yield of GO, eliminating the evolution of NO_2/N_2O_4 toxic gasses and simplifying the disposal of waste water because of the inexistence of Na^+ and NO_3 ions.

1. Introduction

Nanotechnology and Nano science mostly deal with the synthesis, characterization, study and use of nonmaterial. A Graphene is the world's thinnest, stiffest material and strongest as well as being an excellent conductor of heat and electricity. Graphene oxide (GO) is of great interest due to its low cost and extensive ability to convert to grapheme. Graphene, a two dimensional mono atomic thick building block of a carbon allotrope has received worldwide attention due to its excellent thermal, optical, transport and mechanical properties. Current progress has shown that the graphene based materials can have a profound impact on electronic and optoelectronic devices, biosensors, nano composites, and energy storage [1-5].

Currently Researchers are taking into consideration two primary methods for the fabrication of grapheme-; a top down and a bottom up approach. In top down approach, there are reported methods on the production of graphene such as solution exfoliation of

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Hydrothermal Synthesis and Characterization of TiO$_2$ Nanorod Array Grown on FTO Substrate

| Conference paper | First Online: 07 November 2019

| pp 963–970 | Cite this conference paper

Techno-Societal 2018

Harish Suryawanshi & D. R. Patil

👁 **939** Accesses

Abstract

In the present study, TiO$_2$ nanorod array (TiO$_2$ NRA) structure was synthesized on FTO substrate using the hydrothermal method. The effect of hydrothermal temperature and growth time on the morphology of TiO$_2$ NRA was studied in this work. Structural and morphological properties of synthesized TiO$_2$ NRA were investigated using X-ray diffraction (XRD) and Field emission scanning electron microscope (FE-SEM). The optical properties were evaluated using UV–Vis spectroscopy, and fluorescence spectroscopy. From XRD, it was confirmed that synthesized TiO$_2$ have rutile phase. FE-SEM study reveals that synthesized

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MoS$_2$–Reduced Graphene Oxide Electrodes for Electrochemical Supercapacitor

| Conference paper | First Online: 07 November 2019

| pp 1045–1051 | Cite this conference paper

Techno-Societal 2018

K. M. Sarode, S. G. Bachhav, U. D. Patil & D. R. Patil

👁 **901** Accesses

Abstract

In the present study, molybdenum disulfide-reduced graphene oxide (MoS_2-RGO) composite was synthesized via a hydrolysis of lithiated MoS_2 ($LiMoS_2$) and the electrochemical performance of the nano sheets was evaluated for super capacitor applications. The MoS_2-RGO composite electrode exhibited high specific capacitance (203 F g^{-1}) with excellent cycling stability, compared with MoS_2. The high electrochemical performance of the MoS_2-RGO composite electrode is mainly attributed to the improved electron and ion transfer mechanism involving synergistic effects of MoS_2 and RGO.

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Green Synthesis of Silver Nanoparticles Using Mushroom Species, Their Characterization and Catalytic Activity

| Conference paper | First Online: 07 November 2019

| pp 329–335 | Cite this conference paper

Techno-Societal 2018

H. G. Bhangale, S. G. Bachhav, K. M. Sarode & D. R. Patil

👁 **892** Accesses   📄 **1** Citations

Abstract

Present investigation reports the extracellular synthesis of silver nanoparticles by green, low cost and simple method using naturally grown mushroom *species* (*Agaricus species*). The colour of the reaction medium was changed from colourless to brown within 10 h indicated the formation of silver nanoparticles. The prepared silver nanoparticles were characterized using UV-visible spectroscopy, FTIR spectroscopy, particle size analyzer and zeta potential. The SPR peak in UV-spectrophotometer was recorded at 419 nm which confirms the

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'खान्देश' नावाविषयी उत्पत्ती

प्रा.डॉ. मिलिंद भगवानराव बचुटे

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महाराष्ट्राच्या उत्तर दिशेला दख्खनच्या पठारावर वसलेला भू – प्रदेशहा 'खान्देश' या नावाने ओळखला जातो. 'खान्देश' प्रांत हा 'उत्तर महाराष्ट्र' या नावानेही परिचित आहे. खान्देशमध्येसदयकालीन जळगांव, धुळे व नंदुरबार या तीन जिल्ह्यांचा समावेश केला जातो. खान्देशच्या उत्तर भागाला सातपुडा पर्वताच्या पर्वत रांगा असून त्या पर्वतरांगांच्या पायथ्याशी मध्यप्रदेशचा भू – भाग येतो. खान्देशच्या दक्षिण भागात सातमाळा डोंगर व औरंगाबाद हा जिल्हा येतो. पश्चिम दिशेलासह्याद्री पर्वत रांगा व त्याचबरोबर गुजरात राज्याचा डांग, सुरत व भडोच हे जिल्हे येतात. तर खान्देशच्या दक्षिण दिशेला गोदाकाठ, नाशिकचा भू – प्रदेश येतो. पूर्वीच्या काळी खान्देशचीसीमा तापीनदीवर वसलेल्या ब-हाणपूर पासूनते थेटसोनगड (गुजरात), नवापुर पर्यंत होती. उत्तर भागाकडे अशिरगडते थेट दक्षिणेकडीलसह्याद्री पर्वतावरील प्रसिध्द किल्ले मुल्हेर पर्यंत होती. बागलाणचा परिसरही इतिहास काळात खान्देशचा भाग म्हणून ओळखला जात होता.

सध्या 'खान्देश' हे नाव राजकीय व प्रशासकियदृष्ट्या अस्तित्वात नाही. खान्देशचे नामकरण 'उत्तर महाराष्ट्र' असे झालेले आहे. असे असलेतरी या भू – प्रदेशाला 'उत्तर महाराष्ट्र' या नावा ऐवजी 'खान्देश' या नावानेच ओळखले जाते. खान्देशचे इ. स. १९०६ मध्ये इंग्रजांनी पूर्व व पश्चिम दिशांना अनुसरुन दोन विभाग केलेलेहोते. पूर्वेकडील भाग – पूर्व खान्देशतर पश्चिमेकडील भाग हा पश्चिम खान्देश. पूर्व खान्देश म्हणजे जळगांव जिल्ह्याचा भाग व पश्चिम खान्देशात धुळे व नंदुरबार जिल्ह्याचा भाग येतो. पूर्व खान्देशात जळगांव, अमळनेर, मुक्ताईनगर, एरंडोल, धरणगांव, बोदवड, चोपडा, रावेर, यावल, भडगांव, जामनेर, पाचोरा, भुसावळ, पारोळा, चाळीसगांव हेतालुके येतात. तर पश्चिम खान्देशमध्ये धुळे, साक्री, शिरपूर, शहादा, शिंदखेडा, दोंडाईचा, नंदुरबार जिल्हा, अक्कलकुवा, धडगांव, नवापुर, तळोदा या तालुक्यांचा समावेश होतो. खान्देशात नाशिक जिल्ह्यातील मालेगांव, सटाणा (बागलाण), कळवण आणि नांदगांव हेतालुकेहीयेतात. याचबरोबर औरंगाबाद जिल्ह्यामधील सोयगांव तालुका व नागद बनोटीचा परिसरही खान्देशचा भाग म्हणून ओळखला जातो.

'खान्देश' या परिसराचा भौगोलिकतेच्या संदर्भात विचार केलातर पृथ्वीच्या नकाशामध्ये 'खान्देश' हा २०.८ ते २२.७३ उत्तर अक्षांश आणि ७३.४२ ते ७६.२८ पूर्व रेखांशाचा भाग व्यापणारा सुमारे १६० मैल लांब आणि ९० मैल रुंदीच्या परिसरामध्ये व्यापलेला आहे. खान्देशचेक्षेत्रफळहेसुमारे १०,४३१ चौ. मैल एवढे आहे. खान्देशच्या भू – भागाला सातपूड्याचा डोंगर, अजिंठ्याचा डोंगर, चांदवडच्या व सह्याद्री पर्वताच्या पर्वत रांगांनी वेढलेले आहे. उत्तर दिशेला पूर्व – पश्चिम पसरलेल्या सातपुड्याच्या पर्वतरांगा या मध्यप्रदेश व खान्देश यांना विभागतात. दक्षिण दिशेकडील अजिंठ्याचा डोंगरहा खान्देशला औरंगाबाद, जालना, बुलढाणा या जिल्ह्यांपासून विभागतो तर आखा, लळींग व गाळण या सह्याद्री पर्वत टेकड्या खान्देशला नाशिकपासून वेगळ्या (अलग) करतात.

'खान्देश' हा शांत व संपन्न लोकवस्तीचा प्रदेश म्हणून सर्वदूर परिचीत आहे. खान्देशची मातीहीसुपीक माती आहे. त्यामुळे येथील लोकसुखी व संपन्न आहेत. खान्देशात वेगवेगळ्या अनेक नद्या वाहतात. नद्यांमुळे काही ठिकाणी गाळाची जमीनतयार झालेली आहे. ही काळी कसदार जमीन असल्याने भरघोस उत्पन्न येथील लोक काढतात. खान्देशची मुख्य नदीतापी नदीहीहोय. हीतापी नदी 'पश्चिमवाहिनी' म्हणून ओळखली जाते. ही नदीसखोल व विस्तीर्ण पात्र असलेली मोठी नदी आहे. या तापी नदीला खान्देशातील अनेक उपनद्या येऊन मिळतात. त्यात पूर्णा, गिरणा, वाघुर, भोगवती, अरुणावती, गोमाई, वाकी, अमरावती, बोरी, अनेर, पांझरा या उपनद्या होत. खान्देशच्या परिसरामध्ये काळी कसदारसुपीक जमीन असल्यामुळे येथील लोकांचा मुख्य व्यवसाय शेती करणेहा आहे. या व्यवसायाबरोबर शेती व्यवसायाला पुरक जोडधंदा म्हणून पशुपालन करणेहाही व्यवसाय येथे चालतो. खान्देशचे हवामान कोरडे असून पावसाळा, उन्हाळा व हिवाळा हे मुख्य तीनऋतु आहेत. या भागाचे सरासरी पर्जन्यमान चांगले आहे. यामुळे नद्यांना नेहमी पाणी असते व जंगले दाट आढळून येतात.

इ. स. १ मे १९६० ला संयुक्त स्वतंत्र महाराष्ट्र राज्याच्या निर्मितीनुसार खान्देशचे पूर्व खान्देश व पश्चिम खान्देशहे दोन विभाग रद्दबातल ठरवून पूर्व खान्देशच्या ऐवजी जळगांव जिल्हा व पश्चिम खान्देश ऐवजी धुळे जिल्हा असे नवीन नामकरण करण्यात आले. कालांतराने धुळे जिल्ह्यामधूननंदुरबार या स्वतंत्र नवीन जिल्ह्याची निर्मिती महाराष्ट्र शासनाने केली. थोडक्यात आज खान्देश म्हणजे जळगाव, धुळे व नंदुरबार हेतीन जिल्हेहोत. खान्देशला 'खान्देश' हे नाव कशावरुन, कशामुळे पडले वा मिळाले याच्या उत्पत्तीविषयी शोध घेतला असता अनेक मतप्रवाह समोर आलेतत्यातील मुख्य मतप्रवाह.

'खान्देश' नावाविषयी श्री. दा. गो. बोरसे यांनी पुढील उत्पत्ती सांगितलेल्या आहेत–

अ) **आभीरदेश** – ''खान्देशचे पूर्वीचे नाव अश्मक देश असावे. महाभारतात अश्मक देशाचा उल्लेख आहे. बौद्धग्रंथातही अश्मक देशहेनाव आढळते.''

ब) **गोपराष्ट्र** – ''खान्देशात गवळी राजाचा अंमल होता नाशिकच्या आसपास गोपराष्ट्रहोते असे इतिहासकारांचे म्हणणे आहे.''

क) **सेऊणदेश** – ''यादवराजा सेऊणचंद्र यांच्या नावावरुन सेऊणदेश नाव पडले. चांदवड ते सर्व खान्देश या देशात अंतर्भूत होता.''

ड) **अहिराष्ट्र** – ''श्री. दा. गो. बोर्सेनी इ. स. १९३७ मध्ये 'केसरी'त लिहिलेल्या लेखात अहिराच्या या भागातील वस्तीवरुन हे नाव सुचविले.''

इ) **खांडवदेश** – ''पांडवाचा या भागात लाक्षागृह दहनानंतरसंचारहोता. अर्जुनाने खांडववन जाळळे व खांडववनाची स्मृती म्हणून खान्देश नाव पडले.''

ई) **खंडदेश** – ''भरतखंड, रेवाखंड अगर नुसते खंड याचप्रमाणेतापीखंडहे नाव असावे व खंड – खान असे नाव प्रचलित झाले असावे.''

उ) **कानदेश** – ''जामनेरतालुक्यातील कान नदीच्या नावावरुन या नदीच्या आसपासच्या मुलखास कानदेश असे नाव पडले असावे.''

ऊ) **खानदेश** – ''१४ व्या शतकात खान्देशावर फरुकी राजाचा अंमल होता व त्याची राजधानी थाळनेरहोती. त्याचे उपनाव खान यावरुन खानदेश नांव या देशास पडले असावे. अकबराने दानियल मुलावरुन दानदेश सुचविले पण ते रुढ झाले नाही.''

ए) **कान्हदेश** – ''स्वातंत्र्यवीर सावरकरांनी भाषाशुद्धीच्या अभिनिवेशाने या देशाला कान्हदेश म्हणावे असे सुचविले. तथापी गोप (गवळी राजे), आभीर, महानुभाव गुजर, लेवेपाटीदार, राजपूत चारणहे कृष्णाचे भक्त शिवाय या भागात कानबाई, कन्हेर, कानोडचे महत्त्व जास्त म्हणून कृष्ण – कान्ह – खान हीच खान्देशची व्युत्पत्ति संयुक्तिक दिसते.''

प्रसिद्ध इतिहासाचार्य वि. का. राजवाडेंच्या व्युपत्तीकोशामध्ये खान्देशाचे नाव कन्हदेशहोतेहे प्रा. मिराशींना मान्य नाही. 'सेऊणदेश' वा शब्दापासून 'खान्देश' हा शब्द आला असावा,हेही मत न पटण्यासारखे आहे. कारण'सेऊण' देशाचीसीमा व व्याप्ती ही सिन्नर, नाशिकपासून पूर्वेकडील देवगिरी पर्यंत होती. पण खान्देशचा भाषा – संस्कृती संदर्भात विचार केलातर नाशिक, सिन्नर, देवगिरी इथल्या भाषा – संस्कृती मध्ये बरेच अंतर दिसते, म्हणूनही उत्पत्ती बरोबर वाटत नाही. 'खालचा देश' म्हणजे 'खान्देश' व स्कंदपासून बनलेल्या खांद्याचा अहिराणी अपभ्रंश जो'खांद' यापासून खान्देशहा शब्द तयार झाला हेही मत न पटण्यासारखे आहे.

खान्देशच्या नाव उत्पत्तीसंदर्भात श्री. दा. गो. बोर्से म्हणतात, ''खान्देशला अभिर देश, स्कंददेश, गोपराष्ट्र, सेऊणदेश, अहिराष्ट्र, खांडवदेश, खंडदेश, खानदेश, कान्हदेश अशा विविध नावांनी आतापर्यंत ओळखले जात असलेतरी खान्देशहेच नाव आजपर्यंत रुढ झालेले दिसते.''

खान्देशहे नाव 'कन्न' पासून आलेले असावे कारण 'कन्न' म्हणजे कृष्ण. 'कृष्णाचा देशतो खान्देश' हेही न पटण्यासारखे आहे. कन्न म्हणजे कानड – गवळी अशीही एक नामव्युत्पत्ति देता येते. या भू – प्रदेशावर पूर्वी कानडांची वा गवळी लोकांची वस्ती होती. कानड – गवळी लोकांचा मुख्य व्यवसाय गुरे पाळणेहोता. गुरे पाळणेहा मुख्य व्यवसाय असल्याने त्यांना नेहमी भटकंती करावी लागायची. याविषयी श्री. शं. बा. जोशी म्हणतात, ''कन्नड, कन्नडगाव या गावांच्या नावांवरुन तसेच खान्देशमधील विरंगळांच्या स्मारक शिल्पाच्या खुणांवरुन या भागात एक काळी कानडी लोक राहत असावी'' असा महत्त्वपूर्ण निष्कर्ष नोंदवलेला आहे. थोडक्यात खान्देशातील कानड गवळी लोकांच्या जाती, त्यांची नावे, विरंगळांची स्मरणशिल्पेतयार करण्याच्या प्रथेवरुन खान्देशहा कन्नदेश – म्हणजे कानड देशही उत्पत्ती स्विकारार्य वाटते.

निष्कर्ष

१. कन्नड, कन्नडगांव या गावांच्या नावावरुन तसेच खान्देशमधील विरंगळांच्या स्मारक शिल्पाच्या खुणांवरुन पूर्वीच्या काळी येथे कानडी, गवळी राजांची सत्ता व या लोकांचे वास्तव्य असावे. त्या कानडी गवळी लोकांची नाव, जाती व व्यवसायावरुन खान्देशहा 'कानड – गवळी' लोकांचा प्रदेशहोता असे वाटते.

२. खान्देशी आणि अहिराणीहे शब्द ब-याचदा एकाच अर्थाने वापरले जातात पण त्यांच्यामध्येसूक्ष्म भेद आहे. खान्देशीहा शब्द प्रदेशवाचक शब्द आहे

३. खान्देशहा अठरापगड जाती – धर्मांनी वसलेला समृद्ध व शांत प्रदेश आहे.

संदर्भ सूची :

१) बोरसे दा. गो., 'अहिराणी भाषा परिचय', गिरजासाहित्य प्रकाशन, नागपुर

२) खान्देशातील ग्राम दैवते आणि लोकगीते- पगारसयाजी निंबाजी, का. स. वाणी मराठी प्रगत अध्ययन संस्था, धुळे. पहिली आवृत्ती - १९९२.

३) 'अहिराणी भाषा वैज्ञानिक अभ्यास'- सुर्यवंशी रमेश, अक्षय प्रकाशन, पुणे. १९९७.

४) अहिराणी लोकगीते आणि लोकभाषा – पगारे म. सु.