

**CURRICULUM OF
MEAT SCIENCE AND TECHNOLOGY
FOR
POST GRADUATE
(MS/M.PHIL/M.Sc.(Hons.)) DEGREE
PROGRAMME**

(Revised 2017)



**HIGHER EDUCATION COMMISSION
ISLAMABAD**

CURRICULUM DIVISION, HEC

| | |
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| Prof. Dr. Arshad Ali | Executive Director |
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| Dr. Muhammad Idrees | Director (Curriculum) |
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PREFACE

The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic programme are required to undergo to achieve some specific objectives. It includes scheme of studies, objectives & learning outcomes, course contents, teaching methodologies and assessment/ evaluation. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

University Grants Commission (UGC) was designated as the competent authority to develop, review and revise curricula beyond Class-XII vide Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled "Supervision of Curricula and Textbooks and Maintenance of Standard of Education". With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

In compliance with the above provisions, the Curriculum Division of HEC undertakes the revision of curricula regularly through respective National Curriculum Revision Committees (NCRCs) which consist of eminent professors and researchers of relevant fields from public and private sector universities, R&D organizations, councils, industry and civil society by seeking nominations from their organizations.

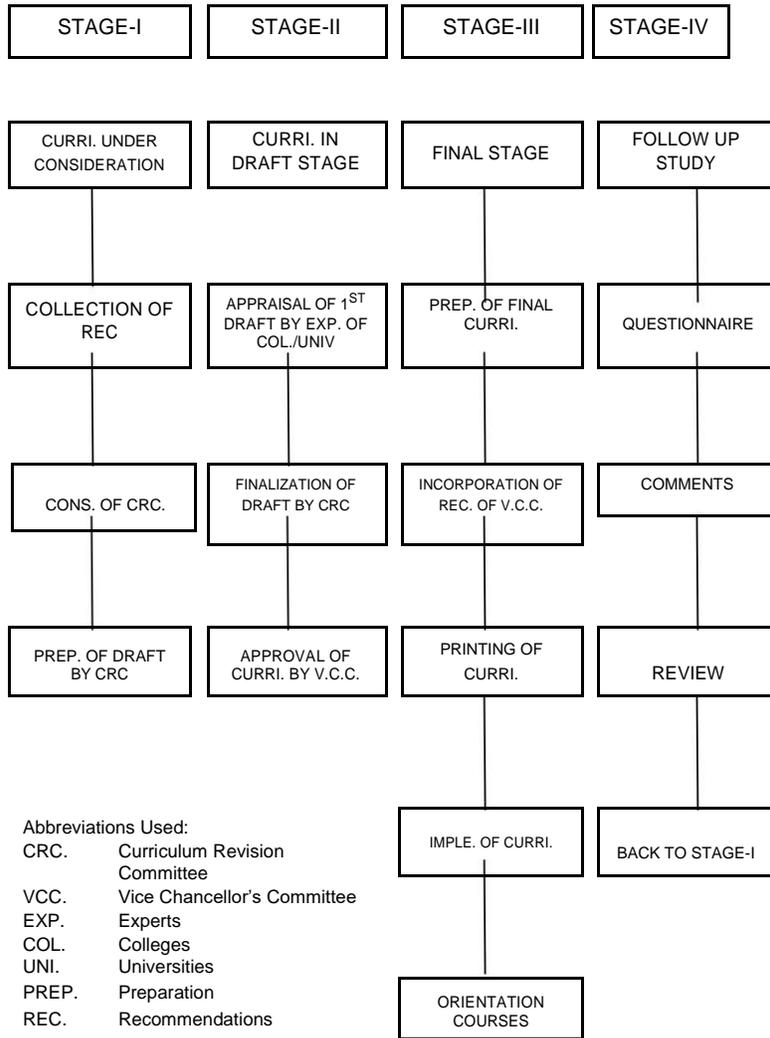
In order to impart quality education which is at par with indigenous needs and international standards, HEC NCRCs have developed unified framework/ templates as guidelines for the development and revision of curricula in the disciplines of Basic Sciences, Applied Sciences, Social Sciences, Agriculture and Engineering.

It is hoped that this curriculum document, prepared by the respective NCRC's, would serve the purpose of meeting our national, social and economic needs, and it would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards. The curriculum is also placed on the website of HEC

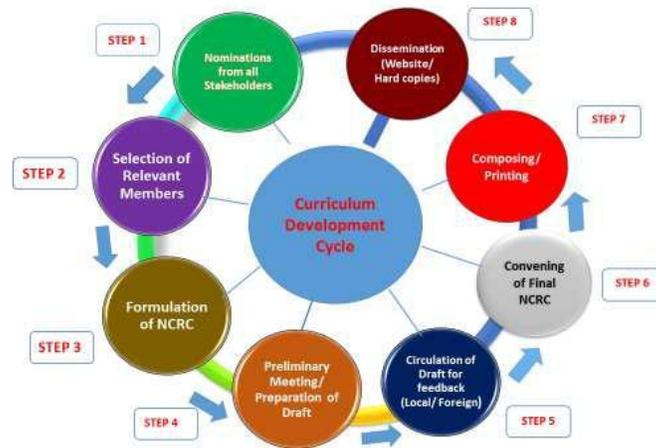
<http://hec.gov.pk/english/services/universities/RevisedCurricula/Pages/default.aspx>

(Muhammad Raza Chohan)
Director General (Academics)

CURRICULUM DEVELOPMENT PROCESS



CURRICULUM DEVELOPMENT CYCLE



MINUTES OF FINAL MEETING FOR NCRC MEAT SCIENCE AND TECHNOLOGY POST-GRADUATE DEGREE PROGRAM

The final meeting of National Curriculum Revision Committee (NCRC) in the discipline of Meat Science and Technology (MS/M.Sc (Hons)/M. Phil) was held from January 12-13, 2017 at Higher Education Commission (HEC), Regional Centre, Lahore. Representatives of different universities participated in the meeting. Dr. Muhammad Idrees, Director, Academics Division, HEC, Pakistan coordinated the meeting. The list of the participants is as below:

| S.N | Name & Institution |
|-----|--|
| 1 | Prof. Dr. Muhammad Iqbal Mustafa (CONVENER) Professor, Institute of Animal and Dairy Sciences, University of Agriculture, Faisalabad. |
| 2 | Dr. Muhammad Hayat Jaspal (SECRETARY) Assistant Professor, Department of Meat Sciences & Technology, UVAS, Lahore. |
| 3 | Prof. Dr. Ahmed Sultan Jatoi, Dean, Faculty of Animal Production & Technology, Shaheed Benazir Bhutto University of Veterinary & Animal Sciences, Sakrand. |
| 4 | Prof. Dr. Abdur Rehman Chairman, Department of Livestock Management, Breeding and Genetics, The University of Agriculture, Peshawar. |
| 5 | Dr. Muhammad Sohaib, Assistant Professor, Department of Food Science and Human Nutrition, University of Veterinary & Animal Sciences, Lahore. |
| 6 | Dr. Amna Sahar Assistant Professor, Department of Food Engineering/ National Institute of Food Science and Technology, University of Agriculture, Faisalabad. |
| 7 | Dr. Sher Ali Assistant Professor , Meat Science and Technology, University of Veterinary & Animal Sciences (UVAS), Lahore |
| 8 | Dr. Muhammad Idrees Director, Academics Division, Higher Education Commission, Islamabad. |

Agenda/objective

The agenda/objective of Meat Science and Technology final meeting was as:

1. To finalize the draft curriculum in the discipline of **Meat Science and Technology (MS / M. Phil/M.Sc (Hons))** according to indigenous needs and to bring it at par with international standards.

2. To review preface, mission, vision, preamble, and rationale of the subject.
3. To revise objectives / learning outcomes, list of contents and assessment criteria (formative & summative) aligned with undergraduate programs (vertical approach) and other MS programs (horizontal approach).
4. To incorporate/suggest latest reading materials/references (local & international) against each course.
5. To revise/update contents keeping in view the uniformity across other disciplines and to avoid overlapping.
6. To make recommendations for promotion/development of the discipline, keeping in view the futuristic needs of the society.
7. To finalize the intake criteria for this degree program.

Proceedings started with recitation from the Holy Quran. The session was coordinated by Dr. Muhammad Idrees (Director Academics Division, HEC). He welcomed the participants and shared the scope as well as objectives with members followed by brief introduction of the participants. Keeping with the tradition, Dr. Muhammad Idrees suggested that NCRC may proceed with previous Convener (Prof. Dr. Muhammad Iqbal Mustafa (Professor Institute of Animal and Dairy Sciences, Faculty of Animal Husbandry, University of Agriculture, Faisalabad) and Secretary Dr. Muhammad Hayat Jaspal, (Assistant Professor/Incharge, Department of Meat Science and Technology, University of Veterinary and Animal Sciences, Lahore). The proposal was accepted unanimously.

Dr. Muhammad Idrees emphasized on the need of revising learning outcomes (LOs) for Meat Science and Technology degree program. After completing the introduction, the importance and need of the Meat Science and Technology degree was briefed by Dr. Muhammad Hayat Jaspal. Afterwards, the nomenclature as well as eligibility of the degree program were discussed.

Sessions 2:

The session was also coordinated by Dr Muhammad Idrees. During this session, the nomenclature of the degree program as Meat Science and Technology was finalized. Afterwards, the courses were reviewed and revised after thorough discussion. The students from following disciplines were made eligible for intake in the degree program:

1. Doctor of Veterinary Medicine (D.V.M)
2. B.Sc (Hons./B.S Animal Science)
3. B.Sc (Hons/B.S Poultry Science)
4. B.S. (Hons.) Applied Microbiology)
5. B.S Food Science and Technology
6. B.S. Food Science and Nutrition

7. B.Sc(Hons) Agriculture with major Food Technology
8. B.Sc Food Engineering
9. B.Sc (Hons.)/MSc Zoology

Note: Above degree programs are eligible provided deficiency courses are undertaken as per university discretion.

Then, the course titles as well as their contents were discussed in detail and comments were added as per suggestions. After incorporating the suggestions of all the members, the duration of degree program, courses along with their contents and credit hours finalized for this degree programme are mentioned below:

| Contents | Credit hour |
|------------------------|--------------|
| 1. Course work | 24 |
| a. Major/core | 12 |
| b. Minor | 6 |
| c. *Compulsory | 6 |
| 2. Research and Thesis | 6-10 |
| Grand total | 30-34 |

*Biochemistry and Statistics

Scheme of Studies MS/M.Phil/M.Sc. (Hons.) Meat Science and Technology

| Course No | Course title | Credit hours |
|-----------|--|--------------|
| MST (01) | Meat Production | 3(2-1) |
| MST (02) | Meat Processing and Byproducts Technology | 4(2-2) |
| MST (03) | Food Animals Welfare | 2(1-1) |
| MST (04) | Meat Biochemistry | 3(2-1) |
| MST (05) | Applied Microbiology and Quality Control | 3(2-1) |
| MST (06) | Meat Refrigeration | 3(2-1) |
| MST (07) | Industrial Meat Processing and Product Development | 4(2-2) |
| MST (08) | Meat Hygiene and Public Health | 3(2-1) |
| MST (09) | Advanced Poultry Processing | 3(2-1) |
| MST (10) | Sea Foods Processing | 3(2-1) |
| MST (11) | Special Problem | 1(1-0) |
| MST (12) | Seminar | 1(1-0) |

Session 3:

In this session, the detail comments on the course contents were made as well as vision, mission, preamble and objectives of this degree program

were finalized. At the end, the planning for next day was made as well as home assignment for improvement in the content of the various courses offered in the degree program were given to members for next day presentation.

2nd DAY:

The session began with a welcome note from Dr. Muhammad Idrees (Coordinator) and he also briefed about previous day activities. The members finalized the remaining course contents of the proposed degree program.

Dr. Mukhtar Ahmad, Chairman Higher Education Commission also honored the committee meeting in the concluding session. He briefed about the role of HEC for the growth and development of higher education sector in Pakistan. He stressed the members to focus on research ethics and quality of research. He further highlighted the role of teachers in character building and social responsibility awareness of students that are going to be future leaders of the country.

At the end, all the members visited processing facility of the Department of Meat Science and Technology, University of Veterinary and Animal Sciences to observe hands on training activities being offered by the department. All the members appreciated the efforts taken by the University for establishing research and training facility.

Recommendations by final NCRC:

1. The department of Meat Science and Technology should be established in all leading institutions across the country.
2. Universities must take initiatives to strengthen the processing facilities in order to initiate the Meat Science and Technology program.
3. Institutions aspiring to initiate M.Sc (Hons)/MS/Mphil in Meat Science and Technology must have rearing and processing facilities or at least have relevant affiliation.
4. Value addition and product development should be promoted rather the export of meat carcass for better profitability.
5. Courses for marketing and quality aspects should be incorporated to promote development and entrepreneur approach in professionals.

CURRICULUM OF MEAT SCIENCE & TECHNOLOGY FOR MS/M.Sc (Hons)/M.PHIL PROGRAMME

Vision

To enhance the competency of graduates for planning, development and executing applied research in the discipline of meat science.

Mission

To produce skilled manpower to cater the needs of meat industry, academia and research organizations by providing excellence in professional learning, guidance and research skills focusing on production, processing and quality of meat and meat products.

Preamble

In spite of the big potential of the large livestock population, meat industry in Pakistan has not been able to make its mark in the international market. The worth of the global Halal industry is US\$ 3 trillion and share of the meat segment is US\$ 600 billion. In this US\$ 600 billion Halal meat trade, the share of Pakistan meat industry was only US\$ 232 million in 2015-16. However, the Indian red meat industry is expanding rapidly and overwhelmingly tapping the international Halal market. Having the same agro-ecological conditions the foreign earnings of India from the meat export is far ahead from Pakistan i.e. US\$2.6 billion vs. US\$ 232 million, respectively. Meat industry is the most important segment of the agricultural economy of Pakistan but unfortunately is still in developing phase and needs further development on international standards. The red meat export industry is annually growing at 30%. Despite this rapid growth, 96% of our exports are restricted to carcass with little or no value addition. To become competitive in the international market use of innovative processing and packaging technologies is direly needed which require trained professional human resource.

Poultry industry in Pakistan has set an example of real knowledge and technology based economy and 75% share of total capital investment has been shared by the professionals. Now these professionals are planning forward integration by establishing poultry processing systems and looking towards the academic institutions to develop such a human resource having complete knowledge and expertise in the field of processing to take their business ahead.

Objectives

To produce skilled professionals for the meat industry of Pakistan

To train graduates in problem solving skills for meat related issues by providing them hands on experience in all aspects of meat science.

To lay a foundation for lifetime professional development in the field of meat production, processing and value addition.

To exclusively focus on applied research according to need of the time and in accordance with issues faced by industry

Admission Eligibility

Doctor of Veterinary Medicine (D.V.M), B.Sc (Hons/B.S Animal Science, B.Sc (Hons/B.S Poultry Science, B.S. (Hons) Applied Microbiology, B.S Food Science and Technology, B.S. Food Science and Nutrition, B.Sc (Hons) Agriculture with major Food Technology, B.Sc Food Engineering, B.Sc (Hons)/MSc Zoology

Duration of Degree Program

Minimum 2 Years (course work may be completed in 2/3 semesters and 1/2 semesters for research and thesis)

Total Credit Hours

30 (24 credit hours course work plus 6-10 credit hour research and thesis). Following is the detail of the minimum requirement

| Contents | Credit hours |
|------------------------|---------------------|
| 1. Course work | 24 |
| a. Major/core | 12 |
| b. Minor | 6 |
| c. *Compulsory | 6 |
| 2. Research and Thesis | 6-10 |
| Grand total | 30-34 |

*Biochemistry and Statistics

**Scheme of Studies MS/M.Phil/M.Sc. (Hons.) Meat
Science and Technology**

| Course No | Course title | Credit hours |
|------------------|---|---------------------|
| MST (01) | Meat Production | 3(2+1) |
| MST (02) | Meat Processing and Byproducts Technology | 4(2+2) |
| MST (03) | Food Animals Welfare | 2(1+1) |
| MST (04) | Meat Biochemistry | 3(2+1) |
| MST (05) | Applied Microbiology and Quality Control | 3(2+1) |
| MST (06) | Meat Refrigeration | 3(2+1) |
| MST (07) | Industrial Meat Processing and Product Development | 4(2+2) |
| MST (08) | Meat Hygiene and Public Health | 3(2+1) |
| MST (09) | Advanced Poultry Processing | 3(2+1) |
| MST (10) | Sea Foods Processing | 3(2+1) |
| MST (11) | Special Problem | 1(1+0) |
| MST (12) | Seminar | 1(1+0) |

Course Title: Meat Production
Course Number: MST -01
Course Duration: 1 semester (16 weeks)
Credits: 3(2-1)

Course Description

This unit is designed to provide opportunity to students to review the latest applied research of commercial significance, and enable them to understand the effect of various production systems; resultantly the lean meat composition and quality implement latest meat production techniques in order to produce good quality meat and understanding of meat value chains. After studying the course, students will be able to understand commercial innovations in red meat production for producing premium quality meat.

Course Goal and Performance Objectives

Goal

To familiarize the learners with the meat production systems

Objective 1

To understand meat production systems for better meat quality

Objective 2

To analyze meat value chains of cattle, sheep, goat and broilers for sustainable meat production

Objective3

To analyze effects of various production practices on carcass quality and meat composition

Course Contents

Meat animal breeds; scope and trends in meat industry of Pakistan; beef industry of Pakistan; goat and sheep production in Pakistan, effects of production systems (extensive and intensive) on carcass quality, lean meat composition, eating quality, nutritional value and shelf life; anatomy and nomenclature of meat animals; principles of feeding management, breeding and reproduction, nutrition and efficiency, environment, health, stock management; farm assurance schemes and its relevance to meat quality; organic meat production and its effect on meat quality, use of nutraceuticals like antioxidants and trans fats to improve meat quality; live animals handling points and its effects on carcass quality; principles of transportation and shipping of livestock and its effects on carcass quality, clean livestock policy for sheep, goat and cattle; effects of anabolic hormones on muscle growth; effects of castration on carcass and meat

quality; procurement of beef cattle for feedlot fattening; value based trading of beef; marketing of beef cattle; dressing percentage and factors affecting dressing percentage; dressing specification for various export destinations; feedlot waste management practices. Current status of broiler production in Pakistan; yield and carcass composition in broilers, transgenic farm animals.

Practical

Meat breeds identification and characteristics; live animal scoring techniques; hands on practice at mandis in animal selection for feedlot farming– weight and health assessment; feasibility studies of various meat business operations like chilled beef, deboning, frozen meat for export and retail meat outlets; development of feasibility studies for meat business, value chains analysis and development, visit to feedlot farms and meat processing facilities.

Detailed Course Outline

| Sr. No. | Theory | Sr. No. | Practical |
|---------|---|---------|--|
| 1. | Scope and trends in meat industry of Pakistan | 1. | Basic definitions related to meat production |
| 2. | Beef industry of Pakistan | | |
| 3. | Meat animal breeds- Cattle and Buffalo, Sheep and Goats | 2. | Visit to livestock markets for meat breeds identification and characteristics- beef cattle. |
| 4. | Goat and Sheep production in Pakistan | | |
| 5. | Current status of broiler production in Pakistan | 3. | Visit to livestock markets for meat breeds identification and characteristics - meat goats and sheep |
| 6. | Growth and carcass composition in cattle | | |
| 7. | Anatomy and nomenclature of meat animals (goat, sheep) | 4. | Body condition scoring |
| 8. | Principles of viable feeding management for better meat quality and carcass composition | | |
| 9. | Principles of breeding and reproduction | 5. | Live animal scoring techniques |
| 10. | Factors affecting meat quality | | |

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|-----|--|-----|--|
| 11. | Effects of intensive and extensive production systems on meat composition | 6. | Live animal scoring techniques in beef cattle- hands on practice |
| 12. | Effects of production system on eating quality, nutritional value and shelf life of meat | | |
| 13. | Concept of farm assurance schemes | 7. | Live animal scoring techniques in sheep and goat- hands on practice |
| 14. | Organic meat production systems | | |
| 15. | Use of functional ingredients in meat production and carcass quality | 8. | Hands on practice in animal selection for feedlot farming – weight and health assessment |
| 16. | Use of antioxidants in meat production | | |
| 17. | Procurement of beef cattle for feedlot fattening | 9. | Live animals handling practice- large ruminants |
| 18. | Animal selection criteria for feedlot fattening | | |
| 19. | Live animals handling practices | 10. | Live animals handling practice- small ruminants |
| 20. | Live animals handling points and its effects on carcass quality | | |
| 21. | Principles of livestock transportation | 11. | Broiler catching operations |
| 22. | Transportation Standards | | |
| 23. | Shipping of livestock and its effects on carcass quality | 12. | Visit to broiler farm (during catching) |
| 24. | Clean livestock policy and its relevance to meat hygiene | | |
| 25. | Clean livestock policy for sheep and goat | 13. | Feasibility studies for feedlot fattening farm |
| 26. | Clean livestock policy for cattle | | |
| 27. | Effects of anabolic hormones on muscle growth and meat composition | 14. | Feasibility studies for meat business, meat shops and retail outlets. |

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|-----|---|----|-----------------------------------|
| 28. | Effects of castration on growth performance, carcass characteristics and meat quality | | |
| 29. | Different methods of castration with relevance to meat quality and composition | 15 | Visit to feedlot farm |
| 30. | Value based trading of beef | | |
| 31. | Marketing of beef cattle | 16 | Visit to meat processing facility |
| 32. | Feedlot waste management practices | | |

Teaching Learning Strategies

| Theory | Practical |
|------------------|------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussion | Group Discussion |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
Intellectual honesty
Regularity and punctuality
Adherence to deadlines
Fairness
Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------|-------------|----------|------------|-------|---------------------------------------|-------|-------|
| | Assign ment | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 4 | 12 | 24 | 40 | 12 (Mini project + Class performance) | 8 | 20 |

Recommended Books/Readings

1. Cottle, D.J. and Kahn, L.P. (2014) Beef Cattle Production and Trade. CSIRO Publishing, Australia ISBN: 9780643109889.

2. Mahgoub, Osman. Kadim, Isam T. and Webb, Edward. (2012) Goat Meat Production and Quality. CABI International Publishers USA.
3. Kempster, T., Cuthbertson, A. & Harrington, G. (2012). Carcass Evaluation in Livestock Breeding, Production & Marketing. Granada Publishing.
4. Court, Jane. Hides, Sue. Webb-Ware, John. (2010) Sheep Farming for Meat and Wool. CSIRO Publishing
5. Kerry, J.P. and Ledward, D. (2009). Improving the Sensory and Nutritional quality of fresh meat. Woodhead Publishing, Cambridge.
6. EAAP publication No 123 (2007) Evaluation of Carcass and meat quality in cattle and sheep. Eds: C. Lazzaroni, S. Gigli and D. Gabina. Wageningen Academic Publishers.
7. Dikeman, W.K., Devine, C. & Dikeman, M. (2004). Encyclopedia of meat sciences (3 vols.). Elsevier Academic Press, London.
8. Khan, B.B., Iqbal, A. and Mustafa, M.I. (2003). Sheep and Goat Production. Dept. Livestock Management, Uni. of Agri. Faisalabad, Pakistan
9. Kerry, J., Kerry, J. and Ledward, D. (2002). Meat Processing: improving quality. Woodhead Publishing, Cambridge, UK.
10. Shah, S.I. (1994). Animal Husbandry. National Book Foundation, Pakistan.
11. Alvi, A.S. (1991). Meat production and Technology in Pakistan, Pakistan Agricultural Research council, Islamabad, Pakistan

Course Title: Meat Processing and Byproducts Technology

Course Number: MST-02

Course Duration: 1 semester (16 weeks)

Credits: 3(1-2)

Course Description

Aim of this course is to equip students with basic knowledge of modern technologies of meat and abattoir byproducts processing in order to improve throughput, quality and wholesomeness of the meat product and abattoir byproducts. After studying the course, students will be updated with the most modern processing practices being implemented in meat processing industry.

Course Goals and Performance Objectives

Goal

To familiarize the learners with the advances in commercial red meat processing

Objective 1

To understand modern practices in meat processing industry and abattoir byproducts processing

Objective 2

To understand modern interventions in red meat processing industry for high quality meat products

Objective3

To Inter-relate all phases of modern slaughter and processing techniques, inspection, and processing and related operations for improving wholesomeness of the product

Course Contents

Red meat industry current trends; global red meat industry; current status of red meat industry of Pakistan; modern meat processing plant layout and design; modern lairage design; effects of lairage malpractices on quality of carcass and meat; livestock and meat traceability systems, current practices and implementation of meat traceability systems from farm to fork; modern equipment used in red meat processing industry; knocking down/restrain box design and implications; advances in slaughtering techniques; bleeding and its effects on meat quality; low voltage electrical stimulation for improving eating quality; rodding techniques and repercussions for meat safety; de-hiding techniques; bunning; evisceration; carcass splitting; hot boning and cold boning principles and comparisons from meat quality and safety perspectives; meat plant cleaning and disinfection; introduction to abattoir byproducts; edible and inedible offal, different types of edible offal (green and red), offal handling in abattoir, primary processing and storage, transportation methods, modern secondary processing of offal into various food, pharmaceutical and industrial products, fat rendering techniques and uses, hides and skin processing, food safety issues and solutions in offal processing, halal authentication in abattoir byproducts manufacturing, abattoir byproducts from poultry industry, gizzard and feather processing; use of abattoir byproducts in pet food industry.

Practical

Terminologies used in red meat processing and abattoir byproducts processing; introduction to processing of live animals into meat and by-products, practical demonstration and “hand-on” training of modern processing operations from slaughter to refrigeration and writing a detailed review paper on assigned processing operations, offal inspection for wholesomeness and different pathological conditions associates with offal, role and use of the main techniques and methodologies used worldwide for the analysis of animal by-products; visit to meat processing plant.

Detailed Course Outline

| Sr. No. | Theory | Sr. No | Practical |
|---------|---|--------|---|
| 1. | Red meat industry current trends | 1. | Terminologies used in red meat processing |
| 2. | Current status of red meat industry of Pakistan | 2. | Terminologies used in abattoir byproducts processing |
| 3. | Modern meat processing Plant layout and design | 3. | Conventional methods of meat processing |
| 4. | Effects of lairage malpractices on carcass quality and meat quality | 4. | Practical demonstration of modern processing operations -slaughter and bleeding |
| 5. | Effects of animal handling on carcass quality and meat quality | 5. | Practical demonstration of modern processing operations -Dressing |
| 6. | Introduction to livestock and meat traceability | 6. | Practical demonstration of modern processing operations -chilling and packaging |
| 7. | Current livestock and meat traceability systems being used in red meat industry | 7. | Hand-on training of modern processing operations- slaughter and bleeding |
| 8. | Implementation of meat traceability systems from farm to fork | 8. | Maintenance of Slaughtering and processing equipments |
| 9. | Knocking down/restrain box design and implications | 9. | Hands-on training of modern processing operations; desking and de-hiding |
| 10. | Stunning methods, Bleeding and its effects on meat quality | 10. | Hands-on training of modern processing operations- evisceration |
| 11. | Use of electrical stimulation in meat processing | 11. | Hands-on training of modern processing operations; carcass splitting |
| 12. | Low voltage electrical stimulation for improving eating quality | 12. | Hands-on training of modern processing operations- deboning |

| | | | |
|-----|--|-----|---|
| 13. | Rodding techniques and repercussions for meat safety | 13. | Hands-on training of modern processing operations- packaging |
| 14. | De-hiding and deskinning techniques | 14. | Carcass grading and meat cuts standardization |
| 15. | Use of bunging technique and its effect on meat hygiene | 15. | Fabrication of meat cuts |
| 16. | Evisceration and its effect on meat hygiene | 16. | Modern equipment used in red meat processing industry |
| 17. | Hot boning and cold boning techniques | 17. | Conventional handling of animal byproducts |
| 18. | Online classification of beef carcasses | 18. | Modern equipment used in byproducts processing industry |
| 19. | Abattoir management systems | 19. | Determination of live weight and dressing percentage of meat animals |
| 20. | Meat plant cleaning and disinfection | 20. | Offal inspection for wholesomeness |
| 21. | Edible and inedible offals | 21. | Postmortem inspection-1 |
| 22. | Green and red offal handling in abattoir with relevance to hygiene | 22. | Postmortem inspection-2 |
| 23. | Modern secondary processing of offal into various food ingredients | 23. | Methodologies used for the analysis of animal by-products |
| 24. | Different industrial products obtained from abattoir byproducts processing | 24. | Use of the main techniques and methodologies used for analysis of animal byproducts |
| 25. | Fat rendering techniques | 25. | Skins and hides handling and processing |
| 26. | Hides and skin processing | 26. | Fat rendering process |
| 27. | Bones processing | 27. | Bone processing |
| 28. | Blood collection and Processing | 28. | Blood Processing |
| 29. | Food safety issues and solutions in offal processing | 29. | Tripe Processing |

| | | | |
|-----|---|-----|--------------------------------------|
| 30. | Halal authentication in abattoir byproducts manufacturing | 30. | Visit to retail meat outlets |
| 31. | Processing of gizzard and liver | 31. | Visit to meat processing plant |
| 32. | Use of abattoir byproducts in pet food industry. | 32. | Visit to byproducts processing plant |

Teaching Learning Strategies

| Theory: | Practical |
|------------------|------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussion | Group Discussion |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
 Intellectual honesty
 Regularity and punctuality
 Adherence to deadlines
 Fairness
 Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------|------------|----------|------------|-------|--------------------------------------|-------|-------|
| | Assignment | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 04 | 12 | 24 | 40 | 12(Mini project + Class performance) | 16 | 40 |

Recommended Books/Readings

1. Chatli, M.K. & Sahoo, Jhari (2013). Text Book on Abattoir Practices & Animal Byproducts Technology. Narendra Publishing House, India
2. Kempster, T., Cuthbertson, A. & Harrington, G. (2012). Carcass evaluation in livestock breeding, production & marketing. Granada Publishing.
3. Nollet, Leo M.L. & Toldra, Fidel. (2011). Handbook of Analysis of Edible Animal By Products. CRC Press book publisher

4. Kerry, J.P. and Ledward, D. (2009). Improving the sensory and nutritional quality of fresh meat. Woodhead Publishing, Cambridge, UK.
5. EAAP publication No 123. (2007). Evaluation of Carcass and meat quality in cattle and sheep. Eds: C. Lazzaroni, S. Gigli and D. Gabina. Wageningen Academic Publishers.
6. Dikeman, W.K., Devine, C. & Dikeman, M. (2004). Encyclopedia of Meat Sciences (3 vols.). Elsevier Academic Press, London.
7. Kerry, J., Kerry, J. and Ledward, D. (2002). Meat Processing: Improving Quality. Woodhead Publishing, Cambridge, UK.
8. Hui, Y.H., Nip, W, Rogers, RW. And Young, O.A. 2001. Meat Science and Application. Marcel Decker Incorporation, NY, USA.
9. Romans, J. R., Costello, W. J., Carlson, C. W., Greaser, M. L., & Jones, K. W. (2001). The meat we eat. Danville, IL.

Course Title: Food Animals Welfare
Course Number: MST -03
Course Duration: 1 semester (16 weeks)
Credits: 2(1-1)

Course Description

Aim of this course is to create awareness about stress involved in animal handling prior to slaughter and its subsequent effect on meat quality and safety. After studying the course, students will be able to optimize their value chain for better welfare, meat quality and safety.

Course Goals and Performance Objectives

Goal

To familiarize the learners with the animal welfare issues relevant to meat producing animals

Objective 1

To understand concept of animal welfare in farm animals

Objective 2

To analyze effects of stress and pain in meat producing animals on meat quality

Objective3

To recognize different ways to overcome welfare issues in farm animals for better meat quality

Course Contents

Introduction to stress physiology in meat animals and its effects on meat quality; current status of animal welfare in meat industry of Pakistan; concept of pain and distress in meat animals; hormonal changes in meat

animals in response to stress; concept of good welfare; concept of 'five freedoms; welfare issues for meat production at markets, during loading, transportation, unloading, lairage and slaughter; slaughter act, animal welfare practical assessment and application; retrospective assessment based on outcomes; stress management during animal handling, stay at cattle market and from farm/market to slaughter; effects of food withdrawal and water restriction; comparison of conventional and ritual slaughter on meat quality; introduction to stunning and slaughter with reference to meat quality; animal welfare-abattoir indicators; welfare issues in poultry like disorders; overstocking; stock management; underfeeding; cannibalism; inadequate lighting; catching and transport; lairage slaughter; animal welfare and guidelines- on farm, transport, animal markets and sale yards; animal welfare legislation; effects of stress on carcass quality in broilers; welfare audits at farm and abattoir.

Practical

Basic terminologies related to course; farm animal handling practices; assessment of stress during feed withdrawal; animal handling during loading; unloading and slaughtering; assessing animal welfare indicators at abattoir, relationship of all these practices on meat quality and safety, value chain optimization for improving animal welfare, meat quality and safety, welfare audits from farm to slaughter plants; mini literature review about animal welfare issues in meat industry; constitution of framework for improvement of animal welfare conditions in Pakistan with reference to meat quality.

Detailed Course Outline

| No. | Theory | No. | Practical |
|------------|--|------------|--|
| 1. | Introduction to stress physiology in meat animals | 1 | Introduction to Practical course and basic terminologies related to course |
| 2. | Effects of stress on meat quality | 2 | Farm animal handling practices |
| 3. | Concept of pain and distress in meat animals Hormonal changes in meat animals in response to stress | 3 | Farm animal handling with focus on meat quality and carcass composition |
| 4. | Concept of 'Five freedoms' | 4 | Hunger and thirst during feed withdrawal |
| 5. | welfare issues for meat production at markets, during transportation and stay at lairage | 5 | Animal handling during loading; unloading |

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|-----|---|----|---|
| 6. | Animal welfare practical assessment and application | 6 | Animal handling during slaughtering |
| 7. | Stress management during animal handling, stay at cattle market | 7 | Assessing animal welfare indicators at abattoir |
| 8. | Effects of food withdrawal and water restriction on meat quality | 8 | Relationship of animal welfare practices and meat quality |
| 9. | Introduction to stunning with reference to meat quality | 9 | Relationship of animal welfare practices and meat safety |
| 10. | Animal welfare-abattoir indicators | 10 | Mini Literature review about animal welfare issues in meat industry |
| 11. | Welfare issues in Poultry - disorders, overstocking, catching and transport, stay at lair age | 11 | Mini Literature review about animal welfare issues and possible solutions |
| 12. | Welfare issues in large and small ruminants | 12 | Writing a detailed review paper on animal stress management at abattoirs, during transportation or handling |
| 13. | Animal welfare and guidelines- beef cattle | 13 | Comparative review of provincial slaughter acts in Pakistan |
| 14. | Animal welfare and guidelines- transport, animal markets and sale yards | 14 | Value chain optimization for improving animal welfare |
| 15. | Animal welfare legislation/Pakistan slaughter act | 15 | Welfare audits from farm to slaughter plants |
| 16. | Welfare audits at farm and abattoir | 16 | Constitution of framework for improvement of animal welfare conditions in Pakistan with reference to meat quality |

Teaching Learning Strategies

| Theory: | Practical |
|------------------|------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussion | Group Discussion |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
Intellectual honesty
Regularity and punctuality
Adherence to deadlines
Fairness
Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------------|------------------------|---------------------|-----------------------|--------------|---|--------------|--------------|
| | Assig nment | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 02 | 06 | 12 | 20 | 12 (Mini project+Class performance) | 8 | 20 |

Recommended Books/Readings

1. Gregory, N.G. (2007). Animal welfare and meat science (2nd ed.), CABI Publishing, Wallingford.
2. Grandin, T. (2007). Livestock handling and transport (3rd ed.), CABI Publishing, Wallingford
3. Warriss, P.D. (2000). Meat Science: an introductory text. CABI Publishing, Wallingford.
4. Fraser, A.F. 1990. Farm Animal Behavior and welfare. Brilliere Tindal & Cossell, London.
5. Roleff, T.R. and J.A. Hurley, 1991. The rights of Animal. Green Heaven press, San Diego, Ca, USA.
6. The Punjab Animals Slaughter Control Act, 1963. Government of Pakistan.

Course Title: Meat Biochemistry
Course Number: MST-04
Course Duration: 1 semester (16 weeks)
Credits: 3(2-1)

Course Description

Aim of this course is to let the students know about the biochemistry of muscle and biochemical changes taking place during the conversion of muscle into meat. The course also covers all the biochemical factors and interventions required for improving optimum visual appeal and eating quality. After studying the course, students will be capable of optimizing commercial red meat and poultry processing plants for producing guaranteed premium quality meat products.

Course Goals and Performance Objectives

Goal

To familiarize the learners with basics and applied principles of meat biochemistry

Objective 1

To understand biochemical aspects of meat quality and safety

Objective 2

To understand biochemical changes which affect meat color, tenderness and texture

Objective3

To understand techniques used in industry to improve meat quality traits

Course Contents

Introduction of meat biochemistry, macro and micro nutrients of meat water, carbohydrates, lipids, proteins, vitamins, minerals, colors, flavors, and others - structure, chemistry, physico-chemical and functional attributes in relation to meat quality, conversion of muscle to meat; gross and micro muscle structure; muscle structure and meat quality; meat color biochemistry; factors affecting meat color and color stability; meat tenderness biochemistry, caplains and meat tenderization; factors affecting meat tenderness; processing and enhancement strategies to improve meat tenderness; meat lipids; factors affecting fatty acid composition of meat; modifying nutritional composition of meat; lipid oxidation, shelf life parameters, antioxidants and meat quality, factors affecting meat quality, ante-mortem influences on carcass and meat quality; post-mortem influences on carcass and meat quality; development of meat flavor, meat taints; pale, soft and exudative (PSE) meat, dark firm and dry (DFD) meat, cold shortening (CS), heat shortening (HS), thaw rigor, taints in meat, meat conditioning, electrical stimulation, meat packaging.

Practical

Sensory evaluation of meat quality; measuring meat color; measuring meat tenderness; measuring water holding capacity; extraction method of

lipid, measuring lipid oxidation, meat composition analysis, shelf life analysis, preparation of coated meat products, aging of meat.

Detailed Course Outline

| No. | Theory | No. | Practical |
|-----|---|-----|--|
| 1. | Terminologies related to meat biochemistry | 1 | Introduction to practical course and basic terminologies related to course |
| 2. | Macro and micro nutrients of meat | | |
| 3. | Water, carbohydrates, lipids | 2 | Meat composition analysis |
| 4. | Proteins, vitamins, minerals, color, flavor | | |
| 5. | Micro Muscle structure | 3 | Proximate analysis of meat |
| 6. | Physico-chemical and functional attributes in relation to meat quality | | |
| 7. | Conversion of muscle to meat | 4 | Sensory evaluation of meat quality |
| 8. | Muscle Structure and meat quality | | |
| 9. | Muscle composition | 5 | Measurement of meat color |
| 10. | Meat color biochemistry and factors affecting meat color | | |
| 11. | Biochemistry of flavor | 6 | Measurement of water holding capacity |
| 12. | Meat tenderness biochemistry | | |
| 13. | Calpains and meat tenderization | 7 | Measuring meat tenderness |
| 14. | Factors affecting meat tenderness, Processing and enhancement strategies to improve meat tenderness | | |
| 15. | Factors affecting fatty acid composition of meat | 8 | Extraction method of lipid |
| 16. | Modifying nutritional composition of meat Oxidation in meat | | |
| 17. | Lipid oxidation of meat | 9 | Measuring water holding capacity |
| 18. | Protein oxidation | | |
| 19. | Shelf life parameters of meat | 10 | Preparation of coated meat products |
| 20. | Antioxidants and meat quality | | |
| 21. | Pre-mortem influences on carcass and meat quality | 11 | Measuring lipid oxidation |

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|-----|---|----|--------------------------------|
| 22. | Postmortem Changes in Muscle that Influence Quality | | |
| 23. | Sensory analysis of meat products | 12 | Measuring protein oxidation |
| 24. | Development of meat flavor | | |
| 25. | Pale, soft and exudative (PSE) meat | 13 | Ageing of meat |
| 26. | Dark, firm and dry (DFD) meat | | |
| 27. | Cold shortening (CS) | 14 | Shelf life analysis of meat-i |
| 28. | Heat shortening (HS) and thaw rigor | | |
| 29. | Meat taints | 15 | Shelf life analysis of meat-ii |
| 30. | Electrical stimulation | | |
| 31. | Modified atmospheric packaging | 16 | pH analysis of meat |
| 32. | Vacuum packaging | | |

Teaching Learning Strategies:

| Theory: | Practical |
|------------------|------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussion | Group Discussion |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
Intellectual honesty
Regularity and punctuality
Adherence to deadlines
Fairness
Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------|------------|----------|------------|-------|---------------------------------------|-------|-------|
| | Assignment | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 06 | 18 | 36 | 60 | 12 (Mini project + Class performance) | 8 | 20 |

Recommended Books/Readings

1. Kerry, J.P. & Ledward, D. (2009). Improving the sensory and nutritional quality of fresh meat. Woodhead Publishing, Cambridge.
2. Lawrie, R.A. & Ledward, D.A. (2006). Lawrie's Meat Science (7th edition). Woodhead Publishing, Cambridge, UK.
3. Dikeman, W.K., Devine, C. & Dikeman, M. (2004). Encyclopedia of meat sciences (3 vols.). Elsevier Academic Press, London.
4. Kerry, J., Kerry, J. and Ledward, D. (2002). Meat Processing: improving quality. Woodhead Publishing, Cambridge, UK.
5. Berle, E.D., Forrest, J.C., Gerrard, E.D. and Mills, E.W. (2001). Principles of Meat Science, 4th Ed., Kendall/Hunt Publishing Co., Dubuque.

Course Title: Food Safety and Quality Control
Course Number: MST -05
Course Duration: 1 semester (16 weeks)
Credits: 3(2-1)

Course Description

The main goal of this course is to provide the students with the recent developments in microbiology for its application in the meat processing chain for improving safety and quality. After studying the course, students will become aware with latest Microbiological techniques used in meat value chain and can make their mind to seek career in Microbiology and quality control.

Course Goals and Performance Objectives

Goal

To familiarize the learners with the use of biotechnology in meat industry

Objective 1

To understand different modern microbiology techniques for good quality meat products

Objective 2

To analyze different microbes and yeast used in meat processing industry

Objective3

To recognize different techniques used for microbial ecology in meat and meat products

Course Contents

Introduction to food safety; types of hazard, micro-organisms and their growth, factors affecting microbial growth, assessing number of micro-organisms, potential contamination sources during red meat and poultry processing, significant micro-organisms in red meat (beef & mutton) and poultry meat; hurdle technologies for reducing cross contamination; sanitation for processing plants; sampling and microbiological criteria, hygiene of slaughter and dressing, sampling techniques used for processing equipment, environment and red meat surfaces, techniques of microbial isolation, enumeration and identification, food safety assurance, risk assessment in primary processing, decontamination techniques used in meat industry, cleaning and disinfection, role of management, assessment of cleaning efficiency. Statistical quality control techniques; Good laboratory practices, cost of quality; HACCP in meat industry; validation and verification of HACCP plan; Role of Codex Alimentarius in food safety, ISO 9001, ISO 22000; Pakistan standards for halal food management system PS3733:2016; global compliance to halal managements system with special reference to Pakistan & Malaysia, Genetic control of meat quality, DNA based tractability of animal.

Practical

Sampling techniques used for processing equipment, environment and red meat surfaces, techniques of microbial isolation, enumeration and identification, food safety assurance, risk assessment in primary processing, decontamination techniques used in meat industry, cleaning and disinfection.

Detailed Course Outline

| No. | Theory | No. | Practical |
|-----|---|-----|--|
| 1. | Introduction to food safety | 1. | Introduction to Practical course and basic terminologies related to course |
| 2. | Concept of microbiology in meat science | | |
| 3. | Factors affecting microbial growth, assessing number of micro-organisms | 2. | Importance of personnel hygiene |
| 4. | Potential contamination sources during red meat and poultry processing | | |

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| 5. | Significant micro-organisms in red and white meat | 3. | Disposal of animal/abattoir waste |
| 6. | Hurdle technologies for reducing cross contamination | | |
| 7. | Sanitation for processing plant | 4. | Hygiene of slaughter and dressing |
| 8. | Techniques of microbial isolation Enumeration and identification | | |
| 9. | Food Borne Illnesses | 5. | Sampling techniques used for processing equipment, air and surfaces |
| 10. | Food safety assurance | | |
| 11. | Risk assessment in primary processing | 6. | Techniques of microbial isolation |
| 12. | Decontamination techniques used in meat industry | | |
| 13. | Cleaning and disinfection | 7. | Food safety assurance |
| 14. | Assessment of cleaning efficiency | | |
| 15. | Characteristics of microbial starters in meat fermentations | 8. | Risk assessment in primary processing |
| 16. | Statistical quality control techniques; | | |
| 17. | Quality Control and Quality Assurance | 9. | Decontamination techniques used in meat industry |
| 18. | Cost of quality | | |
| 19. | Good laboratory practices | 10. | Cleaning and disinfection |
| 20. | Good Manufacturing Practices | | |
| 21. | Good Manufacturing Practices | 11. | Personal hygiene |
| 22. | HACCP in meat industry | | |
| 23. | Validation and verification of HACCP plan | 12. | Risk Assessment |
| 24. | HACCP at farm | | |
| 25. | HACCP based Quality Assurance | 13. | Development of HACCP Plan |

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| 26. | Role of Codex Alimentarius in food safety | | |
| 27. | Microbiological risk assessment | 14. | HACCP Audit |
| 28. | Risk Analysis | | |
| 29. | ISO 9001 | 15. | Halal Standards Application |
| 30. | ISO 22000 | | |
| 31. | Pakistan standards for halal food management system PS3733:2016 | 16. | Halal Audit |
| 32. | Global Halal managements system (GHMS) with respect to International Halal Integrity (IHI) Malaysia | | |

Teaching Learning Strategies

| Theory: | Practical |
|------------------|------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussion | Group Discussion |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
Intellectual honesty
Regularity and punctuality
Adherence to deadlines
Fairness
Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------|-------------|----------|------------|-------|---------------------------------------|-------|-------|
| | Assign ment | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 4 | 12 | 24 | 40 | 12 (Mini project + Class performance) | 08 | 20 |

Recommended Books/Readings

1. Nollet, L.M. and F. Toldrá, (2010) Advanced technologies for meat processing. CRC Press.
2. Hu, Y H., Wai-Kit Nip, R. W. Rogers and O. A. Young. 2001. Meat Science and Application. Marcel Dekker AG, Switzerland.
3. Toldra, F. (2008). Meat Bio-Technology. Springer Publishing, NY, USA
4. B. J. Wood (Ed.) (2005) Microbiology of fermented foods London: Elsevier.
5. Hui, Y.H., Nip, W, Rogers, RW. And Young, O.A. 2001. Meat Science and Application. Marcel Decker Incorporation, NY, USA.

Course Title: Meat Refrigeration
Course Number: MST-06
Course Duration: 1 semester (16 weeks)
Credits: 3(2-1)

Course Description

Aim of this course is to develop background of refrigeration principles and extend expertise to student for efficient chilling and freezing of fresh and processed meat preserving nutritional quality and shelf life. After studying the course, students will be able to understand fundamental and applied aspects of cold meat chain.

Course Goals and Performance Objectives

Goal

To familiarize learners with meat refrigeration

technologies Objective 1

To understand principles involved in heat transfer and cooling involved in meat industry

Objective 2

To understand various issues related to cooling and freezing storage of meat and products

Objective3

To recognize different measurements in meat refrigeration

Course contents

Introduction to chilling and freezing principles, principles of heat addition, basics of heat transfer; weight loss from meat and meat products, electromagnetic heating, heat flow, freezing, secondary cooling, thawing and tempering, chilled storage and product quality, frozen storage and

product quality, transportation of chilled and frozen products, retail display of chilled and frozen products, domestic handling and product quality, initial chilling of red meat and poultry carcasses, freezing equipment, microbiology of chilled meat products; effect of refrigeration on texture of lamb, goat and beef meat; influence of freezing on texture; influence of thawing on texture; color changes during chilling, freezing and storage of meat; Effect of multiple freeze-thaw cycles on meat quality, effect of chilling on evaporative weight loss of meat; the cold chain from carcass to consumer; chilled and frozen storage; types of storage rooms; chilled and frozen retail display; consumer handling of chilled and frozen meat products; process control; secondary chilling of meat products; novel heating, specifying, designing and optimizing refrigeration systems, the food cold chain and environment.

Practical

Temperature measurement: calibration, measuring temperature data; interpreting temperature data; demonstration of various chilling, freezing and cooking equipment for different types of products; calculation of chilling and freezing requirements for storage and retail display. Demonstration of various cooking equipment for different types of products. Calculation of chilling losses in beef carcasses.

Detailed Course Outline

| No. | Theory | No. | Practical |
|-----|---|-----|--|
| 1. | Basic terminologies related to meat refrigeration | 1 | Introduction to Practical course and basic terminologies related to course |
| 2. | Principles of meat refrigeration | | |
| 3. | Introduction to chilling techniques | 2 | Basic terminologies related to practical meat refrigeration |
| 4. | Basics of heat transfer phenomenon | | |
| 5. | Principles of heat addition | 3 | Temperature and pH measurement of fresh meat |
| 6. | Electromagnetic heating | | |
| 7. | Changing temperature; Primary and secondary cooling | 4 | Temperature and pH measurement of chilled meat |
| 8. | Thawing process and tempering | | |
| 9. | Chilled and frozen storage and product quality | 5 | Calibration of temperature |

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| 10. | Transportation of chilled and frozen products | | |
| 11. | Retail display of chilled and frozen products | 6 | Measuring temperature and humidity |
| 12. | Domestic handling and product quality | | |
| 13. | Freezing equipment | 7 | Interpreting temperature data |
| 14. | Microbiology of chilled and frozen meat products | | |
| 15. | Effect of refrigeration on texture of beef | 8 | Demonstration of various chilling equipments for different meat products |
| 16. | Effect of refrigeration on texture of poultry meat | | |
| 17. | Influence of freezing on texture, taste and flavor | 9 | Demonstration of various freezing equipment for different types of products |
| 18. | Color changes during chilling | | |
| 19. | Effect of chilling on evaporative weight loss of meat | 10 | Demonstration of various cooking equipment for different types of products. |
| 20. | Influence of thawing on texture | | |
| 21. | The cold chain from carcass to consumer | 11 | Calculation of chilling requirements of carcass for storage |
| 22. | Stages of refrigeration: chilling, freezing and cooling | | |
| 23. | Consumer handling of chilled and frozen meat products | 12 | Calculation of chilling requirements for meat cuts for retail display. |
| 24. | Optimization of design and operation of meat refrigeration | | |
| 25. | process control; during chilling and freezing of meat products | 13 | Calculation of freezing requirements of carcass and meat cuts for storage |
| 26. | Secondary chilling of meat products | | |
| 27. | Chilled and frozen retail display | 14 | Calculation of freezing requirements of carcass |

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| 28. | Effect of multiple Freeze Thaw Cycles on meat quality | | and meat cuts for retail display. |
| 29. | Specifying refrigeration systems | 15 | Calculation of chilling losses in beef carcasses |
| 30. | Designing and optimization of refrigeration systems | | |
| 31. | Economic cost of meat refrigeration | 16 | Designing and feasibility of cold chains for meat and meat products |
| 32. | Storage and transportation of chilled poultry meat | | |

Teaching Learning Strategies

| Theory: | Practical |
|------------------|------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussion | Group Discussion |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
 Intellectual honesty
 Regularity and punctuality
 Adherence to deadlines
 Fairness
 Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------|-------------|----------|------------|-------|---------------------------------------|-------|-------|
| | Assignm ent | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 04 | 12 | 24 | 40 | 12 (Mini project + Class performance) | 8 | 20 |

Recommended Books/Readings

1. James, S.J., James, C. (2012). Meat refrigeration (2nd Edition). Woodhead Publishing, Cambridge.
2. Kerry, J.P. and Ledward, D. (2009). Improving the sensory and nutritional quality of fresh meat. Woodhead Publishing, Cambridge, UK.
3. Nollet, L.M.L., Toldra, F. (2006). Advanced technologies for meat processing. CRC, Taylor and Francis, New York, USA.

Course Title: Industrial Meat Processing and Product Development

Course Number: MST-07

Course Duration: 1 semester (16 weeks)

Credits: 4(2-2)

Course Description

Aim of this course is to create awareness with the principles of processed meat and the use of further processing equipment for producing consistent quality products. After studying the course, students will be able to manufacture value added products in accordance with international quality and safety standards.

Course Goals and Performance Objectives

Goal

To familiarize the learners with the meat further processing and value Addition

Objective 1

To understand different techniques used in industry for high quality products

Objective 2

To understand various aspects of further processing of meat

Objective3

To improve further processing of meat products and yield

Course Contents

Introduction to processed meat industry; technologies and processes used in product development. Processed meat products, Equipment used for further meat processing, ingredients and seasonings used in meat processing, Role of ingredients (Meat binders, gelling agents, extenders, tenderizers etc) and process on functional attributes of meat and meat products, Hot-boning of meat, Improving functionality of pale soft and

exudative (PSE) meat; dark, firm and dry (DFD) frozen meat, comminution, marination, cooking, cured meat; frozen burger patties, steaks, sausages etc, sensory analysis for product development, Alternative meat upgrading and restructuring systems; New approaches for developing functional meat products; low salt and low fat products, coated poultry products like nuggets, chunks, drum sticks; costing of the product developed & cost reduction techniques, canned meats, restructured meat, meat preservation; lactates preservation; safe production of ready to eat meat products, Microbiological criteria for further processed meat products; meat processing, hygienic packaging and labeling, Introduction to advance meat processing, Emerging technologies for processing; high hydrostatic pressure (HPP), pulsed electric fields (PEF), ultrasound (US), electrical stimulation (ES) usage to improve tenderness,, Meat decontamination by irradiation, biochemical proteolysis for improved meat processing; Innovative technologies for meat safety and enhancing shelf life (such as calcium salt and sodium lactate), cold binders for preparing restructured meat products; Packaging technologies; conventional vs. advanced, modified atmosphere packaging (MAP), Vacuum packaging, vacuum skin packaging, active and intelligent packaging), using gene technology for meat quality, Commercial video image analysis system

Practical

Practical demonstration of making minced meat products like patties using mincer and mixer. how to use bowl chopper, sausage filler to make sausages, how to use kidney plate mincer and mixer for preparing restructured meat products from low value parts of the carcass, making meat emulsions; preparing cured and nutritionally fortified meat products, emphasis is placed on student knowledge of basic meat processing techniques, preparation of different sausages, preparation of burger patties, preparation grilled steaks and coated products, Practical demonstration of low and high voltage electrical stimulation for improving red meat tenderness; using vacuum and modified atmosphere packaging and assessing these technologies for color and lipid stability of fresh meat and meat products.

Detailed Course Outline

| No. | Theory | No. | Practical |
|------------|---|------------|--|
| 1. | Emerging technologies for meat processing | 1. | Introduction to Practical course and basic terminologies related to course |
| 2. | Non-meat ingredients | 2. | Terminologies related to meat value addition |

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| 3. | Seasonings used in meat processing | 3. | Practical demonstration of making minced meat products like patties using mincer |
| 4. | Equipment used for further processing | 4. | Practical demonstration of making minced meat products like patties |
| 5. | Protein solubility | 5. | Demonstration of use of bowl chopper to make sausages |
| 6. | Meat binding and New developments in meat binding | 6. | Practical demonstration of beef cutting |
| 7. | Water holding in lean muscle | 7. | Demonstration of use of sausage filler to make sausages |
| 8. | Factors affecting meat yield | 8. | Preparation of different types sausages-i |
| 9. | New developments in meat binding improving functionality of pale soft and exudative (PSE) meat | 9. | Preparation of different types sausages-ii |
| 10. | Comminution of meat | 10. | Demonstration of kidney plate mincer and mixer for preparing restructured |
| 11. | Coated meat products (Nuggets, Chunks drumsticks) | 11. | meat products from low value parts of the carcass |
| 12. | Sausages making | 12. | Bone saw cutter demonstration |
| 13. | Low salt meat products | 13. | Meat emulsions preparation |
| 14. | Low fat meat products | 14. | Cured meat products preparation |
| 15. | Marination | 15. | Functional meat products Preparation |
| 16. | Canned meat products | 16. | Meat further processing equipments |
| 17. | Restructured meat | 17. | Preparation of burger patties |
| 18. | Preservation and curing | 18. | Preparation grilled steaks and coated products |

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| 19. | Lactates and meat preservation | 19. | Practical demonstration of low voltage electrical stimulation for improving red meat tenderness |
| 20. | Microbiological criteria for further processed meat products | 20. | Selection and grading of raw meat for further processing |
| 21. | Packaging meat products | 21. | Practical demonstration of high voltage electrical stimulation for improving red meat tenderness |
| 22. | Labeling meat products | 22. | Using vacuum packaging |
| 23. | New approaches for developing functional meat products | 23. | Using modified atmosphere packaging |
| 24. | Meat decontamination by irradiation | 24. | Assessment technologies for color and lipid stability of fresh meat and meat products |
| 25. | Introduction to the advance technologies in meat processing | 25. | Hot Boning of meat |
| 26. | Hot-boning of meat | 26. | Preparing restructured meat products |
| 27. | Application of hydrostatic pressure to improve meat quality and safety | 27. | Preparation of Marinade |
| 28. | Using electrical stimulation (ES) to improve tenderness | 28. | Marination Process |
| 29. | Innovative technologies for meat safety and enhancing shelf life (such as calcium salt and sodium lactate) | 29. | Curing Process |
| 30. | Cold binders for preparing restructured meat products | 30. | Quantification of calcium and sodium lactate salt for meat safety and enhancing shelf life |
| 31. | Using packaging technologies (vacuum packaging, vacuum skin packaging, map; active packaging) | 31. | Development of healthy meat products |

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| 32. | Commercial video image analysis system | 32. | Practical demonstration of Commercial video image analysis system |
|-----|--|-----|---|

Teaching Learning Strategies

| Theory: | Practical |
|-------------------|-------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussions | Group Discussions |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
Intellectual honesty
Regularity and punctuality
Adherence to deadlines
Fairness
Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------|------------|----------|------------|-------|---------------------------------------|-------|-------|
| | Assignment | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 04 | 12 | 24 | 40 | 24 (Mini project + Class performance) | 16 | 40 |

Recommended Books/Readings

1. James, S.J., James, C. (2012). Meat refrigeration (2nd edition). Woodhead Publishing, Cambridge.
2. Isabel, G. L. (2010). Handbook of Poultry Science and Technology (Volume 2)-Further processing. Willey publishing, Canada.
3. Nollet, L.M.L., Toldra, F. (2006). Advanced technologies for meat processing. CRC, Taylor and Francis, New York.
4. Feiner, G. (2006). Meat products handbook- Practical Science and Technology. Woodhead Publishing Limited, England, UK.
5. Kerry, J., Kerry, J. and Ledward, D. (2002). Meat Processing: improving quality. Woodhead Publishing, Cambridge.
6. Berle, E.D., Forrest, J.C., Gerrard, E.D. and Mills, E.W. (2008). Principles of Meat Science, 4th Ed., Kendall/Hunt Publishing Co., Dubuque.

7. Varnam, A.H. & Sutherland, J.P. (2005). Meat and meat products. Chapman & Hall.
8. Gunter Heinz and Peter Hautzinger. (2007). Meat Processing Technology for small to medium scale producers, FAO, Regional office Asia, USA.

Course Title: Meat Hygiene and Public Health
Course Number: MST -08
Course Duration: 1 semester (16 weeks)
Credits: 3(2-1)

Course Description

Aim of this course is to train students to get their plants certified for international prevailing standards for meat hygiene and to get knowledge about veterinary public health issues related to meat processing and consumption. After studying the course, students will be able to customize latest food management and quality system as per their need.

Course Goals and Performance Objectives

Goal

To familiarize the learners with the food safety standards

Objective 1

To understand implementation of meat hygiene standards in industry

Objective 2

To understand various standards being used in international food industry

Objective3

To recognize different aspects of current food safety and public health

Course Contents

Introduction to meat hygiene and importance of meat safety; food borne infections; food borne bacteria, viruses and parasites; zoonosis and notifiable diseases; case study of bovine spongiform encephalopathy; basics of food microbiology; hygiene of slaughter and dressing; hygiene of poultry processing; microbiological criteria for carcasses and processed meats; food safety management diary for meat producers; meat inspection; microbiological risk assessment; veterinary public health; microbiological spoilage of meat; cleaning and disinfection; spoilage of vacuum packed raw meat due to cold tolerant clostridia; decontamination of red meat and poultry; food safety assurance; local and international approaches to obtain safe foods;

Practical

Introduction to meat microbiology; Microbiological sampling of meat; Techniques for microbial isolation and identification; food Safety management diary for meat producers

Detailed Course Outline

| No. | Theory | No. | Practical |
|-----|--|-----|---|
| 1. | Introduction to meat hygiene and importance of meat safety | 1 | Introduction to meat microbiology |
| 2. | Food borne infections (bacteria, viruses and parasites) | | |
| 3. | Zoonosis and notifiable diseases in meat industry | 2 | Microbiological sampling of meat |
| 4. | Basics of food microbiology | | |
| 5. | Hygiene of slaughter and dressing | 3 | Microbiological sampling techniques from abattoir |
| 6. | Hygiene of poultry processing | | |
| 7. | Microbiological criteria and Corrective actions | 4 | Techniques for microbial isolation and identification |
| 8. | Microbiological criteria for carcasses | | |
| 9. | Microbiological criteria for processed meats | 5 | Ante-Mortem-1 |
| 10. | Food safety management diary for meat producers | | |
| 11. | Meat Inspection- ante mortem | 6 | Ante-Mortem-2 |
| 12. | Meat Inspection- post mortem | | |
| 13. | Microbiological risk assessment in meat plants | 7 | Group discussion on development of meat safety policy for local meat industry |
| 14. | Microbiological risk assessment at retail outlets | | |
| 15. | Microbiological spoilage of meat | 8 | |

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|-----|--|----|--|
| 16. | Cleaning and disinfection of meat plants | | Use of food Safety management diary for meat producers |
| 17. | Spoilage of vacuum packed raw meat due to cold tolerant clostridia | 9 | Development of procedures/manuals/documents as per different standard requirements |
| 18. | Decontamination of red meat and poultry | | |
| 19. | Food safety assurance of meat | 10 | Post-Mortem 1 |
| 20. | Local and international approaches to obtain safe foods | | |
| 21. | Concept of Zoonosis | 11 | Post-Mortem 2 |
| 22. | Current status of meat and public health condition in the world | | |
| 23. | Current status of meat and public health condition in Pakistan | 12 | Disinfection of meat premises |
| 24. | Food borne illnesses | | |
| 25. | Food borne viruses | 13 | Identification of food borne bacteria |
| 26. | Food borne protozoan parasites | | |
| 27. | Food borne bacteria | 14 | Food borne parasites identification |
| 28. | Zoonosis and notifiable diseases | | |
| 29. | Principles of veterinary public health | 15 | Case study of BSE in UK meat industry |
| 30. | Veterinary public health policy | | |
| 31. | Public health relevance of Poultry Meat | 16 | Review of veterinary public health policy |
| 32. | Risk Management in meat supply chain | | |

Teaching Learning Strategies

| Theory: | Practical |
|------------------|------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussion | Group Discussion |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
 Intellectual honesty
 Regularity and punctuality
 Adherence to deadlines
 Fairness
 Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------------|-------------------|-----------------|-------------------|--------------|--------------------------------------|--------------|--------------|
| | Assignment | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 04 | 12 | 24 | 40 | 2 (Mini project + Class performance) | 8 | 20 |

Recommended Books/Readings

1. Gracey JF. Meat hygiene. Baillière Tindall; (Revised 2002)
2. Boylston T, Chen F, Coggins P, Hydlig G, McKee LH, Kerth C. Handbook of meat, poultry and seafood quality. Nollet LM, editor. John Wiley & Sons; (2012)
3. Davies AR, Board RJ, Board RG. (1998). Microbiology of meat and poultry. Springer Science & Business Media;
4. Riaz, M.N. and M.M. Chaudry, (2003) Halal food production. CRC Press.
5. Pearson, A.M. and Dutson, T.R. (2010) HACCP in meat, poultry and fish processing. Kluwer Academic Publishers.
6. Brown, M., HACCP in the meat industry. (2000), New York: Woodhead Publishing Limited and CRC Press LLC.
7. Food Safety and Management Safety Manuals (2015) Published by International Organization for Standardization (ISO); Available from: www.iso.org.

Course Title: Advanced Poultry Processing
Course Number: MST -09
Course Duration: 1 semester (16 weeks)
Credits: 3(2-1)

Course Description

Aim of this course is to provide background of modern commercial processing practices being practiced in poultry processing industry for producing wholesome quality fresh chicken with minimum yield losses. After studying the course, students will be able to optimize their processing plant and supply chain for consistent quality of fresh chicken.

Course Goals and Performance Objectives

Goal

To familiarize the learners with the poultry meat processing and meat quality

Objective 1

To understand primary processing of poultry

Objective 2

To understand various aspects related to poultry processing and meat quality

Objective3

To understand the commercial and industrial aspect of poultry processing

Course contents

Concepts of primary and further poultry processing; an overview of Pakistan poultry processing industry; global poultry processing market and trends; an introduction to the poultry slaughtering equipment and operations; whole bird selection by weight and quality, standard operating procedures for processing, *i.e.* feed withdrawal, ante-mortem handling of poultry birds, stunning methods; legislative and religious requirements for slaughter of poultry, scalding, Singeing, plucking, evisceration and giblet harvesting, chilling, whole carcass packing, on site sampling of carcass & processing equipments and premises, meat quality issues related to plant hygiene, secondary chilling, portioning and deboning operations, inspection, grading and cuts composition, poultry by products harvesting, feathers, offal and bone, rendering, waste water treatment, poultry packaging; industrial storage, transportation and supply chain of chilled poultry meat; quality control and food safety management systems in poultry processing plants, case studies for small and large scale poultry processors

Practical

Practical demonstration and “hands-on “training of modern processing operations from slaughter to refrigeration; detailed discussion on standard operating procedures (SOP) and documentation; identification of critical control points for ensuring consistent product quality and safety, implementation and quantification of HACCP in poultry processing plants; applying scientific and business principles to manufacturing and process flow of poultry processing; poultry processing plant data management for feedback and traceability.

Detailed Course Outline

| No. | Theory | No. | Practical |
|-----|--|-----|---|
| 1 | Introduction to course and learning outcomes | 1 | Introduction to practical course and basic terminologies related to course |
| 2 | Concepts of primary and further poultry processing | | |
| 3 | An overview of Pakistani poultry processing industry | 2 | Introduction to poultry processing operations |
| 4 | Global poultry processing market and trends | | |
| 5 | An introduction to the poultry slaughtering equipment and operations | 3 | Demonstration of poultry processing line and equipment using multimedia and available equipment |
| 6 | Standard operating procedures for each stage of processing | | |
| 7 | Poultry harvesting and catching methods | 4 | Slaughterhouse Building and Facility Requirements |
| 8 | Standards for transportation of poultry birds | | |
| 9 | Poultry lairage management | 5 | Practical demonstration and “hands-on “training of modern processing operations from slaughter to refrigeration |
| 10 | Ante-mortem handling of poultry birds | | |
| 11 | Stunning methods in industrial poultry processing | 6 | Comprehensive discussion on SOP's involved to carry out each step of processing |

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| 12 | Legislative and religious requirements for the slaughter of poultry | | |
| 13 | Scalding and plucking | 7 | Demonstration and implementation of HACCP in poultry meat plant |
| 14 | Evisceration and giblet harvesting | | |
| 15 | Chilling and its effects on poultry carcass | 8 | Methods of assessment and quantification of HACCP at the processing plants |
| 16 | Whole bird selection by weight and carcass quality | | |
| 17 | Whole carcass packing | 9 | Grading and inspection of poultry meat |
| 18 | Meat quality issues related to plant hygiene | | |
| 19 | Portioning and deboning operations | 10 | Practical demonstration on chilling technologies and their effect on poultry carcass quality |
| 20 | Poultry meat grading and inspection | | |
| 21 | Cut-ups and composition | 11 | Practical demonstration for measuring quality parameters of poultry meat including color, water holding capacity and texture |
| 22 | Poultry by product harvesting | | |
| 23 | Primal cuts packaging | 12 | Poultry processing plant data management for feedback and traceability |
| 24 | Functions of packaging | | |
| 25 | Packaging materials and methods | 13 | Practical demonstration to identify the control points for ensuring consistent product quality and safety |
| 26 | Biopolymer packaging for poultry meat | | |
| 27 | Poultry meat refrigeration and chilling | 14 | Application of scientific and business principles for manufacturing and process flow of poultry processing |
| 28 | Industrial poultry chilling technologies | | |
| 29 | Bone and feather processing | 15 | Visit to a modern poultry processing plant |
| 30 | Rendering and waste water treatment | | |

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| 31 | Industrial poultry storage, transportation and supply chain | 16 | Visit to poultry retail outlets |
| 32 | Case studies of different small and large scale poultry processors | | |

Teaching Learning Strategies

| Theory: | Practical |
|------------------|------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussion | Group Discussion |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
Intellectual honesty
Regularity and punctuality
Adherence to deadlines
Fairness
Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------|-------------|----------|------------|-------|---------------------------------------|-------|-------|
| | Assign ment | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 04 | 12 | 24 | 40 | 12 (Mini project + Class performance) | 8 | 20 |

Recommended Books/Readings

1. Isabel, G. L. (2010). Handbook of Poultry Science and Technology (Volume 1)-Primary processing. Willey publishing, Canada.
2. Richardson, R.I. (2005). Poultry meat science. CABI publishing, Wallingford, UK.
3. Mead, G.C. (2004). Poultry meat processing and quality. Woodhead Publishing Limited, Cambridge, England, UK.
4. Barbut, S. (2002). Poultry products processing-an industry guide. CRC press, London, UK.

5. Sams, A.R. (2001). Poultry meat processing. CRC press, Taylor and Francis Group, London, UK.

Course Title: Seafood processing
Course Number: MST -10
Course Duration: 1 semester (16 weeks)
Credits: 3(2-1)

Course Description

Objective of the course is to impart knowledge and skills for improving eating quality and extending shelf life of fish and fish products. Students will be able to understand fundamentals of fish processing for ensuring eating quality and longer shelf life.

Course Goals and Performance Objectives

Goal

To familiarize the learners with fish post-harvest technology

Objective 1

To understand fish processing in different parts of the world

Objective 2

To analyze fish secondary processing in many parts of the

world **Objective3**

To recognize different aspects of fish processing in order to get high quality products

Course Contents

Introduction to marine sources of food, Fish and shell fish: overview, importance, handling, transportation. Reception, testing and storage. Quality indicators: physical, biochemical, microbiological prospects. Fish preparation: heading, filleting, skinning. Standards for freshness of fish and marine foods. On board handling; icing procedure; offloading; transportation to fish markets; Fish preservation: freezing, defrosting, canning, salt curing, smoking, drying. Biochemical dynamics and quality of fresh and frozen fish; role of food constituents in fish quality; methods of assessing and selecting quality; fish filleting and packing; shelf life of fish food products; packaging; freezing and thawing; chemistry of freezing; pickling; fish pastes; special processing procedures (minced fish, surimi products, gelatin); industrial fish processing; fish oils; fish protein concentrate and byproducts; Legislation and standards for export of sea foods; value addition; fish and fish products, Crabs, Lobsters and Prawns

processing and quality indicators, Active and intelligent packaging for seafood.

Practical

Visit to fish processing plant; freshness tests for fish, Lobsters, prawns (Physical, chemical tests); microbiological examination; proximate composition of fish; Methods of analysis of preserved/canned fish products and by products.

Detailed Course Outline

| No. | Theory | No. | Practical |
|-----|--|-----|--|
| 1. | Introduction to course and learning outcomes | 1 | Introduction to Practical course and basic terminologies related to course |
| 2. | Terminologies related to course | | |
| 3. | On board handling | 2 | Terminologies related to practical course |
| 4. | Initial handling of netted fish-i | | |
| 5. | Initial handling of netted fish-ii | 3 | Freshness tests for fish (chemical tests)-i |
| 6. | Icing procedure-i | | |
| 7. | Icing procedure-ii | 4 | Freshness tests for fish (chemical tests)-ii |
| 8. | Off loading | | |
| 9. | On shore handling | 5 | Microbiological examination-i |
| 10. | Transportation to fish markets-i | | |
| 11. | Transportation to fish markets-ii | 6 | Microbiological examination-ii |
| 12. | Various ways of fish disposal-i | | |
| 13. | Various ways of fish disposal-ii | 7 | Proximate composition of fish |
| 14. | Preservation of fish | | |
| 15. | Preservation of fish by curing | 8 | Special processing procedures (minced fish, surimi products, gelation) |
| 16. | Drying | | |
| 17. | Salting | 9 | industrial fish processing |
| 18. | Smoking | | |

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| 19. | Value added products | 10 | International standards; food laws; food safety; value addition |
| 20. | Fish mince | | |
| 21. | Chilling and freezing of fish | 11 | Methods of analysis of preserved fish products |
| 22. | Canning of fish and fish products | | |
| 23. | Biochemical dynamics and quality of fresh fish | 12 | Methods of analysis of canned fish products |
| 24. | Biochemical dynamics and quality of frozen fish | | |
| 25. | Role of body constituents in governing fish quality | 13 | Methods of analysis of fish by products |
| 26. | Food safety | | |
| 27. | Methods of assessing and selecting quality | 14 | Fish pastes |
| 28. | Fish filleting and packing | | |
| 29. | Shelf life of fish food products | 15 | Pickling |
| 30. | Packaging; assessment of fish quantity | | |
| 31. | Deep freezing and thawing; | 16 | Visit to fish processing plant proximate composition of fish; Methods of analysis of preserved/canned fish products and by products |
| 32. | Chemistry of freezing | | |

Teaching Learning Strategies

| Theory: | Practical |
|-------------------|-------------------|
| Lectures | Performance |
| Presentations | Presentations |
| Group Discussions | Group Discussions |
| Assignments | Peer Analysis |
| Quiz | Assignments |

Class Work Policies

Equal opportunity
Intellectual honesty
Regularity and punctuality
Adherence to deadlines
Fairness

Conformity to discipline

Assessment Strategies

| Modality | Theory | | | | Practical | | |
|-----------|---------------------|----------|------------|-------|---------------------------------------|-------|-------|
| | Assignment and Quiz | Mid Term | Final Term | Total | Class Performance | Final | Total |
| Max marks | 4 | 12 | 24 | 40 | 12 (Mini project + Class performance) | 8 | 20 |

Recommended Books/Readings

1. Regestein, J. and Regestein, C.E. (2007). Introduction to fish technology. CBS Publishers and Distributors, New Dehli.
2. Kuma, G.K. (2007). Tropical fishery products. Oxford 41 BH Publishing Company PVT Ltd. New Delhi.
3. Hall, G.M. (2006). Fish processing technology. Kluwer Academic Publishers.
4. Cornell, J.J. (2005). Control of fish quality. Blackwell Science.

ANNEXURE - A

Statistics-I

Credit 3 (2-1)

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf diagram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and un-grouped data.

Measure of Dispersion, Definition and Calculation of Range, quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

Practical

- a. Frequency Distribution
- b. Stem-and-Leaf diagram
- c. Various types of Graphs
- d. Mean, Geometric mean Harmonic Mean,
- e. Median, Quartiles Deviation, mean Deviation.
- f. Standard Deviation, Variance, Coefficient of variation,
- g. Skewness and kurtosis

Recommended Books

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A. Concise Course in A. Level Statistic with world examples by J. Crashaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2nd Ed. (1986) Fran II. Dietrich-II and Thomas J. Keans

Statistics-II

Credit 3 (2-1)

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Interference

Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using χ^2 (chi-square) Testing hypothesis about variance.

Practical

- a. Sampling random sampling
- b. Stratified random sampling.
- c. Sampling distribution of mean
- d. Testing of hypotheses regarding population mean
- e. Testing of hypotheses about the difference between population means
- f. Chi-square test
- g. Testing of Correlation Coefficient
- h. Fitting of simple linear regression
- i. One-way ANOVA
- j. Two-way ANOVA

Recommended Books

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. Principles and Procedures of Statistics A Bio-material approach, 2nd Edition, 1980 by R. G. D Steel and James H. Tarric
4. Statistical Procedures for Agricultural Research 2nd Edition (1980) by K. A. Gomez and A. A. Gomez

ANNEXURE - B

Introduction to Information and Communication Technologies

| | | |
|--------------------------|---------------------|------------------------|
| Course Structure: | Lectures: 2 Labs: 1 | Credit Hours: 3 |
| Pre-requisite: | None | Semester: 1 |

Course Description

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and World Wide Web, and ICT based applications.

After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
 - Define the basic terms associated with communications and networking
 - Understand different terms associated with the Internet and World Wide Web.
 - Use various web tools including Web Browsers, E-mail clients and search utilities.
 - Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

Course Contents

- Basic Definitions & Concepts
- Hardware: Computer Systems & Components
- Storage Devices, Number Systems
- Software: Operating Systems, Programming and Application
- Software Introduction to Programming, Databases and Information Systems Networks
- Data Communication
- The Internet, Browsers and Search Engines
- The Internet: Email, Collaborative Computing and Social Networking
- The Internet: E-Commerce
- IT Security and other issues

Project Week

Review Week

Text Books/Reference Books

1. Introduction to Computers by Peter Norton, 6th International Edition, McGraw-Hill
2. Using Information Technology: A Practical Introduction to Computer & Communications by Williams Sawyer, 6th Edition, McGraw-Hill
3. Computers, Communications & information: A user's introduction by Sarah E. Hutchinson, Stacey C. Swayer
4. Fundamentals of Information Technology by Alexis Leon, Mathews Leon, Leon Press.