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Chapter - 1

Cooking :- food को Heat Exchange में लाना व ~~एक्सचेंज~~ करना।

⇒ ऐसी प्रक्रिया जिसमे खाद्य पदार्थ को हीट की क्रिया द्वारा पहचान करवाना या उसे पकाना वही Cooking कहलाती है।

Objective :-

→ Taste or quality ↑es. (विषाणु का विनाश)
→ Microdestruction (जीवाणु)
→ digestability ↑es.
→ variety ↑es. (भोजन की ग्राह्यता बढ़ती है।)
→ Consumption ↑es.
→ Nutrient availability ↑es. (Cook करने पर egg का protein.)
→ Antioxidents ↑es.

Disadvantage :-

→ Protein, Vitamins, Minerls, water Soluble Vitamins loss - overheating, burning

Q.1 egg के protein को Bind करके उसके Avilable को रोकने वाला elements कौनसा है।

Dice :- 2MM Brunoise
5MM Macedoine

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Preliminary preparations :-

(1) Cleaning :- फल व सब्जियों को जीवाणु रहित करने के लिए सबसे पहले उन्हें धोया जाता है।

(2) peeling and stringing :- फल व सब्जियों में से अखाद्य रेशों को हटाने के लिए फल, सब्जियों को उबाल कर इनका छिलका उतारा जाता है।

⇒ आलू में विटामिन-C ।

(3) Cutting and grating :- फल व सब्जियों को छोटे छोटे सेप में काटा जाता है जिससे खाना पकाने में आसानी होती है।

Cut :- असमान टुकड़ो में काटना ।
Chop :- असमान टुकड़ो में काटना (बारीक-बारीक)
Dice :- समान क्यूब में काटना ।
Slice :- समान लम्बे पिस में काटना ।
Crate :- ग्रेटर से बारीक-बारीक ।

(4) Sieving :- मोटे रेशों और कीड़ो को हटाने के लिए छाना जाता है।

जैसे :- आटा, मैदा ।

(5) Soaking :- सब्जीयो को नमकीन NaCl या सोडियम बाइकार्बोनेट के पानी में डुबोया जाता है।

(6) Blend :- दो खाद्य सामग्री को मिक्स करके Bind करना ।
Shap

Ex :- ice cream, Milk shake.

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Bind :- Starch, Egg white, white flour.

(7) Beating :- खाद्य सामग्री को लगातार हिलाना ताकि Smoth text प्राप्त कर सके।

(8) Whiping :- तेज गति से ऊपर उठाते हुये फेंटना ताकि खाद्य पदार्थ मे वायु संचार हो सके।

ex :- whiping cream with egg.

(9) fold, ~~Hatthch~~ Mashing, ~~Stuffing~~ :-

(10) Coating :- किसी भी खाद्य पदार्थ को एक लेयर से कवर करते है।

⇒ लेयर = Bread Crum, Starch, white flour.

(a) dredging :- खाद्य पदार्थ को सूखे पदार्थो से कवर करते है।

ex :- मैदा।

Breading :- खाद्य पदार्थो को ड्राई पाउडर से Coat करना।

⇒ फिर इसे egg white के घोल में Coat करना।

⇒ फिर उसे Bread के पाउडर से Coat करना।

फिर उसे fry करना।

(11) Bettering :- Semi liquid का घोल बनाया जाता है।

ex :- पकोड़ा, कॉपता (बेसन, Rice gram).

(12) Blanching :- food को liquid में कुछ समय रखना फिर उसे तुरन्त निकालकर ठंडे पानी मे मग्न करना ।

(13) fermentation :- एन्जाइमो एवं जीवाणु की उपस्थिति मे जटिल पदार्थो को सरल पदार्थो मे तोड़ने की प्रक्रिया ।

⇒ यह एरोबिक या एनारोबिक स्थिति के तहत हो सकती है ।
⇒ ex :- इडली, ब्रेड और ढोकला ।

(14) Marinating :- विनेगर, दही, सिट्रीक अम्ल में कुछ समय तक मीट व फिश को रखा जाता है जिससे इनके अन्दर का रेशा soft हो जाये और flavour बढ़ जाये ।

(15) Sprouting or germination :- सभी प्रकार के चने जैसे मूंग, चना, मटर अनाज को अंकुरित करना ।
⇒ अंकुरित दालो का उपयोग सलाद और करी बनाने मे किया जाता है ।

(16) Grinding :- इसमे वेट तथा ड्राई ग्रांइडिंग दोनो शामिल है ।
⇒ वेट ग्राइंडिंग मे इडली बैटर को ग्राइंड करना और चटनी तैयार करना ।

(17) Drying :- खाद्य पदार्थो में नमी को हटाना जिससे भोजन के शेल्फ जीवन को बढ़ाने मे मदद मिलती है ।

Q1: Custer powder में कौनसा Binding Starch होता है?
Ans:-

Q2: Muses में कौनसा Nutrient inhibitur होता है?
Ans:

* Type of heat :-

(1) Conduction :- इसके अन्तर्गत हीट किसी गर्म सतह से भोज्य पदार्थ तक पहुंचती है जो कि ठण्डा होता है।

⇒ इसके अंन्तर्गत पदार्थ हीट के Direct Contact में आता है।
ex:- तवे पर चपाती सेंकना।

काइनेटिक energy :- गर्म सतह से ठण्डी सतह की ओर move करना।

(2) Convction :- इसके अन्तर्गत हीट का transfer तरल पदार्थ (water air) के सम्पर्क में आने से पकाया जाता है।
जैसे :- आलू को बॉयल करना।
ex:- इडली स्टीम, बेकिंग।

(बेकिंग के अन्तर्गत प्रोलोंग कुकींग की जाती है जिसमे food dry heat exction से पकता है जो कि Convction के तहत आता है।

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(3) Reduction :- इसके अन्तर्गत Heat / Energy का मेग्नेटिक वेक्स के द्वारा इलेक्ट्रॉनिक transfer होता है।

Methods of Cooking :-

(1) Moist heat Methods.
(2) Dry heat Methods.
(3) Combination heat Methods.

Moist heat	Dry heat	Combination heat
Boilling	Roasting	Braishing
Samiling	Grealing / Broiling (आग के Contact)	Micro-wave Cooking
poaching	Toasting	Solar Cooking
Stewing	Baking	
Blanching	Sauteing	
Steaming	frying	
pressure Cooking		

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☆ Methods of Cooking :-

(1) Moist Heat Methods.
(2) Dry Heat Methods.
(3) Combination heat Methods.

Moist Heat	Dry Heat	Combination Heat
(1) Stewing	Roasting	Braishing
(2) Simmering	Grealing/Broiling (आग के (Direct)	Micro wave
(3) Steaming	Toasting	Solar Cooking
(4) Boilling	Baking	
(5) Blanching	Setueing	
(6) poaching	fryeing	
(7) pressure Cooking		

(1) Stewing :- धीमी आंच पर ढक्कन वाले पैन में food को पकाना Stewing कहलाता है।

⇒ यह सिमंरिग के समान है।
⇒ इसमे food को ~~आधा~~ पानी में आधा डुबा हुआ रखकर तब तक गर्म करते हैं जब तक food soft नही हो जाता है।
⇒ Bioling व Stewing में Major differens = temp.
⇒ temp. = 75-98°C.

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⇒ इसमें food को low heat पर लंबे समय तक पकाते है। 1 - 2 - 4 Hour

⇒ Potato, legumes व meat को पकाया जाता है।

Advantase	disadvantase
(1) food को एक अलग taste and flavor देता है।	⇒ Slow method of Cooking ⇒ Need Constant attention. ⇒ ईंधन की बड़ी खपत होती है।
(2) कम पानी मे पकाने से vitamin का loss नही होता है।	

(2) Simmexing :- इस विधि में food को liquid में अच्छी तरह से इबोलीट होने वाले तापमान पर पकाया जाता है। जिससे में 82-99°C रहे। food इबे

⇒ इस प्रक्रिया को Simmering के रूप में जाना जाता है।

⇒ इस विधि में food जब तक भाप बनना पूरी तरह से बन्द नही होता तब तक पकाया जाता है

⇒ इस विधि मे food को तब तक पकाया जाता है जब तक भाप बनना पूरी तरह से बन्द नही होता है।

Ex:- गाजर का हल्वा, खीर

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Advantages :- food एक समान पकता है।
Burning के chance कम होते है।

disadvantages :- ताप से उत्पन्न होने वाले पोषक तत्व नष्ट हो जाते है।

(3) Steaming :- temp° = 100°c

⇒ It is a healthy method of cooking.

⇒ Need spacial untensil.

⇒ इस विधि में पानी के उबालने से जो भाप उत्पन्न होती है उस भाप से food को पकाया जाता है।

⇒ यह Heat के direct Contact मे नही आता है।

Ex:- इडली, सब्जि।

Wet / direct steam :- इस विधि मे food Heat के direct Contect मे आता है,

ex:- इडली।

dry steaming :- यहाँ पर जरूरत होती double बॉयलर की है जिसके अन्तर्गत food direct steaming के Contect मे नही आता है,

Ex:- सॉस।

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Water less Cooking :- इसके अन्तर्गत खाद्य पदार्थ में Present से Stem नमी द्वारा भाप स्वयं उत्पन्न होती है उसी food पकता है।

Ex:- प्रेशरकुकर।

Advantages	disadvantages
⇒ food is soft and easy to digest	इस विधि से सभी खाद्य पदार्थ पकाए जा सकते है।
⇒ Healthy Method of Cooking as no oil used.	Special utensils की आवश्यकता होती है।
⇒ No loss of nutrients.	

(4) Boilling :- इस विधि में food को 100°C के तापमान पर पानी में उबालते है जिससे food easily digestible हो सके।

⇒ Rice, dal, root, tubber etc.

Advantages	disadvantages
⇒ Simple method (खाना पकाने का)	⇒ water soluble vitamins का loss.
⇒ Special utensil की आवश्यकता नही होती है।	⇒ सब्जियाँ अपना रंग खो देती है।
⇒ Easily digestible होता है।	

~~इस विधि में food को 100°C के तापमान पर~~

→ food को liquid में बॉयल करना फिर ~~उसे~~ ~~ठंडे पानी में मर्ज करना।~~ निकालकर

(5) Bleaching :- फल व सब्जियों की skin को ढीलने के लिए इस विधि का उपयोग किया जाता है।

⇒ ~~इस विधि में~~

⇒ टमाटर जैसी सब्जियों को 2-3 Min तक उबलते पानी में रखते हैं इसके बाद इसे पानी से निकाल कर छिलके को ~~e~~ आसानी से हटाया जा सकता है।

⇒ Side dished, Soups तैयार करने के लिए इस विधि का उपयोग किया जाता है।

Advantages :-	disadvantages
⇒ पाचनशक्ति बढ़ाने में मदद करता है।	पोषक तत्वों का नुकसान होता है।
⇒ सब्जियों की बनावट बनी रहती है।	

(6) Poaching :- low Heat and minimum amount में liquid food को पकाना ही, poaching कहलाता है।

⇒ Healthy Method of Cooking.

temp = 80-85°C (

ex:- egg, fish व कुक्कुट को पकाया जाता है।

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Advantages	disadvantages
⇒ No oil is added	⇒ food आसानी से जल जाता है।
⇒ Healthy easily digestible	⇒ खाना फीका होने के कारण स्वाद मे कम आकर्षक।

(v) Pressure Cooking :- भाप के द्वारा खाने पर दबाव देकर कम से कम समय मे food को तैयार किया जाता है।

⇒ Temp :- 100°c से Above.

Advantages	dis advantages
⇒ ईंधन व टाइम की बचत	⇒ Special utensils की आवश्यकता होती है।
⇒ faster method	
⇒ No loss of पोषक पत्व	⇒ प्रेशर कुकर की विधियो, उपयोग और देखभाल के बारे मे पता होना चाहिए।
⇒ No loss of flavor.	

⇒ Dry Heat Method :-

(i) Air use Method :- गर्म हवा द्वारा।

(ii) Grealing / Broiling :- It is a Health Method of Cooking.

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⇒ इस विधि में food को oil या Butter लगाकर पकाते हैं।
⇒ इस विधि में भोजन को लाल गर्म सतहों के बीच में रखा जाता है।
⇒ मीट, चिकन, सब्जियाँ और मक्का इस विधी से पकाया जाता है।

Barbequing :- food को Red Hot surface के ऊपर या नीचे या बीच में रखकर पकाया जाता है।
⇒ food को रेडियेशन के द्वारा Heat मिलती है।
Ex:- मक्का, पापड, बैंगन etc.

Advantages	disadvantages
⇒ Healthy Method.	लगातार देने की जरूरत।
⇒ तेल का कम use.	
⇒ flavor, texture & taste improve.	

(ii) Roasting :- Metal वाले खुले पैन में बिना तेल डाले भोज्य पदार्थ को पकाना, Roasting कहलाता है।
Ex:- मुंगफली, चपाती।

Advantage :- (i) Healthly Methods करता है।
(ii) flavour Increase
(iii) भोजन को सुगंध देता है।

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disadvantages :- (i) यदि समान रूप से भोजन नहीं भुनता है तो वह आसानी से झुलस जाता है।

(ii) लगातार ध्यान देने की आवश्यकता ।

(iii) Toasting :- इस विधि में दोनो तरफ से खाद्य पदार्थ को Heat मिलती है जिससे खाद्य पदार्थ दोनों तरफ से समान प्रकार से सीखता है।

ex'- Bread.

Advantages	disadvantages
→ Quick Method.	→ लगातार ध्यान देने की जरूरत
→ Enhance flavor	→ खाना आसानी से जल जाता है।
→ Enhance texture.	

(iv) Baking :- इस विधि में food को पकाया Oven में जाता dry heat लगाकर है।

⇒ temp. = 120 - 450°C

⇒ केक, बिस्कुट, मांस or ब्रेड बनाया जाता है।

Advantages	disadvanteges
⇒ भोजन हल्का और फूला हुआ होता है।	· Special उपकरण की आवश्यकता ।
⇒ तेल का कम use.	
⇒ unique flavor, texture & aroma.	

(2) fat :-

(i) Sauteing :- इस विधि में food में कुछ चम्मच तेल की डाली जाती है और उसे नरम होने तक धीमी आंच पर ढक कर रखा जाता है।

जैसे :- अदरक, लहसुन का पेस्ट, प्याज, टमाटर आदि।

Advantages	disadvantages
⇒ Simple Method of Cooking.	⇒ लगातार ध्यान रखने की जरूरत है।
⇒ little use of oil.	

(ii) frying :- 2 type

SHallow fat frying :- इस विधि में food को पकने के लिए sauteing से अधिक व deep fry से कम तेल use किया जाता है।

ex :- पराठा।

deep fat frying :- इस विधि में food पूरी तरह डूबा हुआ oil में होता है,

ex :- समोसा, पकोड़ा, चिप्स etc.

Advantages :- Quick Method
Enhance flavour
Enhance textured

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disadvantages :- (i) बहुत अधिक तेल अवशोषित हो जाता है।
(ii) एक ही तेल को बार-बार use करने से स्वास्थ्य को खतरा होता है।

☆ Binding agent :- ऐसे Substance जो खाद्य पदार्थ को Hold करके रखते हैं।

⇒ Chemically, Mechanically, Cohesion, Addition property ∘ होता है।

gum :- gower gum, agar-agar, pectin.

Organic :- bitmees, animal plant glue, polymer.

Inorganic :- liquid glass.
lime
पिप्सम

⇒ egg white is traditional Method.

Nuts and Oils.

⇒ Nuts seeds या fruits होते हैं जिनमें एक edible fat युक्त kernal होता है जो एक hard brittle shell से घिरा होती है।

⇒ Nuts में rich flavour होता है।

⇒ Nuts का उपयोग अधिकांश रूप से ऐनिंग को गार्निश करने के लिए किया जाता है, लेकिन इनका उपयोग recipes में pastes, dried powders or agents के रूप में किया जाता है।

⇒ Oilseed वे seed होते हैं जिनमें oil की मात्रा अधिक होती है और इनका use तेल निकालने के लिए किया जाता है।

⇒ तेल निकालने के बाद बची हुई भूसी का use पशु चारे में के रूप किया जाता है।

⇒ तेल निकालने के बाद तिलहन से एक तिलहन केक प्राप्त होता है जिसका उपयोग पशु चारे के रूप में और अब मानव उपभोग के लिए भी किया जाता है क्योंकि यह प्रोटीन के साथ-साथ अन्य पोषक तत्वों से भरपूर होता है।

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Classification :- Composition के आधार पर Nuts को तीन वर्गों में वर्गीकृत किया गया है :-

(1) Nuts with high amounts of fats :-

Example :- Almonds, cashew nuts and walnuts जिनमें 50% या अधिक fats होती है।

(2) Nuts with high amounts of proteins :-

Example :- groundnuts जिसमें लगभग 25% protein होता है।

⇒ Almond व pistachios (पिस्ता) में भी 20% protein होता है।

⇒ अधिकांश protein युक्त Nuts में high amount में fat होता है।

(3) Nuts with high amounts of carbohydrate :-

Example :- Chestnut में लगभग 50% carbohydrate होता है लेकिन protein or fat में अपेक्षाकृत कम होता है।

☆ Nutritional value :-

⇒ Nut को Rich taste के अलावा good nutritional value के लिए भी जाने जाते है।

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⇒ Nuts and Oilseed में अनिवार्य रूप से fat और calories से rich होती है।

⇒ मुट्ठी भर Nuts large amount में energy की supply कर सकते हैं।

⇒ ये भी good quality वाले protein के excellent sources हैं।

⇒ इन्हे digestible बनाने के लिए, इन्हे ठीक से चबाया जाना चाहिए और कम amount में सेवन करना चाहिए।

⇒ Small children और elderly people के लिए nuts को powder form में use करना ठीक होता है।

⇒ Nuts में लगभग 2% minerals होते हैं जिनमें फॉस्फोरस or ~~pot~~ पोटेशियम का अच्छा अनुपात होता है।

⇒ कुछ nuts में कैल्शियम, सोडियम, मैग्नीशियम और आयरन भी मौजूद होता है।

⇒ वे carbohydrate और roughage का good sources नही है। अपवाद चेस्टनट है जिसमे लगभग 50% carbohy. होता है।

⇒ फोर्टीफाइड उत्पाद के स्रोत इनमें 5% से कम पानी होता है।

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⇒ इनमें नमी की मात्रा बहुत कम होती है यही कारण है इन्हें लम्बे समय तक स्टोर किया सकता है।

⇒ ये vita-E के अच्छे स्त्रोत हैं और मुंगफली विशेष रूप से थायमिन और निकोटिनिक एसिड से भरपूर होती है।

⇒ Almond जैसे कुछ Nuts vita-E के अच्छे स्त्रोत है।

☆ use :- Most Nuts raw from में खाए जाते हैं
(Most of nuts are eaten in the raw from

eg :- Almond, walnuts, groundnut etc.

⇒ to enhance flavour sometimes they are roasted, cooked, fried and salted.

⇒ Cooking and roasting improves the oil content of nuts, making them more palatable.

⇒ ~~if they are used in preparal~~

⇒ they are used to make laddus, Halwa and other sweets.

⇒ It is used to garnish many sweet and savory dishes.

⇒ used in confectionery industry. and added to various types of nut chocolate.

⇒ they are used as ingredients for stuffing meat products.

⇒ coconut and groundnut are used for making chutneys and dips.

⇒ peanut butter serves a delightful spread for breads and bakery products.

⇒ Oil extracted from various nuts and oilseeds, serves as a medium of cooking.

✡ Specific Nuts :-

(1) Almonds :- प्रूनस एमिग्डालस ।

⇒ It is best cultivated in tropical and subtropical regions.

⇒ there are two cultivated varieties of almond (बादाम की दो किस्में उगाई जाती हैं।)

- bitter almond :- Which is used for oil extraction. (कड़वा बादाम) (जिसका उपयोग तेल निकालने के लिए किया जाता है।)

- Sweet almond.

⇒ Kashmir, Himachal pradesh and uttar pradesh are the main producer states in india. (भारत के प्रमुख उत्पादक राज्य हैं।)

⇒ the almond kernels are eaten fresh as dessert nut.
(बादाम की गुठली को मिठाई के रूप में खाया जाता है।)

⇒ Kernels are cleaned, dried, bleached, roasted, fried and salted for use.

⇒ It is rich in fat and protein.
(यह वसा और प्रोटीन से भरपूर होता है।)

⇒ मुख्य The main protein globulin is of low biological value but easy to digest.
(मुख्य प्रोटीन ग्लोबुलिन कम जैविक मूल्य वाला है लेकिन पचने में आसान होता है।)

⇒ Bitter almonds have more protein than sweet almonds.
(मीठे बादाम की अपेक्षा कड़वे बादाम में प्रोटीन की मात्रा अधिक होती है।)

⇒ But Bitter almonds contain 2.5-3.5% amygdalin which is a cyanogenetic glucoside which is not suitable for human.

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(किन्तु कड़वे बादाम में 2.5 - 3.5% एमिग्डालिन होता है जो एक साइनोजेनेटिक ग्लूकोसाइड है जो मानव के लिए उपयुक्त नहीं है।

⇒ Hance bitter almonds are used to extract oil which is further used in cosmetics and used in the pharmaceutical industry.
(इसलिए कड़वे बादाम का उपयोग तेल निकालने के लिये किया जाता है जो आगे कॉस्मेटिक और दवा उद्योगों में use किया जाता है।)

⇒ 100 gm almonds में 20.8 gm protein, 58.9 gm fat, 2.9 gm minerls, 10.5 gm carbohydrate or 655 K.C. energy होती है।

⇒ Almonds का use Milk shakes, sweets, curries, vegetables, Kheers, halwas, laddu etc.

(2) Coconut :- Cocas nucifera.

⇒ It is also called Kalpa vrikshao.
(इसे कल्प वृक्ष भी कहा जाता है।)

⇒ Which means the tree providing all necessities of life. (अर्थ है :- जीवन की सभी आवश्यकताएँ प्रदान करने वाला पेड़।)

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⇒ It is grown in the world primarily in india sri lanka, londo Indonesia, Malaysia and philippines.

(यह मुख्य रूप से भारत श्रीलंका, इण्डोनेशिया, मलेशिया और फिलीपीन्स मे दुनिया के तटीय क्षेत्रो मे उगाया जाता है।)

⇒ the edible part of the coconut is covered by a fibrous outer husk.

(नारियल का खाने योग्य भाग एक रेशेदार बाहरी भूसी से ढका होता है।)

⇒ Cocount water present in coconut is fresh and disinfected drink.

(नारियल मे मौजूद नारियल पानी ताजा और कीटाणुरहित पेय है।)

⇒ It is a source of vitamins-B complex and ascorbic acid as well as minerls like Potassium, phosphorus.

(यह vita-B complex और एस्कोर्बिक एसिड के साथ-साथ K, P जैसे खनिजों का स्त्रोत है।)

⇒ 100gm of fresh coconut Kernel contains 4.5 gm proteins, 41.6 gm fats, 1.0 gm minerls, 13 gm carbohydrates and 444 K.Cal. energy.

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⇒ The fresh kernel is eaten directly but more often ground and used to make sweets, curries and chutneys.

(ताजा गिरी को सीधा खाया जाता है But अधिक बार इसें बारीक करके मिठाई, करी और चटनी बनाने में उपयोग किया जाता है।)

⇒ Coconut is used in the manufacture of Copra, from which oil and coconut cake are obtained.

नारियल का उपयोग खोपरा के निर्माण मे होता है जिससे तेल और नारियल प्राप्त होता है।

⇒ Copra is two forms :- ball Copra and Cup Copra.

⇒ Desiccated coconut is prepared after removing the brown testa from the kernel of white coconut, shredding and drying it to less than 2% moisture.

सफेद नारियल की गिरी से भूरा टेस्टा निकालने, कतरने और 2% से कम नमी तक सुखाने के बाद सुखा नारियल तैयार किया जाता है।

⇒ Coconut juice is a good source of sucrose and ascorbic acid.

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⇒ नारियल का रस सुक्रोज और एस्कॉर्बिक एसिड के अच्छे स्त्रोत हैं।

⇒ In fresh condition it is called sweet tadi or neera. ताजी अवस्था में इसे मीठी ताड़ी या नीरा कहते हैं।

⇒ Fermentation develops tadi to 4% alcohol. Now it is further distilled to make arak with 35% alcohol.

किण्वन से tadi के 4% एल्कोहल विकसित हो जाता है। अब इसे 4% एल्कोहल के साथ अरक बनाने के लिए आगे 35% डिस्टिल्ड किया जाता है।

⇒ Jaggery is also obtained by evaporation and concentration of ~~cocoa~~ coconut juice.

गुड को नारियल रस के वाष्पीकरण व सघनता से भी प्राप्त किया जाता है।

(3) ~~Groundnuts~~ :- ~~Arachis hypogaea~~.

(3) Cashewnuts :- Anacardium occidentale.

⇒ India is the largest producer and exporter of cashew.

भारत काजु का सबसे बड़ा उत्पादक और निर्यातक क्षेत्र है।

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⇒ The fruits obtained from the tree are called cashew fruits.
which are juicy, shiny and Orange in Colour.
(पेड़ से प्राप्त फलों को काजू फल कहते हैं जो रसीले, चमकीले और नारंगी रंग के होते हैं।

⇒ Cashew is Kidney shaped and covered with a shiny shell
काजू गुर्दे के आकार का कठोर व चमकदार खोल से ढका होता है।

⇒ Walnuts contain pungent juice which burns the skin.
अखरोट में तीखा रस होता है जो skin को जला देता है।

⇒ These nuts are eaten fresh, roasted, salted or mixed with Suger
इन मेवों को ताजा, भुना हुआ, नमकीन या शक्कर के साथ मिलाकर खाया जाता है।

⇒ It is used in milkshakes, Sweets, curries, gravies, soups, confectionery.
इसका उपयोग मिल्क शेक, मिठाई ...

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⇒ 100gm Cashew Contains 21.2% protein, 46.9% fat, 2.4% Minerals, 22.3 Carbohydrate and 596 K.C. energy.

⇒ The oil Contains glycerides of oleic and ~~lino~~ linoleic acids.

⇒ Due to the high sugar Content, cashews are fermented to prepare an alcoholic beverage known as okaju, which is distilled to prepare ofenio.

इसके तेल में ओलिक व लिनोलिक एसिड के ग्लिसराइड होते हैं। हाई शुगर के कारण काजु को ओकाजु के रूप में जाना जाने वाला मादक पेय तैयार करने के लिए किण्वन किया जाता है, जिसे ओफनियो तैयार करने के लिए इसे आसुत किया जाता है।

⇒ Cashew shell oil is used in paints and lacquers for waterproofing and protection.

काजू के खोल के तेल का उपयोग जलरोधक व संरक्षण के लिए पेंट्स व लाख में किया जाता है।

Walnut :- जुगलन्स रेजिया ।

⇒ Many varieties of walnuts are grown such as:- European walnut, black walnut, white walnut, japanese walnut.

अखरोट की सबसे प्रसिद्ध किस्में ↗

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⇒ European walnut is the most famous veriety which is grown in india in the hilly areas of kashmir, Himachal pradesh, uttar pradesh and punjab.

युरोपियन अखरोट सबसे प्रसिद्ध किस्म है जो भारत में कश्मीर, हिमाचल प्रदेश, उत्तरप्रदेश और पंजाब के पहाड़ी क्षेत्रों में उगाई जाती है।

⇒ the walnut fruit consists of a leathery exocarp and a woody, wrinkled and two and half endocarp enclasing one four lobed, corrugated oily edible kernel.

अखरोट के फल में एक चमड़े का एक्सोकार्प और एक बुडी, झुर्रीदार और दो आधा एण्डोकार्प एक चार लोब्ज, नालीदार तेल खाने योग्य कर्नल को घेरता है।

⇒ when the fruit is ripe, the shell is removed and the kernel is cleaned, dried and used.

जब फल पक जाता है तो छिलका हटा कर गुठली को साफ, सुखाकर प्रयोग किया जाता है।

⇒ It is one of the desert nuts used in bakery, confectionery, ice-cream.

अखरोट बेकरी, कन्फेशनरी, आइसक्रीम में उसे किए जाने वाले ड्राई नट्स में से एक है।

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⇒ green walnuts are used to prepare pickle, chutney, marmalade.
हरे अखरोट का उपयोग अचार, चटनी, मुरब्बा तैयार करने के लिया किया जाता है।

⇒ It is a good source of ascorbic acid.

⇒ 100 gm Walnuts Contain 15.6 gm protein, 64.5gm fat, 1.8 gm minerals, .11 gm Carbohydrate or 687 K.C. energy.

⇒ Also K, P, Mg or Vita-E also happens.

B.
pistachios :- pistacia vera.

⇒ It is a very expensive nut.

⇒ Origin :- Central asia.
⇒ pistachio is not grown in india, Afghanistan.
⇒ It is a green colored nut with a thin jacket.
(यह पतले जैकेट के साथ हरे रंग का nut होता है।

⇒ The green color of this nut imparts its characteristic color to food preparation.
इस nut का हरा रंग भोजन तैयार करने के लिए अपना विशिष्ट रंग प्रदान करता है।

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uses:- Salted, Milk shake, halwa, kheer, laddu, sweet, confectionary. is made in the from of ice-cream.

⇒ Oil is not extracted from it due to high cost.
उच्च कीमत के कारण इससे तेल नहीं निकाला जाता है।

⇒ 100gm pistachio contains ⇒ 19.8gm protein
53.5 gm fat
2.8 gm Minerals
16.2 gm Carbohydrate
626 k.c energy

CHestnut :- Castanea sativa.
origin:- Southern Europe.

⇒ And Spain, Italy it is produced in large quantities in frdnce. स्पेन, इटली फ्रांस में बड़ी मात्रा में उगा

⇒ It is also cultivated in many parts of the Himalayas. (हिमालय के कई हिस्सो में भी इसकी खेती)

⇒ It can be eaten raw but tastes better when boiled in salt water for 10-15 min.
इसे कच्चा खा सकते है लेकिन 10-15 min तक नमक के पा
में उबालने पर अच्छा स्वाद आता है।

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⇒ It is rich in sugar and starch with very little fat.
यह चीनी और स्टार्च में बहुत कम फैट के साथ समृद्ध होते हैं।

इससे बने आटे का use
⇒ the flour made from it is used in :-
soup, pakoda, stew, stuffing.

⇒ 100 gm chestnut Contains :- 10.9 gm protein
1.84 gm fat
2.25 gm Minerals
54.24 gm Carbohydrate

Brazil nut :- ब्रेजीलिया एक्सेल

⇒ the exporter is not Brazil But Bolivia.
(निर्यातक ब्राजील नहीं बल्कि बोलीविया है।)
where they are called Almendra.
(जहां इन्हें अलमेन्ड्रा कहा जाता है)

⇒ It is the seed of a tree that grows up to 160 feet tall in the Amazon forests.
(यह एक पेड़ का बीज है जो अमेजॉन के जंगलों में 160 fit लम्बा होता है।)

⇒ It contains 14% protein, 11% Carbohydrate, 67% fat.

⇒ It is an excellent source of Selenium and good source of Mg or thiamine.

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Hazelnut :- कोरीलस स्वेलाना ।

⇒ Grows in most parts of Britain.
(ब्रिटेन के अधिकांश हिस्सों में उगता है)

⇒ Nuts are oval. (nut अण्डाकार होता है।)

⇒ ~~Used~~ used :- in preparation of alcoholic beverages and hazelnut butter. में प्रयोग)
(मादक पेय और हेजलनट मक्खन तैयार करने

⇒ It is rich ~~in~~ in fiber, Ca, K, Mg or Vita-e

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Eggs

☆ Egg दुनिया भर में खाया जाने वाला सम्पूर्ण भोजन है।

⇒ विभिन्न पक्षीयो के अण्डे खाए जा सकते हैं लेकिन मुर्गी और बत्तख के अण्डे सबसे ज्यादा खाए जाते हैं।

⇒ अण्डे के प्रोटीन में सभी आवश्यक एमीनो एसिड होते हैं।

⇒ मुर्गी के अण्डे का औसत वजन लगभग 2 औंस यानी 57 ग्राम होता है।

☆ Structure :- अण्डे की संरचना तीन घटकों में विभाजित किया जा सकता है-

(1) Shell :- यह अण्डे का बाहरी आवरण है जो पूरे अण्डे का 9-11% योगदान देता है।

⇒ अण्डे की 94% Shell $CaCO_3$ की बनी होती है।

⇒ इसमे हजारो छोटे छेद होते हैं जो निकास भ्रूण के लिए गैसो को अण्डे से अंदर और बाहर जाने की अनुमति देते हैं।

⇒ छोटे छिद्रो को जिलेटिनस सामग्री म्युकोप्रोटीन की एक पतली परत के साथ कवर किया जाता है, जिसे क्यूटिकल या ब्लूम कहा जाता है।

⇒ यह अण्डे मे सुक्ष्म जीवो को भी प्रतिबन्धित करता है।

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(2) Egg white :- इसे Egg Albumin के रूप में भी जाना जाता है।

⇒ यह अण्डे के तरल वजन का लगभग 65% योगदान देता है।

⇒ इसमे कुल अण्डे के आधे से ज्यादा प्रोटीन होता है।

⇒ अण्डे की उम्र ज्यादा होने पर अण्डे की सफेदी की परत पतली हो जाती है।

⇒ इसलिए ताजे अण्डे कड़ाही मे लम्बे समय तक बैठते हैं जबकि पुराने अण्डे फैल जाते हैं।

⇒ जैसे - जैसे अण्डे की ~~[illegible]~~ उम्र बढ़ती ~~[illegible]~~ है CO_2 बाहर निकल जाता है।

(3) Egg yolk :- yolk अण्डे के तरल भार का लगभग 33% होता है।

⇒ इसमे अण्डे की पूरी चर्बी होती है और अण्डे के कुल प्रोटीन का लगभग 45% होता है।

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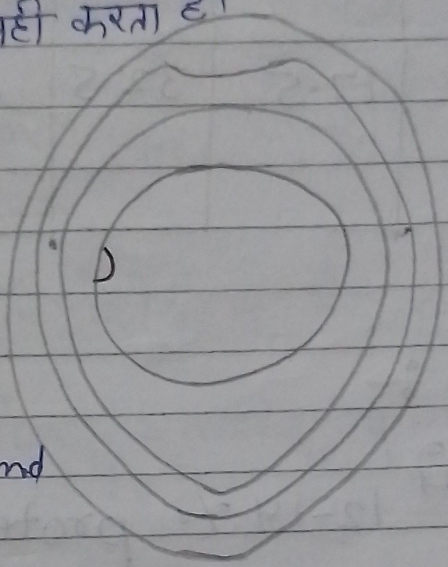
(1) Shell :- यह $CaCO_3$ से बना होता है इसलिए यह सफेद होता है।

⇒ egg का colour, Quality, Cooking, nutritive value पर koi effect नहीं करता है।



(2) yolk :-

⇒ yellow protein of egg.

⇒ इसमे सबसे ज्यादा vita., Minerals and fat होता है।

⇒ germinal Disc

(3) vitelline :-
(yolk membrane)

⇒ यह yolk को Hold करती है।

(4) Chalazae :-

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Composition of egg :-

	%	Water	Protein	Fat	Ash%
Whole egg	100	65.5	11.8	11	11.7
Egg white	58-60%	88	11	0.2	0.8
Egg yolk	31-33%	48	17.5	32.5	2
Shell	9-12%				

☆ Nutritive value :-

(1) protein :- अण्डे में 12-14 % protein होता है।

→ दो अण्डो का Meterial एक वयस्क व्यक्ति को प्रदान करता है।
25% protein

→ अनाज या दाल के मिश्रण के साथ अण्डे का संयोजन भोजन की प्रोटीन गुणवत्ता को बढ़ाएगा।

→ Egg white को एल्बुमिन के रूप में भी जाना जाता है।

→ अण्डे में मौजूद कुल प्रोटीन का 60% योगदान है।

→ Egg white में 50% Ovalbumin protein होता है।

Co-nalbumin = 13%
Ovomucoid = 10%
Lysozymes = 3.5%

→ Egg yolk में विटेलिन प्रोटीन होता है जो लिपोविटेलिन और

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~~लिपोप्रोटीलिपिन~~ के रूप मे लिपोप्रोटीन कॉम्पलेक्स मे मौजूद होता है।

(2) fat :- Egg yolk में fat होता है।

⇒ yolk fat को तीन भागो में विभाजित किया जा सकता है।

(i) ट्राइग्लिसराइड्स (ii) फॉस्फोलिपिड्स

(iii) Lipoprotein

⇒ लिपोप्रोटीन फॉस्फोलिपिड्स के साथ Conjugation मे मौजूद होते है।

⇒ अण्डे मे मौजूद प्राथमिक फॉस्फोलिपिड लेसिथिन है और प्रमुख स्टेरॉल कोलेस्ट्रॉल है।

(3) Carbohydrate :- egg में ~~Carb~~ Carbohydrate glucose, Mannose, galactose कम मात्रा में मौजूद होते है।

⇒ यह सूखे और पके हुए अण्डे की सफेदी मे भूरे रंग की ~~मे~~ मलिनकिरण पैदा करने वाली मैलार्ड प्रतिक्रिया मे भाग लेगा।

(4) Vitamins :- अण्डा Vita-c को छोड़कर सभी विटामिन का समृद्ध स्त्रोत है।

fat Soluble vita - A, D, E, K yolk मे होते है।

(5) Minerals :- Fe, P, Zn, I, K, Na, Cl, S जैसे Minerals अच्छी मात्रा मे मौजूद है।

⇒ आयरन कोनलबुमिन से बंधा होता है इसलिए इसका अवशोषण खराब होता है जबकि जिंक सबसे प्रचुर मात्रा मे मौजूद है।

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✱ functional properties of egg Content :-

(1) Coğulation :- egg का protein नमी के बन्धन और चिपचिपाहट में वृद्धि के साथ गर्म होने पर जम जाता है।

⇒ गर्म करने से अण्डे का Denaturation हो जाता है जो एकत्र होकर जेल नेटवर्क बनाता है।

⇒ इस प्रकार अण्डे का उपयोग एगेंट के रूप में किया जा सकता है।

ex:- कस्टर्ड, केक, क्रीम पुडिंग आदि।

Egg white = 62-65°c] जम
Egg yolk = 65-70°c

⇒ कटलेट, चॉप आदि में Binding agent के रूप में किया जाता है।

(2) Emulsification :- अण्डे में मौजूद फॉस्फोलिपिड्स (लेसिथीन) और कुछ प्रोटीन के रूप में कार्य करता है।

Emulsifying agent

⇒ मेयोनेज नाइस में तेल को निलंबित रखने के लिए egg yolk के रूप में कार्य करता है।

emulsifier

(3) foaming :- foaming egg को पीटने पर इलास्टिक फिल्म बनती है जो हवा को रोक सकती है।

⇒ egg or egg के उत्पाद अच्छे foaming egent है।

⇒ केक, मफिन जैसे बेक किए गये उत्पादो में अण्डे को लीवनिंग एजेंट के रूप में उपयोग किया जाता है।

Cell की size increase होने पर वह कम तोलने लगता है।

☆ testing the quality of egg :-

(1) water test :- यह test density के सिद्धान्त पर कार्य करता है।

⇒ egg को पानी से भरे गिलास मे डालते है यदि egg गिलास के पेन्दे मे बैठ जाता है तो यह egg का है और यदि egg पानी के ऊपर या बीच मे तैरता है तो यह egg अच्छी Quality का होता है।
egg कम Quality का होता है।

(2.) Sensory test :- egg को देखकर, Smelly आदि से egg की Quality का पता लगाया जाता है।

(3) Candling test :- अण्डा खराब है कि नही यह पता लगाने के इस test का सबसे ज्यादा उपयोग किया जाता है।

⇒ इसमे egg को Candle के ऊपर रखा जाता है और निम्न कारको का मूल्यांकन किया जाता है।

(A) Shell पर Cracks (दरारे)
(B) Air cell की Size and position.

☆ Quality checks and Storage of egg :-

⇒ अण्डे को रखने के तुरन्त बाद अण्डा खराब होने लगता है इसलिए अण्डे का सेवन करने से पहले उसकी गुणवत्ता की जाँच करना जरूरी है।

⇒ इसमे निम्नलिखित गुण होने चाहिए :-

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→ yolk center में होना चाहिए।

→ Egg white yolk के चारो ओर वलय के रूप में होना चाहिए।

→ ~~Blood के Spots or~~

→ Blood के Spots or Smell नही होने चाहिए।

☆ Changes occur in egg during storage :-
(Storage के दौरान अण्डे में परिवर्तन)

(1) Moisture कम होने के कारण Cell की Size increase हो जाती है।
(2) CO_2 ~~का~~ loss ~~निकलती~~ है जिससे pH बढ़ जाती है।
(3) Breakdown of protein.
(4) increase in free ~~fat~~ fatty acid in your fat.

☆ ~~grading~~

☆ grading :-

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Role of egg in cookery :-

⇒ egg का use Boiled, scrambled or poached के रूप में किया जाता है।

⇒ Stirred custads, baked custards, soup, puddings में egg का use thickening agent के रूप में किया जाता है।

⇒ Emulsifying agent :- Maynnaise, ice-cream.

⇒ Cake, foamy omelette, souffles, meringue में leaving agent के रूप में।

⇒ Cutlet, french toast या Bombay toast, banana fritters में Binding or Coating agent के रूप में।

⇒ flavouring agent :- Custards

⇒ glazing agent :- pastries

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• Cereals And Millets •

Cereals :- इसकी उत्पत्ति अनाज की रोमन देवी 'सेरेस' से हुई है।

⇒ भारत हरित क्रान्ति के बाद अनाज, दलहन और तिलहन के उत्पादन में आत्मनिर्भरता के स्तर तक पहुँच गया है।

⇒ अनाज पौधे हैं जो उपज देते हैं इसमें चावल, गेहूँ, मक्का, जौ और जई शामिल है।

⇒ Cereals की family :- ग्रेमिनी / पोएसी।

⇒ Cereals Ca, Fe और विटामिन जैसे सूक्ष्म पोषक तत्वों का भी अच्छा स्त्रोत है।

⇒ इनका उपयोग आटा, Bran और अन्य खाद्य पदार्थो के निर्माण में किया जाता है।

⇒ इसको स्टोर करना आसान है क्योंकि इसमें नमी की मात्रा कम होती है।

⇒ भारत में मुख्य रूप से गेहूँ, चावल, मक्का, ज्वार और जौ उगाए जाते हैं।

⇒ अनाज कार्बोहाइड्रेट (60-70%) से भरपूर।

⇒ इसमें लाइसिन की कमी व मिथियोनिन की अधिकता।

⇒ यह कैंसर, कब्ज, ब्रह्दान्त्र विकारों, High Blood Sugar को रोकने में मदद।

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⇒ अनाज नियासिन, लोहा, राइबोफ्लेविन और थायमिन से समृद्ध।

⇒ अनाज में घुलनशील Bran भी होता है जो रक्त में कोलेस्ट्रॉल के स्तर को कम करने और हृदय रोगों को दूर रखने में मदद।

⇒ शिशुओं के लिए आयरन से भरपुर अनाज को प्रमुख ठोस आहार कहा जाता है।

Millets :- बाजरा शब्द अनाज की कई प्रजातियों के लिए शिथिल रूप से लागू होता है जो मक्का की तुलना में छोटे अनाज का उत्पादन करते हैं।

⇒ सामान्य रूप से छोटे पत्तेदार पौधों में होते हैं।
⇒ इसका उपयोग केक या आटे के रूप में किया जाता है।

⇒ मोटे अनाज इस प्रकार हैं+
(i) पनीसेटम टाइफाइडस (बाजरा)
(ii) Panicum miliaceoum (पेशावर बाजरा)
(iii) सेटेरिया इटैलिक (फॉक्स टेल बाजरा) (कंगनी / काकुन)
(iv) सोरघम वल्गारे (ज्वार)
(v) एलुसीन कोरकाना (रागी या फिंगर बाजरा)

⇒ बाजरा आकार में छोटा व गोल होता है और सफेद, ग्रे, पीला या लाल रंग का हो सकता है।

⇒ बाजरा प्रोटीन, खनिज और विटामिन के मामले में चावल और गेहूँ से तीन से पाँच गुना अधिक पौष्टिक।

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• Composition And Nutritive value •

1. Energy :- अनाज का मुख्य स्त्रोत है जो आवश्यकता का 70-80% योगदान देता है।

⇒ 100 gm 340 Kg कैलोरी से अधिक energy देते हैं।

2. Carbohydrate :- अनाज का 80% शुष्क पदार्थ कार्बोहाइड्रेट होता है।

⇒ दो कार्बोहाइड्रेट - (i) Crude fibre (ii) Soluble Carbohydrate.

⇒ fiber Constituents Cellulose, hemicellulase and pentasans हैं जो Bran की परतों में present होता है।

⇒ Soluble carbohydrate में से स्टार्च सभी अनाजों में सबसे महत्वपूर्ण कार्बोहाइड्रेट है।

⇒ इसमें थोड़ी मात्रा में डेक्सट्रिन और शर्करा भी मौजूद होते हैं।

⇒ शुगर में ग्लूकोज, जैसी साधारण शर्करा और सुक्रोज और माल्टोज जैसी डाई सैकेराइड शामिल है।

⇒ सभी अनाजों में से गेहूँ, रागी और सुक्रोज or माल्टोज जैसे डाइसैकेराइड शामिल है।

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(3) Protein :- विभिन्न अनाजो में प्रोटीन की मात्रा अलग - अलग होती है।

⇒ चावल में अन्य अनाजो की तुलना में कम प्रोटीन।

⇒ Endosperm परिकार्प टेस्टा की तुलना में स्कुटेलम और ऐलेरोन परत में Embryo, प्रोटीन की सांद्रता अधिक होती है।

⇒ Cereals में Present protein के प्रकार :- एल्बुमिन, ग्लोब्युलिन, प्रोलामाइन (ग्लिआडिन) or ग्लूटेलिन है।

⇒ ग्लियाडिन और ग्लूटेलिन को ग्लूटेन प्रोटीन के रूप में जाना जाता है। इसका उपयोग ब्रेड और अन्य उत्पादों को पकाने के लिये किया जाता है।

⇒ Cereals में Protein = 6-12%

⇒ अनाज में लाइसिन की कमी तथा मिथियोनिन की अधिकता जबकि दालो में लाइसिन अधिक व मिथियोनिन की कमी होती है।

(4) fat :- चावल में, गेहूँ में = 1-2%
मक्का में = 3%

⇒ Cereals की तुलना में germ व Bran में अधिक वसा Present होती है।

⇒ Wheat germ में lipids = 6-11%
Bran = 3-5%
Endosperm = 0.8-1.5%

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⇒ Maize germ में fat = 35%
Bran = 1%

⇒ fat में mostly पामिटिक, ओलिक और लिनोलिक एसिड के Tryglycerides होते हैं।

⇒ Cereals में phospholipids and lecithin present होते हैं।

Minerals :- लगभग 95% खनिज P, Mg और Ca के फॉस्फेट और सल्फेट हैं।

⇒ अनाज में फॉस्फोरस का काफी हिस्सा फाइटिन के रूप में मौजूद होता है।

⇒ कुछ खनिज तत्व जैसे - तांबा, जस्ता और मैंगनीज भी अनाज मे बहुत कम मात्रा में मौजूद होते हैं।

⇒ Ca, Fe का खराब स्त्रोत = अनाज।
⇒ चावल Ca, Fe का बहुत खराब स्त्रोत।

⇒ रागी Ca, Fe का समृद्ध स्त्रोत है।

⇒ ज्वार, बाजरा, रागी खनिज और फाइबर से भरपूर होते हैं।

Vitamin :- साबुत अनाज, हमारे आहार में विटामिन-B का एक महत्वपूर्ण स्त्रोत है।

⇒ अधिकांश विटामिन Bran में Present होते हैं।
⇒ अनाज को, धोने, उबालने से Vitamin-B कम हो जाता है।

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⇒ मैदा में विटामिन - B कम होता है।
⇒ मक्का को छोड़कर अनाज में Vita. - A या Vita-C नहीं होता है।
⇒ अनाज के दानों के तेल विटामिन - E से भरपुर होते हैं।

Enzyme :- एमाइलेज, प्रोटीज, लिपेज और ऑक्सीडो - रिडक्टेस महत्त्वपूर्ण एन्जाइम हैं।

⇒ अंकुरण होने पर एमाइलेज बढ़ जाता है।
⇒ germ में प्रोटीज अपेक्षाकृत अधिक।
⇒ Indian Council of medical Research के अनुसार चावल की तुलना में fox tail = millet में = 81% protein
⇒ little millet में 84% से अधिक वसा, higher fiber = ~~12/1229~~ % से अधिक मात्रा में आयरन, higher fat = 350%
⇒ little millet में 840% से अधिक वसा, higher fiber 350% और 1229% अधिक मात्रा में आयरन होता है।

Cereal	Moisture %	Carbo.	Protein	fat
Wheat	11%	69	13	2
Rice	11%	65	8	2
Corn	11%	72	10	4
Sorghum	11%	70	12	4
Barley	14%	63	12	2
Oats	13%	58	10	5
Rye	11%	71	12	2

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* Wheat :-

⇒ गेहूँ की जीनस = ट्रिटिकम
⇒ प्रजातियाँ = 30,000
⇒ ट्रिटिकम एस्टीवम (95%)
⇒ ट्रिटिकम ड्यूरम (4%)
⇒ ट्रिटिकम डाइकोकम (1%)
⇒ इसका उपयोग बेकरी, पास्ता उत्पाद।
⇒ गेहूँ का दाना = 1/8 - 1/4 इंच लम्बा।

Wheat structure

(1) Bran = 14.5 - 15%
(2) Endosperm = 83%
(3) germ = 2.5%

⇒ अनाज फलों या फूलों से विकसित होता है जो कि ब्रैक्ट्स या पत्तियों की एक जोड़ी में होते हैं, जिन्हे जेम्मा और पेलिया कहा जाता है।

⇒ गेहूँ का फल प्रकार :- कैरियोप्सिस।
⇒ बीज में Seed Coat, germ or endosperm होते हैं।

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(1) Bran / pericarp :- बाहरी परत पतली दीवारों वाली, लम्बी, आयताकार कोशिकाओं से बनी होती है, जिसे Epidermis कहते हैं।

⇒ ~~Epidermis~~ Epidermis में विटामिन - B से भरपूर।

⇒ Epidermis के बगल में अलग - अलग मोटाई का हाइपोडर्म होता है।

⇒ pericarp (फलभित्ति) की आन्तरिक परत बीज के पकने के दौरान टूट जाती है

⇒ परिपक्व ~~कोशिकाओं~~ अनाज में उन्हे ट्यूब कोशिकाओं नामक हाइफा जैसी कोशिकाओं द्वारा ~~क~~ दर्शाया जाता है।

⇒ बीजावरण या टेस्टा एक पतली एक्स या दोहरी परत होती है।

⇒ गेहूँ के टेस्टा की भीतरी परत प्राय: गहरे रंजित होती है जो अनाज को विशिष्ट रंग प्रदान करती है।

⇒ टेस्टा के बगल में सेलुलर संरचना से रहित हाइलिन परत है जो रंगहीन है।

⇒ टेस्टा का रंग भूरा होता है।

(2) Endosperm :- इसमें विभिन्न आकार, विभिन्न संरचना की कोशिका होती हैं

⇒ Endosperm कोशिका में मुख्य रूप से starch or protein होते हैं

⇒ यह Bran व germ के हटाने पर प्राप्त होता है;

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⇒ Starch गोलाकार कणिकाओं के रूप में होता है।

⇒ Endosperm कोशिकाओं में स्टार्च के दाने का आकार अनाज से भिन्न होता है।

⇒ Endosperm मैदा है।

Aleurone cell layer :- Endosperm कोशिकाओं की एक या अधिक परतों से घिरा होता है, जिसे एल्यूरोन कहते हैं।

⇒ गेहूँ में एल्यूरोन मोटी दीवार वाली कक्षीय कोशिकाओं की एक परत होती है अनाज के भार का 7% होती है।

⇒ कोशिकाओं में लगभग 20% protein, तेल और खनिज पदार्थ होते हैं।

⇒ एल्यूरोन कोशिकाओं में प्रोटीन के साथ फाइटिक एसिड के छोटे दाने भी होते हैं।

(3) germ :- germ में कई भाग होते ~~है~~ हैं।

⇒ स्कुटेलम द्वारा Endosperm से अलग किया जाता है

⇒ जो Endosperm में संग्रहित भोजन को जुटाने और अनाज के अंकुरित होने पर यह भ्रूण / germ तक पहुँचाने का कार्य करता है।

⇒ germ और स्कुटेलम protein or fat से भरपूर।

⇒ अनाज में अधिकांश vita-B स्कुटेलम में मौजूद।

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⇒ लिपिड, प्लांट स्टेरोल, विटामिन-E और अन्य एन्टी ऑक्सीडेन्ट भी Jeum में पाये जाते हैं।

⇒ Jeum में तेल होता है जो आटे की गुणवत्ता को कम करता है। इसलिए मिलिंग प्रक्रिया के दौरान Jeum को हटाया जाता है।

Diagram

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Wheat types

1) Hard wheat :- ग्लूटेन की मात्रा ↑es.

⇒ इसमें Endosperm होता है जिसमे protein में Starch cell भरी होती है।

⇒ ट्रिटिकम एस्टिवम के नाम से भी जाना जाता है।

⇒ Protein अधिक।

⇒ इस आटे का use रोटी बनाने में किया जाता है।

2) Soft wheat :- ग्लूटेन की मात्रा ↓es.

⇒ इसमे एक कम कॉम्पैक्ट स्टार्च - प्रोटीन कॉम्प्लेक्स होता है जिसके कारण स्टार्च की क्षति कम होती है और पानी का अवशोषण कम होता है।

⇒ इसे ट्रिटिकम कॉम्पेक्टम के नाम से भी जाना जाता है।

⇒ Protein ↓es.

⇒ उपयोग :- बिस्कुट, केक और पेस्ट्री के उत्पादन में किया जाता है।

3) Durum wheat :- सबसे कठोर गेहूँ होता है।

⇒ पास्ता व मैकरोनी के लिए उपयुक्त।

⇒ यह एक हल्के पीले रंग का दानेदार आटा होता है जिसे सूजी के रूप में जाना जाता है।

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⇒ प्रोटीन और ग्लूटेन से भरपूर होता है।
⇒ उपयोग - सूजी और मैकरोनी तैयार करने के लिए।
⇒ गेहूँ की तीन प्रजाति इसके अन्दर आती है।

Suitability of wheat flour for particular End use :-

(1) Indian wheat flours :-

wheat powder / flour = germ, endosperm and Bran का मिश्रण।

Atta flour = endosperm and bran का मिश्रण।
Maida flour = endosperm से बना हुआ।

Sooji / rava = ground endosperm से बना हुआ।

(2) plain flour :- एक मिश्रित गेहूँ है।
⇒ इसमें Bread flour की तुलना में कम प्रोटीन = 9-12%.
⇒ यह Soft व Hard wheat दोनों का मिश्रण होता है।
⇒ इसे बेकर्स के आटे के रूप में बेचा जाता है।

(3) Bread flour / strong flour :- यह Hard wheat से बनाया जाता है।
⇒ High protein Content = 10-30%.

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✱ gluten ✱

⇒ ग्लूटेन एक मिश्रित प्रोटीन है। जो गेहूँ or सम्बन्धित प्रोटीन में पाया जाता है।

ग्लूटेन = ग्लूटेनिन + ग्लियाडिन

ग्लूटेनिन = toughness and rubberiness. (बड़ा प्रोटीन)
ग्लियाडिन = Elasticity (लोच) देता है

⇒ ग्लियाडिन की मात्रा जितनी अधिक होगी, उस उतना ही नरम होगा।

⇒ यह dough को ऊने व अपना आकार बनाए रखने में मदद करता है।

⇒ डाइसल्फाइड (S-S) Bond के कारण ग्लियाडिन और ग्लूटेनिन प्रोटीन की अपनी द्वितीयक संरचना होती है।

⇒ गुंधे हुये आटे के निर्माण में S-S बन्ध मौजूद होते हैं।

⇒ रिडयूसिंग ब्रॉन्ड्स द्वारा S-S व S-H (सल्फाहाइड्री बॉन्ड) के अलावा अन्य प्रकार के Bond भी dough के विकास का कार्य करते हैं।
agent

⇒ ग्लूटेन युक्त- गेहूँ, जौ, सूजी, राई आदि।

Cereals starch :- यह एक पॉलीसेकेराइड है जिसमें ग्लूकोज अणुओं की दोहराई जाने वाली लम्बी शृंखला है।

⇒ अनाज में मुख्य कार्बोहाइड्रेट है।

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⇒ स्टार्च दो प्रकार का होता है।
⇒ रैखिक को एमाइलेज और शाखित को एमाइलोपेक्टिन कहा जाता है।
⇒ एमाइलेज पानी में घुलनशील।
⇒ स्टार्च की जेलिंग क्षमता एमाइलोज सामग्री पर निर्भर करती है
⇒ एमाइलेज ($C_1 - C_4$ linkage)
⇒ एमाइलोपेक्टिन ($C_1 - C_6$ ")

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☆ Effect of moist heat :-

(1) Gelatinisation :-

⇒ स्टार्च के दाने ठण्डे पानी में आसानी से नही घुलते है,
⇒ स्टार्च को पानी के साथ मिक्स करके 70-80°c का Heat देते है।

⇒ जिससे एमाइलेज के बीच इन्ट्रामोलेक्युलर H-Bond टूट जाता है और अनाज पानी को अवशोषित करता है जिससे स्टार्च के दाने फूल जाते है और viscosity बढ जाती है।

⇒ आमतौर पर जिलेटीनाइजेशन की प्रक्रिया 88-92°c पर पूरी होती है।

⇒ Starch + Amaelo pectine = Blue Colour.

Starch

एमाइलोज (20-25%) — एमाइलो पेक्टीन (70-75%)

factors affecting gelatinisation :-

(1) Temperature and time of heating.
(2) Proportions of starch
(3) Types of starch.

ताप से सम्पर्क करते है तो H-Bond टूट जाता है और इनका रंग चेन्ज होकर ब्राउन हो जाता है।

(4) Agitation or stirring.
(5) Acid.
(6) fats and proteins.

(2) Retrogradation:- यह प्रक्रिया तब होती है जब पके हुए जिलेटिन युक्त स्टार्च में एमाइलेज और एमाइलोपेक्टिन शृंखला पके हुए स्टार्च के ठण्डा होने पर खुद को व्यवस्थित करते है।

⇒ जब स्टार्च को गर्म किया जाता है और पानी में घोला जाता है तो एमाइलोज और एमाइलोपेक्टिन अणुओं की क्रिस्टलीय संरचना खो बैठती है और वे चिपचिपा घोल बनाने के लिए हाइड्रेट हो जाते है।

⇒ यदि चिपचिपे घोल को ठण्डा किया जाता या लम्बे समय तक कम तापमान पर छोड़ दिया जाता है तो अणु, एमाइलोज और एमाइलोपेक्टिन डी रेडीग्रेड हो जाते है और खुद को एक अधिक क्रिस्टलीय संरचना में फिर से व्यवस्थित कर लेते है।

⇒ रेट्रोगेशन बहुलक नेटवर्क से पानी को बाहर निकाल सकता है इस प्रक्रिया को सिनेरेसिस के रूप में जाना जाता है।

⇒ चीनी, ग्लूकोज, सोडियम नाइट्रेट और इमल्सीफायर स्टार्च के Retrogradation को कम कर सकते है।

Dextrinization:- यह एक Dry Heat Method है।

⇒ जब हम Heat देते है तो glucose टूटता है और डेक्सट्रिन बनाता है। glucose में एमाइलोपेक्टिन और एमाइलेज होते है जो H-Bond से Attach होते है जब वह-

Difference	Cereals	Millets
(1) मूल	ग्रीक भाषा से लिया गया है।	अनाज की कई प्रजातियों के रूप में जाना जाता है।
(2) पोषक तत्वों का महत्व	कार्बोहाइड्रेट से भरपूर (60-70%) और इसमें वसा, प्रोटीन, विटामिन भी होते हैं।	जैसे खनिज P, K, Mg उच्च मात्रा में, वसा, प्रोटीन और विटामिन जैसे पोषक तत्व भी होते हैं।
(3) पाचन	पचने में आसान नहीं।	आसानी से पचने वाला।
(4) विशेष विवरण	मुख्य फसल के रूप में उगाई जाती है, जिसमें बड़े दाने होते हैं अच्छी मिट्टी में उगाई जाती है।	मिश्रित फसल के रूप में उगाई जाती है; जिसके दाने छोटे और खराब मिट्टी में उगाई जाती है।
(5) वर्षा की आवश्यकता	अच्छी मात्रा में वर्षा की आवश्यकता होती है।	कम वर्षा की आवश्यकता होती है।
(6) सूखा प्रतिरोधी	ये शुष्क क्षेत्रों में नहीं उगते हैं।	ये शुष्क क्षेत्रों में उगते हैं।
(7) आर्थिक महत्व	उच्च स्तर पर	कम ~~के~~ महत्वपूर्ण
(8) प्रकार	जई, चावल, राई, जौ, मक्का, गेहूँ, ज्वार आदि।	जैसे बाजरा, बाजरा, ज्वार, रागी, फॉक्सटेल बाजरा आदि।

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⇒ यह प्रोटीन से भरपूर होता है।

⇒ गेहूं की तीन प्रजाति इसके अन्तर्गत आती है।

* Product of wheat *

(1) Whole wheat flour :- Bran बारीक पिसी हुई व. germ व endospeum होता है।

⇒ germ में High fat होता है कभी-कभी खराब स्थिति में भंडारण में बासी हो जाती है।

⇒ यह न केवल Protein की मात्रा व गुणवत्ता में सुधार करता है बल्कि आटे में नमी बनाए रखने और कम तेल अवशोषण जैसी कार्यात्मक विशेषताओं को भी बढ़ाता है।

⇒ आयरन की कमी से होने वाले एनीमिया को रोकने के लिए सफलतापूर्वक उपयोग।

(2) Maida :- मैदा बनाने के लिए जर्म और ~~के~~ मैदा को अलग कर लिया जाता है।

⇒ स्वाद में अधिक नरम और आसानी से पचने वाला होता है।

⇒ इसे एयर टाइट कंटेनर में रेफ्रिजरेटर में स्टोर किया जा सकता है।

(3) Semolina :- Endospeum दरदरा पिसा होता है।

⇒ सफेद आटे के समान होता है।

⇒ मैकरोनी उत्पादों में उपयोग।

⇒ कीड़ों से बचाने के लिए भण्डारण से पहले भुना जाता है।

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Macaroni products :- इसे पास्ता या प्राथमिक पेस्ट भी कहते हैं।

⇒ इसमें मैकरोनी, स्पैगेटी, सेवई और नूडल्स शामिल है।

⇒ मैकरोनी एक ट्यूब, स्पैगेटी रॉड हो सकती है; सेवई एक छोटी छड़ है or नूडल्स फ्लैट स्ट्रिप्स है।

Glutamic acid :- गेहूँ से प्राप्त होता है।

⇒ ग्लूटैमिक एसिड का एक यौगिक मोनोसोडियम ग्लूटामेट है।

⇒ नमक जैसा उत्पाद है सीजनिंग का स्वाद लाने के लिए इसका use किया जाता है।

Wheat germ :- गेहूँ के दाने का 2-3% wheat germ होता है।

Wheat Bran :- यह Bran की जल धारण क्षमता को बढ़ाकर मल के वजन को बढ़ाता है। Bran कब्ज को रोकता है।

⇒ कोलन कैंसर को कम करता है।

* Wheat flour :- गेहूँ के Cernal में Bran, endosperm, germ होते है।

⇒ Bran wheat का Hard बाहरी आवरण होता है।

⇒ पेरिकार्प, बीजकोट, हाइलिन, एल्यूरोन परत को वानस्पतिक रूप से कई परतों के कोट के रूप में जाना जाता है।

⇒ fiber व पोषक तत्व ↑

⇒ Endosperm = 80% ↑

Pules

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⇒ pules में unavailable sugars के रूप में raffinose family के Oligosaccharides पाए जाते हैं। जो मनुष्य में पेट फूलना पैदा करते हैं।

⇒ fermentation, germination, Cooking, soaking and autoclaving Oligosaccharides को कम करता है।

(3) protein :- pulses में मुख्य रूप से ग्लोब्युलिन प्रोटीन होते हैं लेकिन कुछ प्रजातियों में एल्बुमिन भी मौजुद होते हैं।

⇒ pules protein में सल्फर युक्त amino acid की कमी होती है।

⇒ pules में लाइसीन की अधिकता व मिथीयोनिन व ट्रिप्टोफेन की कमी होती है।

Fat :- pulses contain = 1-5%.

⇒ इसमें उच्च मात्रा में polyunsaturated fatty acids होते हैं।

⇒ लिनोलिक एसिड से अधिकांश फलीदार बीज के तेलो में लिनोलेनिक एसिड का उच्च अनुपात होता है। जो भण्डारण के दौरान Oxidative rancidity को कम करते हैं जिसके कारण protein solubility का नुकसान होता है।

⇒ Oleic, स्टीयरिक और पामिटिक एसिड भी मौजूद है।

Minerals:- Ca, Mg, Zn, Fe, K, P.

⇒ 80% फॉस्फोरस फाईटेट के रूप में मौजूद होता है।

⇒ Cooking, Soaking, germination and fermentation के द्वारा फाईटिन की मात्रा को कम या समाप्त कर सकते है।

Vitamins :- legume के Seeds विटामिन-B कॉम्प्लेक्स, थायमिन, फोलिक एसिड और पैंटोथेनिक एसिड का उत्कृष्ट स्रोत है।

⇒ Cereals की तरह इनमें कोई Vita-A या Vita-C नहीं होता है लेकिन अंकुरित फलियों में Vita--C होता है।

Antioxidant activity:- Rajmah and Soyabeen में अन्य दालों की तुलना में ज्यादा Antioxidant value होती है।

⇒ Bangal gram dal (Roasted) में सबसे कम Antioxidant होते है।

⇒ Boiling and pressure cooking से whole gram, green gram, black gram and Bengal gram को पकाने से की फेनोलिक सामग्री बढ़ जाती है।

Soaking and sprouting करने से मूंग में फेनोलिक सामग्री बढ़ जाती है।

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glycaemic index :- Beans, peas, lentils और अन्य दालों में ग्लाइसेमिक index कम होता है।

⇒ legumes आमतौर पर protein से भरपूर होती है और उच्च fibre प्रदान करती है। और इसमें एन्जाइम अवरोधक होते हैं इसलिए ग्लाइसेमिक इन्डेक्स कम होता है।

☆ pulse cookery :- India में 80% pulses का consumed dal or besan के रूप में होता है।

⇒ शेष 20% whole seed के रूप में।

⇒ pulse को cook करने में cereals की तुलना में longer time लगता है।

⇒ pulses को cook करने से softness प्राप्त होती है। और volume increase व texture improve होता है।

⇒ pulses वाले खाद्य पदार्थ बनावट में चिपचिपे और अनाकर्षक (unattractive) होते हैं।

⇒ खाना पकाने के दौरान ~~गर्मी~~ heat treatment दिया जाता है जो व्यक्तिगत कोशिकाओं को अलग करने की अनुमति देने के लिए Middle lamella को हीला करने के Intercellular Matrix में मदद करता है।

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⇒ कोशिकाओं का पृथक्करण Mg और Ca की Middle lamella के पेक्टिनोसियम Matrix से सम्बन्धित स्थिति से हटाने हो सकता है।

Effect of Cooking :-

(1) Antinutritional factors :- बिना पके फली के बीज में एन्टीन्यूट्रिशनल फैक्टर होते हैं जिसका बड़ी मात्रा में सेवन करने से विषाक्त हो सकते हैं।

⇒ किडनी, उड़द और सोयाबीन में पॉलीफेनोलिक यौगिकों की मात्रा अधिक होती है।

(2) Protein Quality :- अतिरिक्त Heat bean protein की गुणवत्ता को कम कर देती है।

⇒ दालों की प्रोटीन गुणवत्ता Dry heat treatment की तुलना में Moist Heat द्वारा अधिक सुधारी जाती है।

⇒ भुनी हुई दालों की तुलना में प्रेशर कुकर में पकाई गई दालों में लाइसिन की मात्रा कम होती है।

⇒ Heat treatment से मिथिओनिन की हानि होती है।

(3) Minerals :- खाना पकाने से Ca, Mg और दालों की कम प्रभाव पड़ता Iron Content है।

(4) Vitamins :- Heat लगाने से थायमिन की हानि हो सकती है।

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(5) Colour :- सोडियम मेटाबाइसल्फाइट मसूर के रंग को बनाए रखने में प्रभावी होता है।

⇒ नरसिम्हा और देसिकचारी (1978) द्वारा किए गए अध्ययनों से पता चला है कि खाना पकाने का समय सीधे PCMP सरंचा से सम्बन्धित है।

PCMP = Free pectin + Calcium + Magnesium
2-phytin.

P = पेक्टिन
P = फाइटिन
C = कैल्सियम
Mg = मैग्नीशियम

⇒ factors affecting cooking quality :-

⇒ hardness two types :-

(1) Hard shell (2) Sclerema.

⇒ Hard shell में को physical condition के रूप वर्णित किया जाता है। जिसमें Seed water को Absorb करने में fails रहते हैं।

⇒ Sclerema cotyledons (बीजपत्रों) में होता है जो विभिन्न कारकों से प्रेरित होता है। कुछ किस्में पकाने में कठिन होती हैं।

(6) Inherent Character :-

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⇒ खाना पकाने का समय एक वंशानुगत गुण है जो जीनोटाइप के बीच व्यापक रूप से भिन्न होता है।

⇒ पूरे बीज को पकाने का समय चने में सबसे अधिक होता है। इसके बाद अरहर, काले चने और हरे चने का स्थान आता है।

(2) Environmental factors :- किस्मों के बीच दालों की पकाने की गुणवत्ता में भिन्नता के कारण :-

- location.
- Soil moisture.
- Soil fertility.

(3) Storage Conditions :- Cooking Quality time. temp. और Humidity से प्रभावित होती है।

⇒ ~~Storage time~~

⇒ food को जितने समय तक स्टोर करेंगे, खाना पकाने में समय उतना ही ज्यादा लगेगा।

⇒ 10% से अधिक नमी वाले food को स्टोर करते हैं तो उसकी Cooking Quality में गिरावट आती है।

(4) Seed maturity :- परिपक्वता के समय उच्च तापमान Cooking time को प्रभावित करता है।

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⇒ Seed maturity के में वृद्धि के साथ Cooking time भी बढ़ता है।

⇒ Hard Seed को पकाने में अधिक समय लगता है।

Dehulling :- इससे खाना पकाने का समय 70% कम हो जाता है और पाचनशक्ति बढ़ जाती है।

Soaking :- Cooking Qualities को improve बनाने के लिए साबुत चनों को पानी में भिगोया जाता है।

⇒ इस उपचार के बिना साबुत चना जैसे चने की दाल वांछित गाढ़ेपन तक नहीं पकाया जा सकता है।

Precooking :-

Salts :- पानी के अलावा 1% NaCl व 0.75% युक्त नमक के घोल में बीजो को $NHCO_3$ भिगोकर बीजो की कठोर स्थिति को समाप्त किया जा सकता है।

⇒ कार्बोनेट या बाइकार्बोनेट न केवल क्षार एन्जेट और बफर के रूप कार्य करने के अलावा प्रोटीन को अलग करने वाले घुलनशील या डेडरिंग एजेंट के रूप में भी कार्य करते हैं।

Phytin Content :- मिट्टी में उच्च मात्रा में फॉस्फोरस होता है जो कि मिट्टी में उच्च फाइटिन सामग्री में योगदान देता है जिससे खाना पकाने में मदद मिलती है।

⇒ खाना पकने से दालों पर फाइटिन का नरम प्रभाव पड़ता है जो बीज पत्रों में मौजूद सोडियम / पोटेशियम फाइटेट के बीच प्रतिक्रिया के माध्यम से होता है।

Calcium and Magnesium :-

~~Cellulose~~ :-

Cellulose :- पेलिसेड परत की मोटाई और बीज कोट में लिग्निन और α-सेलुलोज की सामग्री दाल की Cooking Quality का महत्वपूर्ण कारक है।

⇒ Hard Shell के बीज पानी का अवशोषण नहीं करते हैं जिससे दालों के पकने में देरी होती है।

⇒ सोडियम बाइकार्बोनेट सेलुलोज को नरम करता है जिससे खाना तेजी से पकता है।

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☆ Toxic Constituents :-

(1) Trypsin inhibitors :- यह एक प्रोटीन होता है जो आंत में ट्रिप्सिन गतिविधि को रोकते हैं और आहार में प्रोटीन की पाचन क्षमता में बाधा डालते हैं।

⇒ अग्नाशय वृद्धि और विकास मंदता उन जानवरों में होती है जो ट्रिप्सिन अवरोधक युक्त आहार का सेवन करते हैं।

⇒ ये आमतौर पर गर्म होते हैं और Moist heat treatment जैसे प्रेशर कुकिंग उन्हें नष्ट कर देते हैं।

⇒ 120°C पर 15-30 Min. तक ऑटोक्लेव करने से लगभग सभी ट्रिप्सिन अवरोधक निष्क्रिय हो जाते हैं। ~~ये अवरोधक~~

(2) Lathyrogens :- लैथ्रिज्म एक स्नायु रोग है जो मनुष्य को पंगु बना देता है

⇒ यह बीमारी अब लैथिरस सैटिवस पल्स के अत्यधिक सेवन से होती है।

⇒ 15 से 45 वर्ष की आयु के युवा पुरुषों को प्रभावित करता है।

⇒ लैथिरियस को "एवेसारी दल" से जाना जाता है।

⇒ यह छिलके वाले बीज बंगाल चने की दाल या लाल चने की दाल के समान होते हैं इसलिए कभी-कभी अन्य दालों में मिलावट के रूप में केसरी दाल का उपयोग किया जाता है।

लक्षण - मांसपेशियों की कठोरता, कमजोरी
पैर की मांसपेशियों में पैरालायसिस।

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Stages of lathyrism :-

(1) first stage :- यह नॉनस्टिक स्टेज है।

⇒ रोगी अपने शेष जीवन के लिए इस स्थिति में रह सकता है।

(2) Second stage :- मांसपेशियों में अकड़न बढ़ जाती है जिससे मांसपेशि व्यक्ति झुककर चलता है इसके लिए एक छड़ी की आवश्यकता होती है।

⇒ इसे वन - स्टिक स्टेज कहा जाता है।

(3) third stage :- मांसपेशियों की कठोरता इतनी अधिक होती है कि रोगी को सहारा लेने के लिए दो उंडो की आवश्यकता होती है।

⇒ और सन्तुलन बनाए रखने के लिए Pelvis (श्रोणि) को एक तरफ झुका दिया जाता है।

⇒ इसे टू - स्टिक स्टेज कहा जाता है।

(4) final stage :- इस समय रोगी के घुटनों के काफी मुड़ने और जकड़न के कारण सीधा चलने में असमर्थ हो जाता है।

⇒ ये लैथिरिज्म के लिए जिम्मेदार न्यूरोटॉक्सिन β-N-Oxalyl-α, β diamino propionic acid है

⇒ विष को उबालकर हटाया जा सकता है।

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Steeping process (भिगोने की प्रक्रिया):-

→ चार गुना बीजो को पहले उबाला जाता है।
→ Seeds को two hours के लिए Hot water में Soaked किया जाता है।
→ water निकल जाता है।
→ Seeds को Cold fresh water से washed किया जाता है फिर धूप में सुखाया जाता है।
→ इस Method से 80-90% toxic को removed किया जाता है।

parbaling process (हल्का उबालने की प्रक्रिया):-

→ Seeds को 12 Hours के लिए Cold water में भिगोया जाता है।
→ फिर Seeds को 20-30 Min. तक Stemed किया जाता है।
→ Again Seeds को 1 Hours तक Soaked किया जाता है।
→ इस process से भी 80-90% विष बाहर निकल जाता है।

(4) favism:- फेविज्म एक बीमारी है जो हेमोलिटिक एनीमिया की विशेषता है
→ ग्लूकोज-6- फॉस्फेट डिहाइड्रोजनेज की कमी वाले व्यक्ति फैवा बीन्स या ब्रॉड बीन्स का सेवन करते है तब होती है।

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⇒ फैबा बीन्स में अलग-अलग यौगिक होते हैं इनमें से दो ग्लाइकोसाइड्स हैं जिन्हें विसिन और कोविसीन के नाम से जाना जाता है और तीसरा एक एमिनो एसिड डेरिवेटिव है जिसे डायहाइड्रोक्सी फिनाइल एलानिन, DOPA के रूप में जाना जाता है।

⇒ अंकुरित होने और उबालने से ये विषैले पदार्थ कम हो जाते हैं।

(5) हेमाग्लगुटिनिन :- ये प्रकृति में प्रोटीन होते हैं जो कभी-कभी फाइटो एग्लूटीनिन या लेक्टिन के रूप में व्यक्त होते हैं।

⇒ ये फलीदार बीजों में व्यापक रूप से पाए जाते हैं।
⇒ हीमाग्लुटिनिन भोजन का सेवन कम कर देता है जिसके कारण वृद्धि खराब होती है।

⇒ हेमाग्लुटिनिन सोयाबीन, फील्ड बीन, सफेद बीन, उबल बीन और कुल्थी से अलग किये जाते हैं।

(6) Saponins :- ये सोयाबीन में मौजूद होते हैं।

⇒ सैपोनिन्स पानी से हिलाने पर झाग पैदा करते हैं।
⇒ ये उच्च ग्लाइकोसाइड हैं।
⇒ सैपोनिन मतली और उल्टी का कारण बनता है।
⇒ खाना पकाने से पहले भिगोने से समाप्त हो गया।

(7) Goitrogens :- ये पदार्थ थायरॉइड ग्रन्थि द्वारा आयोडीन के अवशोषण में बाधा डालता है

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⇒ ये सोयाबीन और मूंगफली में मौजूद होते हैं।
⇒ इन खाद्य पदार्थों के अत्यधिक सेवन से गोइटर की वर्षा हो सकती है।

(v) Tannins- टैनिन संघनित पॉलीफेनोलिक यौगिक होते हैं

⇒ ये फलियों (अधिकांश) के बीज कोट में (उच्च मात्रा) मौजूद होते हैं।
⇒ टैनिन लोहे के साथ अपरिवर्तनीय रूप से बन्धते हैं और लोहे के अवशोषण में बाधा डालते हैं

⇒ फलियों के बीज आवरण को हटाने से टैनिन की मात्रा कम हो जाती है।
⇒ इस ~~प्रकार~~ प्रकार की उपस्थिति, बनावट, खाना पकाने की गुणवत्ता, स्वाद, अनाज की पाचन क्षमता और पोषक तत्वों की जैव उपलब्धता में सुधार होता है।

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☆ Processing :- Cotyledons (बीजपत्रों) से भूसी (husk) निकालने की प्रक्रिया को छिलका उतारना कहते हैं।

⇒ cleaning, polishing and grading को milling के रूप में जाना जाता है।

⇒ मिलिंग के लिए उपयोग की जाने वाली मशीनरी से मिलिंग के type and Quality को 10-15% नुकसान हो सकता है।

Most Moisture Content :-

Harvesting time = 15-20%
Storage time = 12-14%

⇒ Milling के two major steps :-

(i) भूसी को ढीला करना (loosening of husk)
(ii) भूसी को हटाना और मशीन की मदद से बीजपत्रों में विभाजित करना।

⇒ rules मिलिंग के Methods :-

(1) wet milling (2) Dry method.

(1) Wet milling :- इस विधि में धूल, गन्दगी, भूसी, पत्थर के टुकड़े, अपरिपक्व अनाज और अन्य बीजों को हटाने के लिए सफाई कि जाती है।

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⇒ जिन दालों का छिलका निकलना आसान है उन दालों को 2-8 घंटे के लिए पानी में भिगोया जाता है।

⇒ तथा जिन दालों का छिलका निकालना मुश्किल होता है (अरहर, उड़द, मूंग) उन दालों को लाल मिट्टी से उपचारित किया जाता है।

⇒ इसके बाद दाल को सुखाया जाता है और फिर दाल प्राप्त करने के लिए छिलका और चीरा लगाया जाता है।

(3) Dry milling:- इस विधि में दाल को साफ करने के बाद रोलर डीहस्कर में डाला जाता है जिससे बाहरी बीज कोट पर एक खरोंच या दरार बन जाती है।

⇒ पिसी हुई दाल में सतह पर तेल लगाने के बाद दाल को 1-3 तक रख सकते हैं।

⇒ 100 kg दाल पर 150 x 250 gm तेल लगाया जाता है।

⇒ तेल भूसी और बीजपत्र में फैलकर भूसी को ढीला करने में मदद करता है।

⇒ जल उपचार भूसी को और ढीला करने में मदद करता है।

⇒ फिर दाल को सुखाया जाता है फिर छिलकर विभाजित किया जाता है।

⇒ Home Scale milling:- होम स्केल मिलिंग में दाल को ओखली और मूसल में कूटा जाता है।

⇒ दाल को पानी या तेल से उपचारित करते हैं।

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pulses
↓
Cleaning
↓
Soaking in water
↓
Drying
↓
Dehusking
↓
Spliting
↓
Dal.

Wat Method

pulses
↓
Cleaning
↓
pitting into Roller Dehusker
↓
Oil Smearing
↓
water treatment
↓
polishing
↓
Drying and Cooling
↓
Dehusking
↓
Spliting
↓
Dal. (Dry Method)

⇒ दाल को रातभर पानी में भिगोया जाता है अगले दिन धूप में सुखाया जाता है।
⇒ मूसल और मोटरि या ~~हथ~~ पत्थर की चक्की से भूसी को अलग किया जाता है।
⇒ इसके बाद भूसी को फटककर अलग कर लिया जाता है।

⇒ Commercial scale milling :-

(i) Cleaning and grading :- मिल से प्राप्त होने वाली दालों को साफ

करने और उच्च गुणवत्ता की दाल प्राप्त करने के लिए आकार में वर्गीकृत करने की आवश्यकता है।

⇒ छिलका उतारने की क्रिया के दौरान दालों का छिलका, टूटी, फटी हुई दाल, भूसी वाली दाल (भूसा) बिना छिलके वाली दालों को अलग किया जाता है।

⇒ दो क्लीनर का उपयोग किया जाता है-
(1) रेसिप्रोकेटिंग एयर स्क्रीन
(2) रील स्क्रीन

⇒ रेसिप्रोकेटिंग में हवा को दो छलनी के माध्यम से उड़ाया जाता है जो धूल, डंठल, सूखे पत्ते आदि को अलग करते हैं।
⇒ ऊपरी छलनी में बड़े छिद्र व दूसरी छलनी में छोटे छिद्र होते हैं।

(2) Drying :- मिल से प्राप्त होने वाली दालों में नमी की मात्रा ज्यादा होती है इसको कम करने के लिए दाल को सुखाया जाता है।

⇒ छिलका ढीला करने के लिए दालों को पानी में भिगोने के बाद सुखाया जाता है।
⇒ बीजपत्रों को अलग करने के लिए दालों को सुखाना बहुत आवश्यक है।
⇒ Drying के लिए गर्म हवा का तापमान 60°C - 120°C तक भिन्न होता है।

(3) Loosening of husk :- भूसी को ढीला करने के दो अलग-अलग तरीके हैं।
(1) गीली विधि (2) शुष्क विधि।

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(4) Dehusking :- कोटेड रोलर डीहस्कर्स का उपयोग दालो को डीहस्क (छिलका उतारने के) करने के लिए किया जाता है।
(छिलका उतारना)

(5) Splitting :- इस प्रक्रिया में बीजपत्रों के बीच बन्धन को ढीला किया जाता है।

⇒ दाल को 2-12 घण्टे के लिए पानी में भिगोकर बाद में 4-8 घण्टे के लिए धूप में सुखाया जाता है।

⇒ स्पिलटिंग के लिए अडंर रन डिस्क रोलर (URD), इम्पैक्ट मशीन, रोलर मिल जैसी मशीन का उपयोग किया जाता है। जिससे दो बीजपत्रों से पुड़ा भ्रूण टूट जाता है, जिससे दाल की रिकवरी में 1.5-2% की कमी हो जाती है।

Soaking :- कई दाली का बाहरी आवरण कठोर होता है उन्हे पकाने से पहले भिगोने की आवश्यकता होती है जिससे पानी छिलके के माध्यम से बीज कोट में भर जाता है।

→ साबुत दाल को रात भर गर्म पानी (60-70°C) या ठंडे पानी मे 4-5 घण्टे तक भिगोते है।

→ भिगोने से नाडी कोमल होती है।
→ यह फाइटिक एसिड और ओलिगोसेकेराइड को भी कम करता है।
→ मूंग, लोबिया बिना भिगोये ही अच्छी तरह पक जाते है।

→ Rehydration से moisture 10% से बढ़कर 60-70% हो जाती है।

→ जब फलियां गर्म या ठंडे पानी के सम्पर्क में होती है तो फलियो से पानी मे घुलने वाले कुछ पोषक तत्व ~~नष्ट~~ ~~हो~~ पानी मे चले जाते है।

→ इन नुकसानो को कम करने के लिए भिगोने के लिये जो पानी लिया जाता है उस पानी को खाना पकाने मे काम मे लिया जाता है।

Germination :- साबुत चने को रात भर पानी मे भिगोकर पानी निकाल देना चाहिए और बीजो को एक सूती कपड़े मे बांधकर लटका देना चाहिए और दिन में दो-तीन बार

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जल का छिड़काव करना चाहिए। जिससे एक-दो में अंकुरण हो जाता है।

⇒ अंकुरण के लिए नमी व गर्मी की आवश्यकता होती है।

⇒ मुंग को कम समय में अंकुरित किया जा सकता है।

⇒ गर्मियों में अंकुरण सर्दियों की तुलना में ज्यादा होता है।

Advantages :-

(1) अंकुरण के दौरान पोषक मूल्य मे सुधार होता है, निष्क्रिय एन्जाइम सक्रिय हो जाते है, पाचनशक्ति मे सुधार होता है।

(2) अंकुरण एन्जाइमो के कारण ट्रिप्सिन अवरोधक कारकों को कम करता है।

(3) अंकुरित बीजो मे माल्टोज की मात्रा अधिक होती है।

(4) अंकुरण के दौरान साइटेस और पेक्टिनेज की क्रिया जारी होती है और कोशिकाभित्ती टूट जाती है, और पोषक तत्वों की उपलब्धता बढ़ जाती है।

(5) अंकुरित होने से खाना पकाने का समय कम हो जाता है।

(6) अनाज के अंकुरित होने और सूखने पर छिलका ~~उतारना~~ उतारना आसान हो जाता है।

(7) अंकुरण ऑलिगोसैकेराइडस को मेटाबोलाइज करता है। जिससे पेट नहीं फूलता है।

(8) स्वाद और बनावट में सुधार।

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fermentation :- यह प्रक्रिया पाचनशक्ति को बढ़ाती है।

⇒ यह खाना पकाने की प्रक्रिया को बढ़ाते है।
⇒ यह स्वादिष्टता और Vitamin-B व C में भी सुधार करता है।
⇒ किण्वन के द्वारा दालो के विषैले पदार्थो को समाप्त किया जा सकता है।
⇒ आवश्यक एमीनो एसिड की उपलब्धता मे सुधार करता है।

Parching and puffing :-

FISH AND POULTRY

The unit should be constructed with adequate infrastructure facilities like good lighting, proper ventilation, adequate potable water and proper drainage system for hygienic processing of chicken meat. Separate space must be provided for handling meat and other edible offal whereas separate area to be provided for unclean operations such scalding, de-feathering and evisceration to handle inedible parts of the slaughtered birds. Sufficient facilities are to be provided for chilling/storing the carcasses. The walls and floor must be easily cleanable in nature.

1. Hygienic slaughter of birds: Birds must be fasted for 12 hours prior to slaughter, but provide adlibidum water, which facilitates to minimize the microbial load in the intestine of the birds to reduce the risk of contamination during evisceration.

2. Stunning: Hang the birds for slaughter in such a way for easy stunning. By stunning the birds, maximum blood can be removed from the carcass which helps in extending the shelf life of the meat.

3. Bleeding: Immediately after stunning, the birds must be stuck with a sharp knife by serving kthe major blood vessel sin the neck. Allow 2-3 minutes for bleeding. Provide bleeding cones for hygienic and aesthetic removal of blood.

4. De-feathering: De-skinning is one of the methods and more safe method of removing the feather as the chances of microbial contamination is less in this method. But, commonly the slaughtered birds are scaled by dipping in hot water of 50-60oC which loosens the feather and by hand picking the feathers will be removed. Scalding tanks as well as de-feathering machines are available for removal of feathers in a more hygienic way.

5. Evisceration: Eviscerate the carcass as quick as possible by removing the anal gland followed by opening the abdomen next to the keel bone and remove the visceral organs and collect the edible and inedible offal separately for easily processing and delivery. 6. Washing of carcass: After evisceration, the carcass is looked for any change in color, or / and abnormality and the carcass without any deviation is allowed for further processing. Remove the neck. Wash the carcass thoroughly with potable water. 7. Storage: In most of the days the meat will be sold immediately. If it doesn't happen chilling the carcass to 4oC in a chiller/refrigerator. In case of small processors keep the meat in the insulated boxes with ice.

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Equipments used in lab

Direction for using the common equipments

1. Balance
- Set the balance to zero before weighing
- Do not take weight directly on the pans. always use lightweight plates or cups for weighing the ingredients.
- Bring the food to the plate gradually till the required weight is shown on the scale.
- Avoid spilling while weighing
- Always read the balance at the eye level.
- After weighing, the extra food material should be kept back in the supply container
- Do not take away the pans from the balance
- clean the balance and the table after use.

2. Measuring cups & spoons:
- Use metallic measuring cups for measuring solids and glass/plastic cups for liquid.
- Measure liquid at eye level.
- Fill material like flour and sugar lightly & never shake or press. Use a straight edged

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knife or a spatula to level the surface.
- Measure solid fat by packing tightly into the cup or spoon, leaving no air space in
- Use measuring spoon & cups only for measurement and not for any other purpose e.g. transferring the food items or for storing the used/unused food items.
- After use, clean and return them to the storage place.

3. Pressure cooker
- Clean the cooker before use.
- Keep the air vent clean, to avoid explosion.
- When more than one foodstuff has to be cooked always use separate container.
- Add required amount of water in the cooker before placing the food inside.
- close the tightly according to instruction given.
- Allow steam to come out before the pressure weight is inserted.
- In order to get good result keep the cooker on the fire for specified period of time for each food.
- Keep the cooker on the fire.
- Slow down the fire when the whistle start blowing.
- Reduce the pressure slowly before opening the cooker
- Keep the cooker open while not in use to remove the flavour of food

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4. Oven

A. Electric oven

- Heat the oven for a few minutes before placing the food for baking
- Adjust the temperature as required in the recipe
- Do not spill the food in the oven while inserting the container
- If spilled clean immediately.
- Note the timming for best result.
- Do not open the oven in b/w as it affects the quality of the baked products.
- Remove the baked product only after switching off the oven.
- Leave the door half open for cooking the oven.
- Always use the right type of baking pan to avoid overflowing & also to get the desired result.
- Do not store any food in the oven.

B. Microwave oven

- Microwave oven heats by radiation, but it uses a monochromatic form of electromagnetic wave frequency. Microwave generator (magnetron) capable of converting electric power into microwave. The microwave causes the moisture molecule of food to vibrate vigorously about 2450 million times a second. the resulting friction causes heating of

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food at 400°f. But the container (moisture free) are not similarly affected absorbing them. Cooking is nearly ten times faster in it.

C_5 Non-Electrical oven.

- They are generally made up of Tin, G.I sheet, aluminium etc. having no attachment for regulation or to control the temperature and time for baking.

- clean and keep the oven on the fire to heat it.
- keep the bricks inside the oven to maintain heat.
- Insert a piece of white paper inside the oven and see that it changes the colour within a few minutes. This indicate that the oven is ready for baking.
- keep the mix ready in the container and place it on the hot bricks.
- close the door and notes the timmings.
- Do not open the door in b/w to avoid variations in the temperature.
- After the prescribed time, check the product
- Remove the food and put off the fire
- Allow the oven to cool down by leaving the lid / door open

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5. Gas Tandoor
- Open the tandoor and clean the inside portion with a cloth.
- Cover the lid and keep on the fire for few minute to heat it.
- When hot, keep the ingredients for baking
- Do not open in between
- After the prescribed time, check the food, if done, put off the fire.
- Remove the food and clean the tandoor before storing.

6. Solar cooker
it consist of a box insulted on all side expect the upper face where double glass cover is provided for intercepting solar radiation. the cooker is so designed that blackened surface absorb the insulation and convert into heat which is used for the cooking of food. it saves fuel and organoleptic qualities of food when used properly. solar cooker is used for boiling, roasting, baking and can also be used as hot case for at least 250-300 days in a year.

7. Refrigerator: has two parts
the upper part or the freezer which is used for freezing or storing frozen food and the lower

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part is used for storing perishable foods.
- Do not store hot food in the refrigerator
- Food should be covered before placing in the refrigerator. this will prevent the transfer of moisture and flavour from the food. this also increase the storage life of food.
- Store the food in proper container.
- do not open the door very frequently as it bring variation in the temperature.
- If too much of ice is deposited in the freezer, it should be defrosted according to the instruction given in the operation manual of refrigerator.
- Complete cleaning of refrigerator improves its efficiency.

8 Electric Blender
- Blender is used for mixing beverages preparing vegetables for cream, soup and for blending of fruit & vegetable.

⇒ Points to remember while using blender

- Set the motor to off position
- Fix the jar properly in place and check it before use.
- Fill the jar 1/3 and place the lid.
- Be sure to have sufficient liquid in it.

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- Start the with low speed and then increase the speed gradually.
- Do not operate the motor for longer periods. If required to operate for longer period stop the motor in b/w as to avoid generation of too much heat.
- Do not open the lid when the motor is on.
- Transfer the food in another container and clean the jar properly with soap and warm water.
- While cleaning, avoid wetting the motor.

9. Juice Extractor (electric juicer)

- open the extractor and clean thoroughly
- Fix it back to the motor properly
- Remove the pressure and place the food.
- Put the pressure with proper back and switch on the motor
- Hold the pressure with downward force.
- Collect the juice in the proper container
- Switch off the motor and open the extractor, clean, dry and fix back before storing.

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Stocks

The preparation of stocks has been simplified in many ways since the days of Escoffier, although this does not mean it demands less care or skill. Few chefs today bother to tie vegetables for a stock into a bundle, for example. They're going to be strained out anyway. The number and variety of ingredients is usually not as great as it once was. Nor is it common to cook stocks for as many hours as was once thought necessary. All these details are taken up one by one in this section. A stock may be defined as a clear, thin—that is, unthickened—liquid flavored by soluble substances extracted from meat, poultry, and fish, and their bones, and from vegetables and seasonings. Our objective in preparing stocks is to select the proper ingredients and then to extract the flavors we want—in other words, to combine the correct ingredients with the correct procedure.

Glaze Sauce

A glaze is basically just a cooked sauce. It can be used on vegetables or proteins. The important thing is that it has a sweet element, like honey or sugar. As the glaze cooks down this sweet element caramelizes, gets sticky, and forms a beautiful glossy coat on whatever you're cooking.

SOUP: EIGHT GARNISHES

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With just the right garnish, a simple soup becomes a nuanced dish awash in flavor. Local cookbook author Becky Selengut shares some of her favorites.

Caramelized onions

A sweet garnish that marries well with earthy soups, such as lentil, bean or parsnip.

Crispy sage leaves

Delicious with squash soups. Remove leaves from stems and fry in an inch of oil over high heat until they turn from light green to dark. Drain on a paper towel.

Stone-ground mustard

Stir a tiny bit with a good drizzle of olive oil (or sour cream, or crème fraîche) into lentil or sausage soups just before serving.

Herbal pesto

Add a dollop to any vegetable- or tomato-based soup. Any bright green herbal-nut mixture will work well, from traditional basil and pine nut to mint and pistachio.

Poached eggs

A sweet garnish that marries well with earthy soups, such as lentil, bean or parsnip.

Toasted dried ancho or pasilla chiles

Toast quickly in a pan, let cool, crush and sprinkle over tortilla soup along with the traditional (lime wedges, tortilla chips, cilantro and sliced avocado).

Cashew cream

A creamy and delicious nondairy garnish to balance spicy soups. Find whole cashews in our bulk section, then make it at home with this easy recipe.

Morels

Saute with a little preserved lemon, put a bit in a bowl and pour asparagus soup around it for a lovely presentation. Try dried morels, available in our grocery aisles, when fresh are not available.

27. COOKING OF FOODS

Some foods like fruits, vegetables and nuts are eaten raw. It is good that they are consumed raw as in the uncooked condition they retain most of their nutritive value. However, most foods are cooked before they are accepted. Cooking of food is the use of heat to bring about desirable changes in foods being consumed. The source of heat may be the result of combustion of wood, coal, gas or oil; by electric heating elements contained in hot plates or electric ovens; or by a microwave cooker.

27.1 Objectives of Cooking Food

Cooking of food produces improvement in flavour, texture, and appearance, and this makes the food more palatable and easily digestible. Most foods in the raw state contain harmful microorganisms and they are destroyed during cooking.

27.1.1 Improvement of Food Quality Cooking improves the natural flavour of food, e.g., the flavour of meat is developed and enhanced by heating; the flavour of bread develops in the crust during baking; coffee flavour is formed during the roasting of green coffee, and so on. If a blend of flavours is required, several foods could be cooked together to bring about this. If the object is to change the flavour of a food, cooking helps achieve this by addition of required flavouring material. Cooking could also destroy the flavour of a food. In such a case, if the original flavour of a food is to be retained, there should be minimum cooking. Overcooking results in the volatilization of flavour substances and a less desired product may be obtained. Colour and texture also influence flavour. Cooking helps develop the desired colour and texture in foods.

27.1.2 Destruction of Microorganisms Microorganisms are ubiquitous in their distribution; they are found everywhere in every environment, and adapt themselves to almost every growth condition. They make their presence known in many ways. Their action may be beneficial as in the production of cheese, pickles, leavening of bread, etc., or harmful as in food spoilage.

The latter type of microorganisms are not normally present as food contaminants. When present they cause infections or produce toxins. Infective types of bacteria, such as *Salmonella* and *Shigella*, multiply in the intestinal tract and cause disease through the infection of the host. In contrast, bacteria like *Staphylococcus aureus* and *Clostridium botulinum* produce the toxins present in the food at the time of consumption and are the direct causes of illness. Food storage under conditions that prevent bacterial growth do not provide safety against infective pathogens but do so against toxinogenic food poisons.

Molds also produce toxins. The mold *Aspergillus flavus* produces a toxin (aflatoxin) which, when present in food, is a health hazard. There are many other molds producing toxins referred to as mycotoxins. One of the most important methods of protection of food against harmful microorganisms is by the application of heat. Cooking food to the required temperature for a required length of time can destroy all harmful microorganisms in foods.

27.2 Methods of Cooking

Heat may be transferred to the food by conduction, convection, radiation or by the energy of microwaves (electronic heat transfer). Conduction is the method of transfer of heat by contact. Convection is the transfer of heat as a result of the flow of a liquid or gas travelling from the hotter to a less hot part of an oven or saucepan. Radiation is the emission of heat in the form of waves from hot objects. Microwaves are a form of electromagnetic radiations similar to radio, TV, radar, light and infrared waves.

27.2.1 Conduction In conduction, heat flows from the source to the material absorbing it. Certain materials are better conductors of heat than others. Copper utensils are the best conductors; aluminium ones conduct heat more slowly, and steel ones still more slowly. Glass is a very much less efficient conductor of heat than any of the metals. For efficient conduction to take place from a hot surface to another surface, such as the bottom of a saucepan, it is important that there is as large an area of contact as possible. Hence, the bottoms of pans should be flat and thick.

27.2.2 Convection When a liquid or air is heated, the portions nearest to the heat become warm and less dense. They rise and are replaced by the denser material, i.e., convection currents flow from a more dense to less dense areas. The convection currents usually flow in a vertical direction and they are hindered by solid materials. Roasting is mainly accomplished by convection. The heat source at the bottom of the oven heats the air which rises and is continuously replaced by cold air. These convection currents create uniform temperature in the centre of the oven where the food is kept, resulting in roasting.

27.2.3 Radiation Radiation waves travel at the same speed as light rays. Like light rays they are absorbed by dull black or rough surfaces and

reflected by smooth, white or metallic surfaces. Radiation waves travel through gases, clear liquids or glass without heating them, or through vacuum. In cooking, when heat radiations reach the food, only the surface is heated by them. They do not penetrate the food. The rest of the food is cooked mostly by conduction and also to some extent by convection. Radiation heat is used in broiling. Toasting of bread is essentially by radiation heat.

27.2.4 Microwave Heating Microwaves are absorbed and penetrate the food. The energy of these electromagnetic radiations excite the water molecules (in food) which bear a positive electrical charge in one portion and a negative charge at another position of the molecule (dipole). When the electric field of the microwave interacts with the water dipole, the water molecules begin to vibrate very rapidly in food. This vibration produces friction that creates heat within the food, thereby cooking it. The excitation of water molecules occurs as far within the food as the microwaves are able to penetrate. This is different from heating by convection methods which transmit heat from the edges of the food to the centre. Heating of food beyond the depth of penetration of the microwaves occurs as a result of the conduction and/or convection of the heat created by microwaves.

27.3 Cooking Media

Cooking can be carried out in various media or no media at all. Air, water, steam and fat, or combinations of these, are used as cooking media. Microwave heating involves generation of heat within the food; it is not a cooking medium.

27.3.1 Cooking in Air Grilling, roasting and baking take place in air. Grilling consists of placing the food below or above a red-hot surface. When under the heater, the food is heated by radiation only. This results in the browning of many foods. Then the heat is more slowly conducted through the surfaces of the food downwards. As heating is mostly superficial, grilled foods are usually reversed or rotated in the oven. If the food is above the heater, heat is transmitted to the food through convection currents, as well as radiations with consequent increased efficiency.

Roasting and baking are essentially the same. They are carried out in an oven between temperatures of 120° and 260°C. Generally, the term roasting is applied to meat cooking, while baking is used for breads, cakes and biscuits. The food is cooked partially by dry heat and partially moist heat, if the food is high in moisture content. In baking, the oven atmosphere should be moist initially so that the moisture condenses on the cold dough. This helps in heat transfer and plays a part in the formation of crust. Roasting and baking involve heat transfer from the heat source in the oven by radiation, conduction and convection. Heat is transferred directly onto the container of the food through which it is conducted to the food. Convection

currents of air help keep the temperature of the oven fairly uniform. Rough and black surfaces absorbing more radiated heat are more efficient for baking than the bright shiny ones.

Broiling is the cooking of food by exposing it to direct heat. In this case, cooking takes place by conduction through direct contact of food with the hot broiler. Some radiation cooking also takes place in broiling.

27.3.2 Cooking in Water Boiling, simmering or stewing involves cooking in water. In these cases the medium transferring heat is water. Water receives heat by conduction through the sides of the utensil in which the food is cooked and passes on the heat by convection currents which equalize the temperature and become very vigorous when boiling commences. Water is a poor conductor of heat and its heat capacity is high, i.e., it requires more heat than any other liquid of the same weight to raise the temperature. The boiling point of water is 100°C and it is altered at high altitudes and in presence of electrolytes. Simmering and poaching are methods of cooking of food by immersing in a hot liquid maintained at a temperature just below the boiling point.

27.3.3 Cooking in Steam Steam is the medium of cooking in steaming, "waterless" cooking and pressure cooking. Cooking by these methods involves moist heat. In steaming, food is cooked by steam from added water, whilst in waterless cooking the steam originates from the food itself. Cooking food wrapped in aluminium foil or in a plastic bag is a form of waterless cooking. In this case, there is the advantage of preventing the transmission of flavour from or to the sealed food. Pressure cooking is a device to reduce the cooking time by increasing the pressure so that the boiling point of water is automatically raised. While water boils at 100°C at normal atmospheric pressure, it boils at 121°C at a pressure of 1.07 kg/cm^2 which is the pressure at which food is cooked in a kitchen pressure cooker. In cooking by steam, the food is heated as a result of steam condensing on the food, and the release of the large quantity of heat (latent heat) contained in the steam. This continues until the heated food reaches the same temperature as steam.

27.3.4 Cooking in Fat Fat is used as a medium for cooking in sauteing, shallow fat frying (pan frying) and deep fat frying. Sauteing is the cooking of food in a slightly greased pan. Only thin pieces of food (dosas, for example) are cooked this way. This prevents food from sticking to the pan. The heat is transferred to the food mainly by conduction. The food is to be turned from one side to the other to complete the cooking. In shallow fat frying, food is cooked in a larger amount of fat, but not enough to cover it. Heat is transferred to the food partially by conduction by contact with the heated pan and partially by the convection currents of the food. This prevents local burning of food by convectioning away the intense heat of the frying pan. As in sauteing, even in this case, the food must normally be turned over to ensure some degree of uniform cooking. Both sauteing and pan frying are really a type of baking.

Deep fat frying is similar to boiling. Food is cooked by vigorous convection currents and cooking is uniform on all sides of the food. As fat can be heated to a much higher temperature than the boiling point of water, cooking can be rapidly completed in deep fat frying. In most foods, this high temperature results in rapid drying-out of the surface, and the production of a hard, crisp surface, usually brown, and the absorption of a fair amount of fat, which raises the calorific value of the food substantially. Fats should not be heated to the smoking point as they decompose at that point to fatty acids and glycerol, followed by the decomposition of glycerol to acrolein, which causes irritation to the eyes and nose.

Foods may also be prepared by a combination of media. Preparation of uppuma, for example, involves the use of a combination of fat and water media. Some components (onions) of the preparation are first browned in a small quantity of fat followed by the cooking of semolina in water.

27.4.2 Limitations of Microwave Cooking There are some limitations to microwave cooking. As the process of cooking does not rely on the conduction or convection of the material being heated, it is normally possible to heat the whole of the food simultaneously. Due to the short period of time of cooking, the food does not become brown on the surface as many foods do when they are roasted or baked in a conventional oven. Baked products without a brown surface do not have appeal. To overcome the problem created by lack of browning a microwave oven is combined with a browning unit. Another disadvantage of microwave cooking is that it cannot be employed for simmering or stewing for tenderizing foods, as also for deep-fat frying. Also, the short cooking time may not give a chance for the blending of various flavours to develop as in the conventional methods of cooking.

27.5 Changes in Cooking

When food is subjected to heat many changes occur; there is some destruction of proteins, lipids and vitamins, which is detrimental to the nutritional value of food. However, there are also some beneficial changes. Cooking is required if we have to obtain the maximum nutritive value of some foods and maintain a safe and wholesome food supply. Heat treatment is also one of the most common and effective methods of food preservation and may be used alone or in combination with other preservation techniques. Some of the changes that take place in the constituents of food during cooking are discussed below.

27.5.1 Changes in Proteins The principal effect of heat on protein is denaturation. This results in the destruction of microorganisms and inactivation of microbial and natural enzymes within the food. Cooking also destroys the toxic proteins and peptides, enzyme inhibitors, antivitamins and other natural toxicants in food, which can seriously affect their nutritive value. Legumes contain trypsin inhibitors, haemagglutinins and other toxic substances which affect the digestibility and availability of sulphur-containing amino acids. These are destroyed by heat. Approximately 40 per cent of the growth-depressing effect of uncooked soyabeans is due to the presence of trypsin inhibitors. Of the remaining proteins of soyabeans digestibility

increases after cooking. Cereal grains also contain trypsin inhibitors and natural toxicants. Heat destroys these antimetabolites in rice, wheat and oats, but has little effect in other cereals.

Cooking can also result in the interaction of protein with nonprotein components of the food system; there can be interaction of protein with carbohydrate or lipid oxidation products. There can also be interprotein and intraprotein reactions in the presence or absence of oxygen. These changes in cooking result in nutritional unavailability of proteins.

There is significant loss of lysine and the sulphur-containing amino acid cysteine after heating proteins. On prolonged heating, tryptophan, methionine and the basic amino acids are also lost. Charring and the presence of off-odours during cooking is due to destruction of amino acids and proteins. These changes affect the palatability of the final product.

Interaction between the free amino groups of proteins with reducing sugars or carbonyl groups formed by lipid oxidation results in nonenzymatic browning (Maillard browning). This reaction is of importance because it is responsible for many of the specific tastes, aromas and colour of foods. In this reaction, the α-amino group of the essential amino acid lysine reacts with carbonyl groups of sugar and fatty-acid oxidation compounds (see Subsection 2.4.1), which results in a decrease in the nutritive value of proteins.

27.5.2 Changes in Carbohydrates Monosaccharides, oligo- and polysaccharides undergo many transformations when cooked in an aqueous medium. The sugars are subjected to degradation and epimerization and, of over 100 compounds that are formed by such transformations, hydroxymethyl furfural is the most important compound. This compound and furfural are also products of nonenzymic browning reactions. But these compounds have no adverse effects.

Starch molecules which are the main source of calories in many diets, when heated in an aqueous or moist environment, swell and rupture, and this permits greater enzymatic digestion by enzymes like amylases. Cooking thus increases the digestibility of carbohydrates. Starch, when subjected to dry heat at a temperature of 200°C or higher, breaks down resulting in the formation of dextrin and volatile compounds like furfural and hydroxymethyl furfural.

27.5.3 Changes in Lipids Lipids undergo hydrolytic, oxidative, polymeric or other degradative changes which modify not only the physical properties of the lipid but also their biological properties when heated. The hydrolytic and oxidative changes result in rancidity. Hydrolytic rancidity is catalyzed in food at high temperature and pressure in an aqueous medium in the presence of acids, alkalis and lipolytic enzymes (lipases). Hydrolytic rancidity by itself does not bring about any significant change in the nutritive value of the food. However, the objectionable flavour imparted by free fatty acids lowers the consumption of food.

Oxidative rancidity is responsible for more losses in the quality and nutritive value of lipids than any other change. This rancidity results in the formation of hydroperoxides as primary products owing to the attack of oxygen on the unsaturated centres of lipids (see Subsection 3.6.1). The products of oxidation exhibit strong unpleasant flavours even when present in extremely low amounts. The oxidation of a fat at high temperature, in addition to volatile and nonvolatile compounds associated with lipid oxidation at normal temperature, gives isomerization products (trans- and conjugated double bond products), cyclic compounds, dimers and polymers. While lipids oxidized at normal temperatures exhibit no toxicity, thermally oxidized lipids have shown various detrimental effects. But the lipid or food system would be unpalatable long before the concentration of the toxic compound reached a hazardous level.

In addition to the effect on the biological properties of lipids, thermal effects bring about physical and chemical changes also. In sauteing and shallow fat frying, the quantity of oil used is small, cooking time is short and there is generally no reuse of fat or oil and thus there is little concern over the nutritional effects of lipids absorbed from such cooking. In contrast, there has been a great deal of concern over deep fat fried foods. If the deep fat frying is continuous, oxidative changes are small because the fat absorbed by the food is constantly replaced. In discontinuous deep fat frying, as is common in homes, there is liberation of fatty acids due to the addition of water to the oil from the food, decreased unsaturation and increase in peroxides, conjugated double bonds and polymers. Such fats absorbed by foods could be toxic when consumed.

27.5.4 Changes in Vitamins and Minerals These are lost primarily by leaching, oxidation of the water-soluble nutrients and thermal destruction. The loss of water-soluble vitamins ranges from 0 to 60 per cent as a result of leaching and thermal destruction. In addition to losses by water and heat, ascorbic acid is lost by oxidation due to exposure to air of food during cooking. Vitamin A and carotene are water insoluble and, as such, are not lost as a result of leaching and their destruction due to oxidation is very slight. Frying and roasting cause their loss up to 40–60 per cent. Minerals also are lost on account of leaching and their losses are smaller (0 to 35 per cent).

27.5.5 Changes in Colour Colour factors in foods (see beginning of Chap. 8), such as anthocyanins, carotenoids, chlorophylls, myoglobin, etc., are affected by heat. In addition to heat, the acidity or alkalinity of the cooking medium, oxygen and presence or absence of metals, also contribute to colour changes when heated. In some cases, the colour changes that take place in foods on cooking are desirable (as in baking) while in some other cases the changes may be undesirable (as in the prolonged cooking of

cabbage). The cooking condition should be so organized as to obtain the desired colour qualities in the cooked food.

For the cooking of pulses, milk, meat, eggs, fish and sugar, see the relevant chapters.

Definition

A binding agent (or binder) is a substance that holds or draws other materials together mechanically, chemically or as an adhesive, to form a cohesive whole.

Source

Organic binders include gums made by boiling plants and glues made by the boiling the hooves, bones, or skin of animals. Some natural bio-adhesives are also made from organic sources such as natural resins.

Properties

Liquid binders are added to a dry substance in order to draw it together in such a way that it maintains a uniform consistency, transforming the mixture into a more solid structure. For example, Xanthan and Guar gums are plant-derived powders used as binding agents in gluten-free baking as replacements for the binding action of gluten, or in vegan cooking to replace eggs. When they are added to water, it becomes more viscous and gummy. Their binding properties are activated when mixed with other ingredients, such as flour.

Uses

Some of the main binding agents are shown below, along with examples of the kind of applications they are commonly used for.

Product	**Type**	**Examples of Use**
Accroides	Resins	Binder in fireworks and flares.
Candelilla	Wax	Binder in chewing gum.
Guar	Gums	Binder in baking, meat and tablets.
Gum Arabic	Gums	Binder in baking, personal care products, incense, photography, watercolour paints, ceramic glazes and fireworks.
Karaya	Gums	Binder in baking and paper manufacturing.
Shellac	Shellac	Binder in mascara, eyeliners, fireworks and pyrotechnics.
Tragacanth	Gums	Binder in icing, tablets, incense and pastel paints.

Xanthan	Gums	Binder in baking, laxatives and toothpaste.

23. MEAT

Man has satisfied his hunger with animal food from the earliest of times. The term meat refers to muscle of warm blooded terrestial four legged animals, the chief ones being cattle, sheep and pigs. Meat also includes the glands and organs of these animals. Meat products include many of the by-products from animal slaughter, such as animal gut used for sausage casings, the fat from the meat used in the manufacture of lard, gelatin and others.

The annual consumption of meat of any country depends upon its economic status, affluent countries consuming more than others. The average per capita consumption of meat is 65 kg per annum in the US which is more than that of many other countries. The per capita consumption of meat in India is of the order of 1.5 kg per annum. The world demand for meat is growing up steadily, because of preference based on palatability. However, because of its cost and limited supply, there is a need to substitute meat by vegetable proteins.

Meat is rich in most of the nutrients required by man. This is to be expected since the tissues and body fluids of man are very similar to those of animals. Meat is rich in protein (15 to 20 per cent) and contains all the essential amino acids. It is also rich in minerals and vitamins. Phosphorus, copper and iron are present in significant amounts in meat. Of particular interest is the quantity of iron and copper contained in liver. Thiamine, riboflavin and niacin occur in good amounts in all meats. Liver usually contains a useful amount of vitamin A.

23.1 Structure of Meat

Skeletal muscle is composed of long, cylindrical, multinucleated cells (fibres) varying in length from a few millimetres to several centimetres and averaging 60 μm in diameter. The fibres are arranged in a parallel fashion to form bundles, held together by connective tissues. The connective tissues merge at the terminal of the muscle to form a tendon, which in turn connects the muscle to bone.

The surface of the muscle, called the "sarcolemma", is composed of three layers: an outer network of collagen fibrils, a middle amorphous layer and

an inner plasma membrane. Invaginations of the plasma membrane form the transverse (T) system. The T system has the function of extending the plasma membrane into the interior of the muscle.

The semifluid material within the muscle cell, called the "sarcoplasm", contains soluble components, such as myoglobin, some enzymes and some metabolic intermediates. Glycogen particles and lipid droplets also occur in some muscle cells, depending upon the state of the muscle. Sarcoplasm, in addition, contains other constituents including the contractile apparatus.

Each muscle fibre is composed of the many parallel smaller fibrils (myofibrils) constituting 60 per cent of muscle. Approximately 2,000 myofibrils, 1.0 to 3.0 μm in diameter, are found in an average sized fibre. The characteristic striated appearance of skeletal muscle is due to a specific repetitive arrangement of proteins in the myofibrils. When viewed under a microscope they show alternate dark and light bands. The dark bands are termed A (anisotropic) bands, and the light bands I (isotropic) bands. In the centre of each of the I bands is a dark line, called the Z line. The centre of the A band, called the H zone, is lighter than the rest of the A band. Usually, in the centre of the H zone there exists a darker M line. The contractile unit is called "sarcomere" and is the material located between, and including, two Z lines. The structure of skeletal muscle is shown in Fig. 23.1.

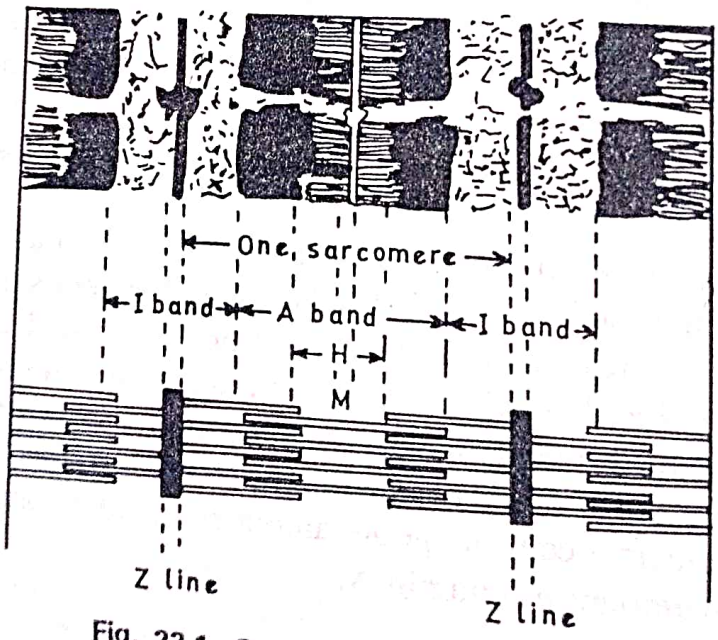

Fig. 23.1 Structure of skeletal muscle

The A band consists of thick and thin filaments and the I band the thin filaments. The thin filaments are attached to the Z line and they extend outwards in both directions of the line. In parts of the A band the thin filaments overlap the thick filament. The lighter zone in the A band (H zone), is the area where the thick and thin bands do not overlap, i.e., the H band consists of only thick filaments. Where the thin and thick filaments slide past each other, a contraction of the muscle occurs. During contraction, the length of the A band remains constant, while the I band and H zone both shorten.

23.2 Muscle Proteins

Muscle contains three types of proteins—contractile, soluble and insoluble proteins. The contractile proteins are soluble in salt solutions of high concentration. The enzymes and myoglobin are soluble in water and dilute salt solutions. The insoluble fraction consists of connective tissue proteins and membrane proteins.

23.2.1 Contractile Proteins

Myosin: This is the major protein of the thick filaments. Myosin contains two identical polypeptide chains wound around each other and constituting the "tail". The molecule has a globular head, made up of four smaller polypeptide chains, which is responsible for its enzyme (ATPase) activity and its ability to interact with actin. The globular heads are in two fractions and represent the termini of the extremely long myosin-molecule. The globular head region of the protein can be separated from the long tail by the action of the proteolytic enzymes on myosin and the fraction thus separated retains its ATPase activity and ability to react with actin.

Myosin constitutes about 60 per cent of the myofibrils. The myosin molecules develop polarity when they interact, joining in head-to-tail fashion. This results in myosin molecules with globular regions on either side and the straight portion in the centre. The polarities of the myosin molecules are reversed on either side of the centre, but all molecules on the same side have the same polarity. It is this polarity which allows contraction to occur.

Actin: This is a major protein of thin filaments and constitutes 15–30 per cent of the myofibrils. Actin consists of two fractions, fibrous or F actin, and globular or G actin. G actin is the monomeric form of the protein, soluble in water where it occurs as a stable dimer. Globular actin binds firmly to ATP and, in presence of magnesium, spontaneously polymerizes to form F actin with the concurrent hydrolysis of ATP.

Actomyosin: Actin and myosin interact to form actomyosin. This interaction is responsible for muscle contraction. Actomyosin has ATPase activity but this is somewhat different from the ATPase activity of myosin. Pure myosin requires Ca^{2-} for its activity and is inhibited by Mg^{2+}. The ATPase activity of actomyosin, however, is stimulated by Mg^{2+}. The interaction of actin and myosin in the absence of ATP influences the quality of meat.

Other contractile proteins: A few other proteins are involved in muscle contraction. Tropomyosin B is a protein found in thin filaments. It forms a complex with F actin. Tropomyosin A is another protein found in some specialized muscles. It functions to lock actin and myosin together so the shell can remain closed without an expenditure of energy.

Another protein, troponin, is a component of the contractile system. Troponin-C confers calcium sensitivity to the tropomyosin-troponin-actomyosin complex, while troponin-I inhibits the contraction activity.

α-Actinin and ß-actinin are two other proteins found in small quantities and have important roles in muscle function. These proteins are associated with filaments. α-Actinin causes gelation of F actin, which is reversed by tropomyosin B. It is believed that α-actinin is also involved in the structure of the Z line. ß-Actinin may be associated with troponin.

Muscle contraction: Muscle is stimulated by a nervous impulse which helps the release of calcium ions from the sarcoplasmic reticulum. The released calcium interacts with the troponin-tropomyosin complex and this results in the activation of Mg-ATP at the relaxing site of the myofibrils. The relaxing site is the inhibitory site responsible for preventing myofibrillar ATPase activity. When the inhibition is overcome, ATP is hydrolyzed by the actomyosin complex, which provides energy for systematic changes leading to muscular contraction.

When muscle contracts, the thin and thick filaments slide past each other. This helps the globular head portion of the myosin molecule to interact with actin and then pull the actin filaments parallel to the fibre axis. Maximal contraction varies from 20 to 50 per cent of the rest length of the sarcomere.

Relaxation occurs when calcium ions are removed from the sarcoplasm. This takes place through an energy-supported active transport. At reduced concentrations of calcium, myofibrils lose their capacity for the hydrolysis of ATP. Then ATP functions as a plasticizing agent, causing the separation of actin and myosin, and the sarcomeres relax to their rest length.

23.2.2 Connective Tissues Connective tissues hold and support the muscle, through the component tendons and other tissues. They consist of various fibres, several different cell types and amorphous ground substances. The amorphous ground substances are a nonstructured mixture of carbohydrates, proteins and lipids. The fibrous proteins are collagen and elastin.

Collagen: Collagen is the most abundant of all proteins in higher vertebrates making up one-third or more of the total body proteins. It is abundant in tendons, skin, bone, vascular system of animals and connective tissue sheaths surrounding muscle. Collagen contributes to toughness and its partially denatured product, gelatin, is a component in many food products.

The structural unit of collagen is tropocollagen, a long cylindrical protein. It consists of three polypeptide chains wound around each other in a triple-helix (see Subsection 4.3.1). Tropocollagen molecules are linked end to end and adjacently to make collagen fibrils. The intermolecular linkages are mostly hydrogen bonds and there are some covalent linkages. The solubility of collagen decreases as intermolecular crosslinks increase.

The amino acid composition of collagen is unusual. It contains one-third glycine (distributed uniformly) and one-fourth proline and hydroxyproline. It also contains hydroxylysine. Tryptophan is absent and, from a nutritional point of view, collagen is not important.

With an increase in the age of the animal, there is an increase in the number of linkages binding the individual strands of the collagen molecule and there is also bonding between neighbouring molecules in the fibrils. The

new linkages will be mostly covalent bonds. In addition to these changes, the quantity of collagen in connective tissues increases with the animal's age. These changes are responsible for the greater difficulty in the chewing of meat of older animals than those from younger ones.

Elastin: Elastin, the other principal protein found in connective tissues, consists of strands which are randomly linked and cross-linked at intervals with strong bonds. Elastin is toughter than collagen and is a constituent of the ligaments. Elastin is resistant to changes during heating; no significant changes occur in elastin when meat is cooked. However, this does not matter as the content of elastin in muscle is low.

23.3 Composition of Meat

Meat contains 15–20 per cent proteins of outstanding nutritive value. The lean meat contains 20–22 per cent proteins. Of the total nitrogen content of meat, approximately 95 per cent is protein and 5 per cent is smaller peptides and amino acids. The amino acid make up of meat proteins is very good for the maintenance and growth of human tissue.

The fat content of meat varies from 5 to 40 per cent with the type, breed, feed and age of the animal. When the animal is well fed, fat deposits subcutaneously as a protective layer around the organs. Then it accumulates around and between muscles. Finally, fat penetrates between the muscle fibre bundles and this is known as "marbling". Marbling is desirable with some meats (like beef) because the amount of fat, and consequently the water holding capacity of the meat, greatly influences juiciness.

Meat fats are rich in saturated fatty acids and it is likely that it produces certain forms of atherosclerosis. The cholesterol content of meat is about 75 mg for 100 g. The lean portion of meat contains greater proportions of phospholipids (0.5–1.0 per cent), and these are located in the membranes of the cell. The fatty acids in the lean portion of meat have a higher proportion of unsaturated fatty acids than tissue fats.

Carbohydrates are found only in very small quantities in meat. Two carbohydrates found in meat are glycogen and glucose.

Meat is an excellent source of some of the vitamins of the B complex and a good source of iron and phosphorus. Meat also contains sodium and potassium. The vitamins and minerals are found in the lean portion of the meat. The approximate composition of meat is given in Table 23.1.

Meat contains the protein hydrolyzing enzymes, cathepsins, and these are responsible for the increased tenderness of meat during ageing.

The colour of meat is due primarily to myoglobin. Variations in colour of meat depend upon the chemical state of myoglobin. Meats cured with nitrates remain pink as nitric oxide myoglobin is stable. Haemoglobin also contributes to the colour of meat to some extent.

Table 23.1 Composition of meat of different animals per 100 g of edible portion

Name of flesh foods	Moisture (g)	Protein (g)	Fat (g)	Minerals (g)	Energy (Kcal)
Beef	74.3	22.6	2.6	1.0	114
Bos taurus Mutton muscle	71.5	18.5	13.3	1.3	194
Pork muscle *Sus cristatus Wagner*	77.4	18.7	4.4	1.0	114

Source: *Nutritive Value of Indian Foods* (NIN), ICMR, Hyderabad, India, 1984.

23.4 Postmortem Changes in Meat

Muscle is a highly specialized tissue; it converts chemical energy to mechanical energy. Muscle requires a large outlay of energy for the contractile apparatus and this energy is derived from ATP. For long-term activity, ATP is derived by the oxidation of carbohydrates and lipids. When muscle is under heavy stress and the oxygen available not sufficient, the anaerobic glycolysis system becomes predominant. In glycolysis, glycogen is converted into pyruvate and this is then reduced to lactate. Under usual conditions lactate enters the liver, where it is converted into glucose. The glucose is then carried back to muscle, where eventually glycogen is resynthesized.

When the animal dies, the circulatory system ceases to work resulting in lack of oxygen. Due to glycolysis in postmorterm muscle, there is an accumulation of certain waste products, especially lactic acid. Also, the ATP concentration decreases and is lost in 24 hours or less.

The increase in lactic acid concentration results in decrease in pH of postmortem muscle. Also, in the absence of ATP, there is a formation of permanent links between actin and myosin, i.e., the actin and myosin bridges remain permanently fixed. The muscle passes into a state known as rigor mortis (stiffness of death). These postmortem effects bring about changes in the quality attributes of meat, such as texture and water-holding capacity, colour and flavour. Nutritional quality, however, is not much affected.

23.4.1 Ageing of Meat If the meat is held cold for some time after it has gone into rigor mortis, the muscle again becomes soft and pliable with improved flavour and juiciness (resolution of rigor). Some changes take place during this period known as ageing or ripening. During ageing there is progressive tenderization of meat owing to the denaturation of the muscle proteins and mild hydrolysis of denatured proteins by the intracellular proteolytic enzymes, the cathepsins. The enzymes slowly break down the connective tissues between muscle fibres as well as the muscle fibres themselves.

Ageing or ripening is done by holding meat at a temperature of 0.5° to −2°C in a cold room. Ageing may take 1 to 4 weeks. The best flavour and

the greatest tenderness develop in meat aged from 2 to 4 weeks. During ageing, humidity of the cold room is to be controlled and meat may be covered with wrapping to minimize drying and weight loss. The ageing of meat may also be effected by holding it at a higher temperature for a shorter time, usually 20°C for 48 hours. Ageing with even higher temperature for less time is practised commercially. In such cases, ultraviolet light is used to keep down surface bacterial growth.

Beef is usually the only kind of meat that is commercially aged. Lamb and mutton are occasionally aged. Pork is never aged because of its high fat content.

23.5 Tenderizing Meat (Soft)

Tenderness is the most desired quality in meat. The amount and distribution of connective tissues and the size of both muscle fibres and bundles of fibres determine the tenderness of meat. As already stated, the number and strength of cross-linkages between the peptide chains of collagen increase with the age of the animal and this decreases the amount of collagen that may be solubilized during cooking thus contributing to decreased tenderness.

Cold room storage results in the natural ripening of meat with tenderizing from the meat's natural enzymes. There are several artificial methods of increasing the tenderness of meat to various extents. These include mechanical methods, use of enzymes and salts.

The mechanical methods of tenderizing meat include pounding, cutting, grinding, needling or pinning and the use of ultrasonic vibrations. Mechanical methods cut or break the muscle fibres and connective tissues. The pounding process breaks and tears only surface meat fibres and connective tissues. Grinding breaks and cuts all the muscle fibres and connective tissues and increases tenderness in meat. Insertion of needle-like blades into the meat increases tenderness of certain meat cuts. Ultrasonic vibrations break the meat fibres.

The art of using enzymes for tenderizing meat is an old one. Wrapping of meat in papaya leaves before cooking results in tenderization. This is the result of the action of the enzyme papain on meat proteins. This enzyme is presently commercially available and is used extensively in meat tenderization. Other enzymes used for meat tenderization are bromelin from pineapple, ficin from figs, trypsin from pancreas and fungal enzymes. These proteolytic enzymes catalyze the hydrolysis of one or more meat proteins. The extent to which different proteins are hydrolyzed varies to some extent. The enzymes also hydrolyze the elastin of the connective tissues.

The effectiveness of an enzyme as a tenderizer depends upon the way in which it is used. Commercial papain sprinkled on the surface of meat penetrates to a depth of 1 mm per hour. Penetration is improved by punching the papain treated surface. This, however, does not result in the uniform distribution of the enzyme throughout the meat. To achieve uniform tender-

ness, papain is injected into the veins of animals some 10 minutes before their slaughter. This results in the uniform distribution of the enzyme throughout the body of the animal by the circulating system resulting in the increased tenderness of cooking meat. Freeze-drying meat and rehydrating in water containing proteolytic enzymes has been found to be effective in tenderizing meat.

Tenderizing enzymes remain inactive until the meat is heated. Papain, for example, becomes active when the meat is heated to 55°C and acts on the proteins during the cooking operation until the meat temperature reaches about 82°C. Therefore, enzymes are ineffective with roasts unless the injection method has been used. Overtenderization by enzymes is not good as it changes the texture of meat and results in the loss of flavour and juiciness.

Meat may be tenderized by the use of low levels of salts. Salt increases the water holding capacity of the muscle fibres resulting in tenderness and juiciness. Salt also solubilizes the meat proteins. Tenderness of meat is improved when freeze-dried meat is rehydrated in a weak salt solution instead of water. Salts used for tenderization are sodium chloride, sodium bicarbonate and sodium or potassium phosphate.

Another method of increasing tenderness in meat is by change of pH. Decreasing or increasing the pH of meat increases hydration and its tenderness. Soaking beef for 48 hours in concentrated vinegar increases its tenderness and juiciness.

23.6 Curing of Meat

The prime object of ageing or ripening and use of tenderizers is to increase the tenderness of meat. The curing of meat has additional objectives. Curing brings about the modification of meat that affects preservation, flavour, colour and tenderness due to added curing agents.

Originally, curing was practised as a means of preservation before the days of refrigeration. In less developed countries, curing is still an important method of preservation. When modern methods of preservation are available, the prime purpose of curing is to produce the unique flavoured meat products and a special purpose is to preserve the red colour of meat. Thus, cured beef (corned beef) and cured pork (ham), remain red on cooking while in the uncured condition they become brown.

The ingredients used for curing are common salt, sodium nitrate or nitrite, sugar and spices. Salt retards microbial growth and gives flavour to the meat. Nitrite fixes the red colour of myoglobin. Nitrite has also a beneficial effect on the flavour of cured meats and an inhibitory effect on *Clostridium botulinum*. Sugar helps stabilize colour, counteract saltiness and also adds flavour. Spices are added mainly for flavour.

During the curing process, the curing mixture may be rubbed dry on the surface of a cut of meat or the meat may be immersed in a solution of the curing agent (pickling). These processes of curing are slow when the meat cut is large. The curing ingredients may be much more rapidly and uni-

formly distributed throughout the meat by pumping the solution via an artery if it is intact or the cure may be injected with multiple needles into the cut of meat.

During curing by salts, the high osmotic pressure of the external fluid initially draws water and soluble proteins out of the meat. Later, salt diffuses into the meat and binds to the proteins, causing some expelled protein to diffuse back in. This causes a swelling of the meat. The salt-protein complex that forms binds water well.

Curing has also some detrimental effects during storage. The pink colour of nitrite cured meat changes to brown, in the presence of oxygen. Thus, cured meat should preferentially be packed in containers from which oxygen has been excluded. The salts of cured meat enhance oxidation of lipid components and thus reduce shelf life. Also, there is some concern about the carcinogenic effect of nitrite, particularly when cured meat is heated to a high temperature (also see Subsection 29.15.4).

Smoking: A cured meat may be dried and smoked. Smoking also was originally used as a method of preservation but today smoking is used mostly for its flavour contribution and coagulation of proteins. Ham is frequently processed by smoking. The sawdust from hardwoods is used as a fuel for smoking. Slow smoking is preferable since the extended period enables more drying to occur on the surface. Drying is responsible for much of the preservative action of smoking. The smoke contains compounds having antiseptic properties which destroy the microorganisms present in meat. Smoking also prevents the development of rancidity in meat.

23.7 Classes of Meat

23.7.1 Beef Various terms are used to designate meat from different types of cattle. Veal is the meat from cattle slaughtered 3 to 4 weeks after birth. The carcass of 14 to 52 weeks cattle is classified as calf. Beef is the term applied to meat of cattle over one year old. Beef carcass is classified according to the sex, age and sexual conditions of the animals as follows:

Stear : A bovine male animal castrated at very young age.
Heifer : A female bovine animal that has not borne a calf.
Cow : A female bovine animal that has borne a calf.
Stag : A male bovine animal that is castrated after maturing.
Calf : A male or female bovine animal up to 12 months of age, generally from 3 to 8 months of age.

The quality of meat from stear and heifer is the same if the animals are of the same grade. The quality of meat from cow and bull depends upon maturity, but is generally inferior to that of stear and heifer. The quality of meat from stag varies depending upon the age at which the animal is castrated.

23.7.2 Mutton Sheep carcasses are classified under three main classes, based largely on the age of the animal.

Lamb: The flesh of young ovine animals of both sexes whose age is twelve months or under. Lamb carcasses, as a group, are distinguished from mutton carcasses by their smaller and lighter bones, lighter coloured flesh and softer and whiter external and internal fats. The usual test for lamb carcass is the "break joint" of foreleg. When the feet is broken off sharply from the leg above the regular joint, the break shows four distinct ridges that appear smooth, moist and red with blood.

Yearling mutton: Carcasses of young sheep usually from 12 to about 20 months old are termed yearling mutton. Such carcasses are distinguished from lamb carcasses by harder and whiter bones, darker and somewhat coarser flesh and thicker external and internal fat. The break joint of the foreleg usually breaks in ridges similar in shape to a lamb joint but the surface is rough, porous, dry and lacks redness.

Mature mutton: This is the flesh of both the males (castrated and uncastrated) and females of the ovine species that are 20 months in age at the time of slaughter. The colour of the mature mutton ranges from light to dark red. The break joint fails to break due to the hardening and ossification of bones. Mutton has a strong characteristic flavour different from the delicate flavour of lamb. With proper preparation, however, either lamb or mutton will be acceptable to most people.

23.7.3 Pork Pork is the meat of swine. Good quality pork is obtained from animals between the ages of 3 to 12 months before the amount of fat becomes excessive. Pork is not differentiated according to the age and size of pig. Generally, pork has more fat than other meats. Because of this, pork is a tender cut of meat. The colour of young lean pork is highly pink and changes to rose as the animal matures. Bacon is the cut from the belly portion of hog carcass and has a high percentage of fat.

Pork obtained from animals fed on uncooked garbage may contain the hazardous organism, *Trichinella spiralis*, a worm that causes "trichionosis" in man. The organism is destroyed by smoking or cooking to an internal temperature of 58°C. Freezing to −5°C for 20 days or −28°C for 6 days (if the diameter is about 15 cm) also destroys the organism.

23.7.4 Organ Meats These include liver, kidney, heart, sweet bread (thymus and pancreas), brain, lung, tripe (first and second stomach of the ruminants), head and tail of the animal. From the point of view of economy, variety and nutritive value, these organ meats are less expensive and more nutritive. Some of these are tender, while others are less tender, and therefore their cooking methods vary according to tenderness.

23.7.5 Sausages These are made of ground or minced meat. Mostly cured meat and, to a lesser extent, uncured meat are used for this purpose. There are hundreds of varieties of sausages marketed under different classes depending upon whether the ground meat is fresh or cured, and whether the sausage is cooked or uncooked, smoked or unsmoked, and dried or not

during manufacture. The cooked and smoked sausages are known as table-ready-meats.

Sausages are enclosed in casings. Normal casings are made from the animal intestine. As natural casings are expensive, nonuniform artificial casings made of film plastic are used now.

23.8 Cuts and Grades of Meat

Meat carcasses are commonly divided into relatively larger wholesale cuts and these are further divided into smaller retail cuts. Distinguishing features of a cut of meat are the size, shape and location of bone, the size and shape of muscle found in the cut and the amount and distribution of fat. The skeletal structure of beef, veal, lamb and pork is basically the same and therefore cuts from analogous parts of different animals are similar. The carcasses of beef, being bigger in size, are cut into more number of wholesale cuts than those of other animals.

The commonly used meat in India is lamb mutton; about 70 per cent of all meat used comes from sheep and goat. The wholesale cuts of lamb are legs, loin, racks, breasts, shanks and shoulders. These cuts are related to the bones with which they are associated. Each of the wholesale cuts is further cut into retail cuts, such as chops (different types of legs), roasts, neck slices, etc. The retail cuts of other animals are similar to those of lamb.

Meat that is sold in the market must be wholesome and fit for human consumption. The Indian Standards Institution has laid down specifications to ensure this. According to this, the animals from which meat is obtained should be healthy and slaughtered in a hygienically managed slaughter house. The slaughter should be supervised by a competent authority. The animals and the carcasses thereof should be subjected to antimortem and postmortem examination according to prescribed methods. The carcasses and cuts thereof should be certified as being sound and free from contagious and infectious diseases and fit for human consumption.

Apart from inspection for wholesomeness, in many countries, meats are graded for quality. Standards have been established for such grading. Two major factors used to evaluate the quality or palatability of meat are maturity and marbling. The maturity of an animal affects the texture, firmness and colour of the meat. Fine structural lean meat is usually slightly more tender than the one with a coarse texture that contributes to decreased tenderness. The tenderness of the meat of a very young animal increases as it matures to an optimum age. Marbling, which refers to the amount and distribution of fat appearing as white flecks within the lean, is an important index of quality. However, the marbling requirements now considered for good grades of meat are not as high as in previous standards as there are no measurable differences in the eating qualities of meat with minimum marbling and those with good marbling. The quantity, consistency and character of juices or extractives contained in muscle fibre also contribute to the quality of meat.

Good quality lamb and mutton have a smooth covering of clear white brittle fat over most of the exterior. The lean in pinkish red in colour in lamb and deeper red in mutton. The texture of the lean is fine-grained and velvety in appearance. The bones are porous and reddish in colour in lamb, and they are hard and white in mutton. Poor quality meats have darker flesh and the grain is coarse and fibrous. The fat layers are heavy and have a strong flavour. The quality of beef, veal and pork is determined by considerations similar to those of lamb. The grading according to ISI for lamb and beef is as follows:

Lamb and Mutton	Beef
Prime	Prime
Choice	Choice
Good	Good
Commercial	Commercial
Utility	Utility
Cull	Cutter and canner

23.9 Cooking of Meats

Cooking can make meat more tender or less tender than the original raw cut. When meat is cooked, three types of changes contribute to increased tenderness. They are the melting of fat, dissolution of collagen in hot liquids to become soft gelatin, and tissue softening and muscle fibre separation. There are also toughening influences of heating. Overheating can cause muscle fibres to contract and meat to shrink and become tougher; evaporation of moisture occurs and dried out tissues become tougher.

There are two methods of cooking meat: the dry heat and moist heat methods. Selection of the method to use for a meat cut depends upon whether it is a tender or less tender cut. Less tender cuts become more tender when prepared by moist heat methods since this provides a means for the conversion of collagen to gelatin. Moist heat methods of cooking include braising, stewing (cooking in simmering water) and pressure cooking. Tender cuts do not require the conversion of connective tissue. Then, they are cooked by dry heat methods, which include roasting, broiling, pan broiling and frying.

For any method of cooking, an appropriate cooking temperature must be chosen. Generally, lower cooking temperature for a longer period of time is better than a higher temperature for short periods of time for any degree of doneness. This results in decreased drip loss, less shrinkage, increased juiciness and more uniform colour throughout the cut.

Testing for doneness is an important aspect in meat cookery. This is tested by the use of a meat thermometer. The recommended temperature in the centre of cut for rare, medium and well done stages for lamb is 77°C.

79°C and 82°C respectively and for beef 60°C, 71°C and 77°C. Fresh pork is to be heated to well done stage (77°C) to destroy *Trichinella spiralis*. Moist heat methods will produce well done meats in every instance. It is not necessary to use a thermometer when employing moist heat cookery methods.

23.9.1 Dry Heat Methods Tender cuts of beef, lamb and pork may be cooked by these methods. Use of dry heat permits the selection of the desired final interior temperature of meat.

Roasting: Roasting is one of the simplest and most commonly used methods of cooking meat. The meat is placed uncovered on a rack in a shallow pan to keep the meat out of drippings. A meat thermometer is inserted into the thickest part of the meat taking care to see that it does not touch bones or fat. The roasting pan is placed in the centre of the oven and an oven temperature of 163°C is maintained till the desired internal temperature is indicated on the meat thermometer. This ensures the adequate browning of meat for good flavour and good appearance. For small roasts, an oven temperature of 177°C is used. Roasts continue to cook at the centre even after they are removed from the oven. This is because heat is transmitted into the interior from the outer surface. Charts for the cooking times of various cuts of different meats are available.

It should be noted that no covering of any type is used when meat is being roasted. If a cover is placed on the roasting pan, the steam from the roasting meat is trapped inside the container and the meat cookery method becomes moist heat cookery.

Broiling Broiling consists of cooking meat by direct radiant heat, such as the open fire of a gas flame, live coals or electric oven. In open fire or coal broiling heat comes from below, whereas in oven broiling, the heat comes from above. Broiling is applied to tender cuts that are at least 2.5 cm thick. Thinner cuts will be too dry if broiled.

To broil, meat is placed on a rack and the rack is adjusted in such a way that the top of the meat is some 5 to 10 cm from the source of heat. Shorter distances are used for thinner cuts of meat. A tray should be placed beneath the meat rack to collect the melted fat. Broiling is carried out at a temperature of 176°C until the topside is brown. At this stage the meat is approximately half done. The broiled side is salted and turned and broiled on the other side.

Broiling is a faster method of cooking meat by dry heat than roasting. But roasting produces more juicy and tender meats than broiled meats. However, meats with unusual flavour can be obtained by broiling by marinating meats in some types of salad dressings or juices an hour before broiling. This treatment also permits some hydrolysis of protein to occur and thus produces a small increase in tenderness.

Pan broiling: In pan broiling, heat is transferred to meat primarily by conduction from the pan or griddle. Meat is placed in a cold griddle and heated so that meat cooks slowly. Any fat that accumulates in the pan is removed so that the meat will continue to pan broil rather than pan

fry. Pan broiling is the preferred method of cooking for thin cuts of meats, because the equipment required for cooking is simpler. A low temperature is sufficient to brown the meat. Pan broiled meat should be turned occasionally to ensure uniform heat penetration.

Frying: This is a useful method for cooking tender cuts of meat which are thin (about 1–1.5 cm thick). There are two methods of frying: pan frying and deep-fat frying. In pan frying, a small amount of fat is added to the frying pan so that the melted fat is about 0.5 cm deep. In deep-fat frying, the melted fat will be deep enough to cover the meat.

In pan frying, as with pan broiling, it may be necessary to turn meat occasionally to develop an even colour on the meat, but turning should be kept to a minimum. The temperature is to be controlled such that the meat does not develop a burned flavour and dryness. With high temperatures, fat decomposes to acrolein which impairs the flavour of meat. With thin cuts and properly controlled temperature, the interior of the meat will be well done before the exterior becomes too brown.

In deep-fat frying also the control of temperature is very important. Too high a temperature not only causes the fat to smoke but also the meat to be underdone in the middle when the outside is a pleasing colour. If the temperature is too low, it will lengthen the frying time and result in a greasier product. A well prepared deep-fried product will have a pleasing brown exterior and done in the centre.

23.9.2 Moist Heat Methods Moist heat method is used for less tender cuts of meat. The combination of moisture, heat and a long period of cooking causes meat to become tender owing to the conversion of connective tissue to gelatin. If a flavourable liquid is added, in this method of cooking, the flavour of meat also will be enhanced.

Braising: In this method of cooking, the meat is first carefully browned on all sides by broiling, pan broiling or frying. Then a small amount of water is usually added to the browned meat and the pan used for cooking is covered with a tight fitting lid and cooked with a low heat until the meat becomes tender.

It is not necessary to add water in braising because steam from the water in the meat itself can provide the moisture needed for changes that take place in meat during braising. Water, when added, should be kept to a minimum. The cooking liquid from the braised meat is very flavourful and can be used for making gravy or sauce. Although water is commonly used as liquid, tomatoes and fruit juices may be added as liquids. The juices not only furnish liquid for softening the collagen but also afford a variety of flavours and may hydrolyze protein because of their acidity.

Stewing: Large pieces of tough cuts are cooked in water until tender. Meats that are to be stewed may be browned, if desired, or simmered in water with no preliminary browning at all. The meat is placed in a kettle or vessel with sufficient water to cover the meat. The vessel is then covered and

heated so that the water simmers. The cooking is continued until the meat is tender.

Pressure cooking: Braising and simmering of meat takes a long time for cooking. In pressure cooking, a relatively short cooking time is required as cooking is done in steam at a temperature higher than that of boiling water. Pressure cooking brings about the same changes in meat as in other methods of cooking with moist heat. However, pressure cooked meats are less juicy and cooking losses are great.

Cooking frozen meat: Frozen meats may be cooked by the usual cooking methods either in the frozen condition or after thawing. Frozen meats take about one-and-a-half times more time to cook than unfrozen cuts of the same size and shape. Frozen meat may be thawed in a refrigerator at room temperature or in running water. Refrigerator thawing is recommended as it results in uniform thawing and the best appearance of the meat. There are no differences in the tenderness, juiciness and flavour associated with cooking frozen or thawed cuts of meat.

23.10 Changes Produced during Meat Cooking

A number of changes take place during the cooking of meat. Heat destroys the microorganisms that may have contaminated meat. It also brings about changes in colour, flavour and tenderness owing to changes taking place in meat fibre and connective tissue. At high temperatures, there is a considerable shrinkage of meat, toughening of protein and loss of juiciness.

Cooking brings about changes in the colour of the meat. When fresh meat is cooked, its protein pigments are denatured. Denaturation of the proteins causes rapid release of the haem pigments from the globin part of the molecule, and the free haem is very sensitive to oxidation. On heating, therefore, red meat generally turns brown due to the oxidized pigments. However, the extent of denaturation depends upon the temperature to which meat has been cooked. The changes in the colour of pigment in meat, when heated, are used as an index of doneness. Meat cooked to rare condition has less of oxymyoglobin denatured and is more red. Well done meat is more denatured and more brown. However, meats cured with nitrite remain red throughout cooking.

Heat treatment brings about the denaturation of most other proteins. Thus, the enzymes present in meat are inactivated. Myosin and actin are also enzymes and their inactivation brings about textural changes since the contractile proteins become tougher. However, very often this is counteracted by the concomitant conversion of the collagen of the connective tissues to gelatin. This is the reason why tough cuts of meat are cooked for a long time in the presence of water.

Ideal cooking methods for meat should minimize the hardening of contractile proteins and maximize the softening of the connective tissues. Cooking temperature and time should be adjusted so that the tenderizing effect

due to the conversion of collagen to gelatin is not offset by the increasing toughness owing to an excessive coagulation of contractile proteins.

Many components of meats are responsible for its flavour. With heating, several of the components undergo changes. Proteins and free amino acids of meat, on heating, produce some volatile breakdown products. These include sulphur-containing compounds, aldehydes, ketones, alcohols, amines and others. Lipid components also break down into various volatile compounds. These volatile compounds in both the fat and lean portions of the meat, contribute to the flavour and odour of cooked meats.

During heating, meat fat melts, adipose tissue cells are ruptured, and there is a redistribution of fat. Some fat is dispersed finely in locations where collagen has been hydrolyzed. When meat is eaten warm, the melted fat serves to increase the palatability of the product by giving a desirable mouthfeel.

Meat contains a high percentage of water. Only a small percentage of this water is bound very closely to the protein of muscle tissue and the rest exists as free molecules within the muscle fibres and connective tissues. Heating reduces the water holding power of meat. The water holding capacity of meat, among other things, is related to its juiciness. The loss of water on cooking does not bring about changes in the nutritive value of proteins, and done stages are more juicy than well done meats.

The nutritional value of cooked meat generally remains high. Normal cooking does not bring about changes in the nutritive value of proteins, and minerals are not lost by heat. Some minerals may be lost in meat drippings but, on the other hand, cooking dissolves some calcium from bone and so enriches the meat in this mineral. There is loss of some B vitamins during cooking. But most of the cooked meat retains more than 50 per cent of the B vitamins present in the uncooked meats.

23.11 Meat Substitutes

Meat is an important component of the food of the population of advanced countries and is the major supplier of their protein requirements. Proteins derived from meat are more expensive than vegetable proteins. In some cases, as much as ten times more vegetable protein can be obtained from farm produce than from aminals that feed on them. A country with a dense population and limited amount of available land for farming cannot afford to feed animals food which is good for human consumption. Where the food supply is limited, human beings must gather their requirements of proteins and other nutrients from plants instead of allowing animals to do this for them. This necessitates the substitution of vegetable proteins for meat proteins.

The fat content of meat is high. High consumption of meat can lead to health problems including the hazards of heart attack. Further, in many societies, there are religious beliefs of various types which forbid the use of any meat or certain types of meat. These and the limited supply of food for

the world have added considerable impetus to the development of vegetable protein products.

Proteins of animals origin are of high nutritive value while those of vegetable origin are of poor quality because they lack one or more of the essential amino acids either in quantity or they are present in unfavourable proportions. However, the quality of vegetable protein may be improved if the limiting amino acids are supplemented. This can be achieved by a proper mixture of different vegetable proteins or the addition of synthetic amino acids.

The most important and abundant sources of proteins of vegetable origin are the low-fat oilseed cakes of groundnut, coconut, soyabean, cottonseed, etc. In developing countries where protein-calorie malnutrition exists, oilseed protein can help solve this problem. In India, oilseeds can provide more proteins than what is now available through animal products, such as milk, meat, eggs and fish. These proteins, with proper additives—particularly colour and flavour additives—can give products closely resembling the animal products. In addition to seed protein, leaf and yeast proteins can successfully substitute meat proteins for human consumption.

Amongst the vegetable proteins, the one that has been commercially exploited to replace meat is soyabeen protein. Soyabean has a high protein content. If all the oil and most of the soluble carbohydrates are removed from soyabean, a protein content of nearly 70 per cent can be obtained, and this can be processed as a meat substitute. The defatted flour is blended with water, vitamins, flavour and colour, and cooked. The dough is extruded at an elevated temperature and pressure and finally forced through a suitable die when the expansion of the product takes place due to a sudden release of pressure. Extrusion is used in the manufacture of granules which are marketed as *textured vegetable proteins* (TVP).

Textured vegetable proteins contain more protein than the meats themselves. Therefore, TVP is used as a meat extender. Because of its low cost and high nutritive value, the use of TVP as an extender in ground meat products up to 30 per cent is permitted in the US school lunch programme. TVP must be rehydrated with water before use. After rehydration, it can be used in the preparation of a variety of vegetarian and nonvegetarian dishes. Textured vegetable proteins and other vegetable protein foods are now manufactured in the country.

23.12 Gelatin

When collagen is heated, some intermolecular and a few main-chain peptide bonds are hydrolyzed. This results in the conversion of the triple helical structure of collagen to a more amorphous form known as gelatin. Thus, gelatin is a partially degraded collagen. If the collagen molecule is completely unstructured, glue, instead of gelatin, is produced.

Gelatin is prepared from the collagen of connective tissues and bones of animals. The bones are first demineralized to remove calcium and phos-

phorus by soaking in acid. The demineralized bone (ossein) is then hydrolyzed with alkali or acid. The commonly used method is alkaline hydrolysis with lime. About 1,500 tonnes per annum of gelatin is prepared by this way in the country.

Gelatin forms a gel in water even at a concentration of one per cent. Gel formation is due to the property of large molecules to form colloidal dispersions (sols) which, in some cases, become viscous leading to rigidity when cooled. The gel formation is due to a partial renaturation of the collagen molecule ("collagen fold"). Those parts of collagen that are rich in proline and hydroxyproline regain some of their structure, following which they can interact. When many molecules are involved, a three-dimensional structure is produced which is responsible for the gel at low temperatures. When once a gel is formed it can, without liquifying, stand a temperature higher than that required for its formation. Usually, the rigidity of a gel increases on further cooling or, sometimes, on standing. On continued standing, the gel loses water and shrinks in the syneresis process. A gelatin gel, when re-melted, sets into a gel faster than it does the first time.

Different grades of gelatin and modified gelatins are used in various industries. Gelatin used for edible purposes should be pure and conform to the statutory laws laid down by the country of its use. Gelatin, with its multiplicity of properties, finds use in the commercial manufacture of food products, such as canned foods, semi-preserves, confectionery, salt products, marshmallows, ice cream and gelatin desserts. In its simple form, gelatin is used in the form of jellies such as jelled desserts, sponges, cream salads, etc. In our country, due to the practice of vegetarianism, gelatin, is not as much used as food as in other countries. Gelatin, moreover, is a protein of low biological value as it is deficient in essential amino acids, such as tryptophan, threonine, methionine and isoleucine.

23.12.1 Gel Formation Preparation of gelatin gel is a two-step process requiring complete dispersion of the gelatin to form a sol and chilling it to form the desired gel. Gelatin is first soaked in three to four volumes of cold water for a short time. To the soaked gelatin, hot water or the desired liquid is added in small portions, with good stirring after each addition of liquid, till a final temperature of 35°C is reached. When once all the gelatin is dispersed, on cooling to room temperature, gelatin sets into a gel. Rapid gelation by cooling in ice should be avoided as it does not give a uniformly set gel and may lose its structure when removed to room temperature. A good gelatin product will be clear, will hold its shape when cut and yet be tender. There will be no rubbery areas or small gelatinous particles in the gel.

A number of factors influence gel formation and the rigidity of the gel. They are the concentration of gelatin, temperature, molecular weight of gelatin, added substances and the pH in certain ranges. The concentration of gelatin affects not only the firmness of the gel but also the rate of setting time. Generally, a gel of good texture is obtained with 1.5 to 2.0 per cent gelatin. If the molecular weight of gelatin is low, the rigidity of the gel is

poor. Beating or mechanical stirring reduces the rigidity of the gel. Temperature has a marked effect on gelation; low temperature increases the rigidity of the gel. pH variations which are not far removed from the isoelectric pH of gelatin have very little effect on gelation. Higher acidity (due to the use of vinegar and lemon juice), however, decreases the gel forming ability of gelatin. In such cases, a higher proportion of gelatin will help give a gel of good texture. The influence of salts on rigidity is not considerable. Sugar influences the setting time as well as the gel strength. A very small amount of sugar increases the setting time of a gel but a higher concentration of sugar decreases the setting time.

Gelatin preparations: Gelatin preparations, such as jellied fruits and vegetables, sponges and creams are very popular. If fruits and vegetables are to be combined with gelatin, the gelatin dispersion should be allowed to cool until it is ready to form a gel. Then vegetables or fruits, fresh, frozen or canned, may be added and allowed to cool further. Raw pineapple should not be used with gelatin. The enzyme bromelin present in pineapple hydrolyzes gelatin and prevents it from setting into a gel.

Gelatin forms stable foams. When gelatin is dispersed in some liquids at room temperature, the product could be whipped into a foam. On cooling, the gelatin will set in the foam and such foams are stable and firm as long as they are chilled but the stability is lost at room temperature.

24. POULTRY

The term poultry refers to domestic fowls reared for their flesh, eggs or feathers and includes chicken, ducks, geese, turkeys, guineas and pigeons. Of these, chicken and turkey are most commonly used for their meat.

24.1 Desi Birds

The present-day breeds of chicken found all over the world have descended from the jungle fowl of the Himalayan, central and southern parts of India. The sport of cock-fighting which was very common in India and some other Asian countries was mainly responsible for the domestication of wild birds. From these parts the domestic fowls gradually spread to other parts of Asia and from there to other parts of the world. The turkey is considered to be of American origin.

Breeding poultry as a profession came into existence about three centuries ago but its development as an important industry all over the world has been just for about 100 years. In spite of the long tradition of poultry keeping in India, very little was done through the centuries for the development of the industry. In our country, for several years, poultry meat was met by utilizing spent hens (after laying) and cocks that were culled from poultry groups from time to time. There was no proper poultry forming. However, during the past few decades poultry development work has been taken up in an organized way and developed into a small-scale industry.

Till the poultry development work took place, the Indian varieties of birds were the "desi" breeds. They are not good from the point of egg and meat production. Their egg production is only about 53 compared to the world average production of 120 eggs per hen per annum. Though their meat content is less it is delicious. The desi birds have been improved.

A number of imported breeds have been bred and acclimatized to India. Chief among them are the White Leghorn, New Hampshire and Rhode Island Red. A number of other breeds have also been successfully introduced into the country.

These developments have resulted in a large number of poultry farms and an increase in poultry meat production.

The production went up from 89,000 tonnes in 1971 to over 100,000 tonnes in 1980. In spite of this, the consumption of poultry in the country is far below the world standard. Our consumption in 1980 was 0.61 kg per head per annum as against 3.6 kg in many western countries. In USA, the annual per capita consumption of chicken was 23.6 kg and turkey 4.5 kg in 1979.

24.2 Classification

Chicken are classified into different types depending on the fowl's ability to produce a product of commercial value, such as egg type, meat type, dual-purpose type and miscellaneous type. Meat types are generally large in size with plenty of flesh but they are not good layers. The meat is tender. The dual-purpose type also yields meat of excellent quality alongside a good number of eggs.

Each kind of poultry marketed is classified on the basis of age. Age influences tenderness and fat content, and this determines the cooking method. The classification according to Indian standards are as follows.

Broiler or Fryer: Chicken of 8 to 10 weeks of age of either sex, tender-meated with soft, pliable, smooth textured skin and flexible breastbone cartilage.

Rooster: A young chicken, usually 3 to 5 months of age, of either sex, tender-meated with soft, pliable, smooth-textured skin and breastbone cartilage that may be somewhat less flexible than that of the broiler or fryer.

Stag: A male chicken, usually under 10 months of age, with coarse skin, somewhat toughened and darkened flesh and a considerable hardening of the breastbone cartilage.

Stewing chicken or fowl: A mature chicken, usually more than 10 months of age, with meat less tender than that of a roaster and nonflexible breastbone tip.

Cock: A mature male chicken, usually over 10 months of age, with coarse skin, toughened and darkened meat and hardened breastbone tip.

Other forms of poultry are classified in a similar way.

24.3 Poultry Processing

Poultry is marketed in ready-to-cook form, i.e., the head, feet and entrails are removed (dressed chicken). Birds are generally not fed for 12 hours before slaughter to ensure that their crops are empty, which helps cleaner operations. They are killed by a method that minimizes struggle. The birds are stunned and made unconscious with a blow on the head. In large establishments, stunning is carried out by electrical stunners. The jugular vein is cut so that the bird bleeds well. Bleeding takes 1 to 3 min. and it should be complete in order to produce a product of quality.

After bleeding the birds are scalded, i.e., dipped in hot water briefly. The temperature of the scald water may be 60°C and the bird is kept in it for

about 45 s. or, more safely with less chance of the outer layer of the skin (cuticle) removal, at 52°C for 2 min. Scalding loosens the feathers on the chicken and thus helps defeathering. Then, the feathers are removed, generally by mechanical methods. Pin feathers (feathers which have not quite emerged) may be removed manually or by suitable mechanical methods.

After defeathering, evisceration of the bird takes place. The abdominal cavity is opened by means of a transverse cut, and after inspection, the entrails are removed. The lungs and kidney which are difficult to remove may be done so by a suction tube. The head, feet and oil glands are then removed from the drawn bird. The eviscerated birds are thoroughly washed and chilled.

Rapid chilling to 1.7°C is essential to control the growth of bacteria which contaminate the flesh once the skin is broken. Cooling is also necessary from the point of view of tenderness of meat. The time of onset of rigor, its duration and the tenderness of meat once rigor has gone, are influenced by the way the bird is cooled. Muscle from poultry cooled in ice-water is more tender than that held in water at higher temperatures and that cooled in air. Eviscerated and washed birds are to be promptly cooled to avoid toughening of the muscle due to lowering of pH by accumulation of lactic acid. Poultry, like meats, goes into and out of rigor, but more rapidly than other meats. A minimum of 4–5 hours from the time the chicken is slaughtered is required until it is cooked.

Dressed chicken is graded before it is marketed. Grading takes into consideration the condition of the bird prior to the slaughter, during evisceration and packing. Each country has set standards for grading and the number of grades of chicken. In India, two grades are assigned to chicken, Grade 1 and Grade 2. This is based on conformation (deformations that detract from the normal appearance), meatiness, fat covering, defeathering, cuts and tears and discolouration.

The graded poultry is individually packed in low-moisture and low-oxygen transmission film or bags. Before sealing the packs, care is taken to expel the air between the carcass and the bag. The sealed bags may be stored under refrigeration or frozen. Refrigerated poultry has a shelf-life of only a few days (6–10 days). Frozen poultry, at – 23° to – 18°C, may be stored up to 9 months.

24.4 Composition and Nutritive Value

Poultry meat has a high protein content varying from 18–25 per cent, and is comparable in quality and nutritive value to other meats. It contains all the essential amino acids required for building body tissues. There is little fat on the meat of young birds, but the fat content is influenced by age, and species of poultry. In any case, the fat content of poultry is less than half that of other meats. Chicken fat is more unsaturated than the fat of red meat and this has nutritional advantages. Like other animal tissues, poultry flesh is a good

source of B vitamins and minerals. The dark meat of chicken is richer in riboflavin than the light, but the light meat is richer in niacin.

Because of its high protein-to-fat ratio, poultry meat is advantageous to persons who must restrict the intake of fats. The importance of poultry in a country like ours with low nutritional standards cannot be overemphasized. Use of poultry products in our diet will help avoid malnutrition. Another advantage of poultry in our country is that it is eaten by persons who have objection to eat beef or pork.

24.5 Poultry Cooking

Raw chicken has little or no flavour; it develops during cooking. The principles of cooking poultry are basically the same as for cooking meats. The cooking method is selected on the basis of the tenderness of the poultry and its fat content, both influenced mainly by the age of the bird. Moist heat methods are applied to older and tougher birds in order to make them tender and palatable. Dry heat methods are applied to young tender birds.

The changes that take place during the cooking of poultry are similar to those of other meats. To obtain tender, juicy and uniformly cooked poultry, low to moderate heat is to be used. Intense heat results in the toughening of proteins, shrinkage and loss of juiciness.

24.5.1 Broiling and Frying Young tender poultry is cooked by broiling, frying, baking or roasting. For broiling, the bird is placed in the broiler with the skin side down. The whole bird or halves may be broiled. The broiler is placed about 10 cm from the flame or heating element and cooked at a broiling temperature of 177°C till the internal temperature of the breast muscle reaches 95°C (about 45–60 min.). Because of the low fat content of the young birds, basting with melted fat will improve the flavour, palatability and appearance of the preparation.

Frying and deep fat frying are particularly suitable for cooking low-fat, young, tender poultry and more frequently used than broiling. The halves of the birds are frequently fried. Before frying they are coated with seasoned flour or beaten eggs and bread crumbs. They are then carefully cooked to prevent overbrowning before the meat is tender. If deep-fat-fried, the bird must be steamed until the stage of doneness before being dipped in flour or in egg and crumbs, and fried slowly. The time required for browning in deep fat is too short to promote thorough cooking of meat.

24.5.2 Roasting Poultry may be roasted, stuffed or unstuffed. When the whole bird is roasted, tender parts, such as the breast, may be overcooked before the legs and thighs are cooked to the desired state. For stuffed birds, roasting should be continued till the internal temperature of the stuffing reaches 74°C. This eliminates the possibilities of bacterial food poisoning. When the poultry is roasted without stuffing, it is cooked at an oven tem-

perature of 163°C till the internal temperature of the thigh muscle reaches 85°C.

24.5.3 Tandoor chicken This is a well known and popular Indian chicken dish. This is barbecued chicken. The cooking is done in a clay oven called a tandoor. Tandoor is a long earthenware pot embedded in clay and earth. Charcoal is put inside and the oven is made red hot. Other types of ovens are designed and used. Tender chicken, either whole or cut, is used. The skin is removed from the chicken and the flesh pricked with a fork and sprinkled with salt. Tandoor sauce is then smeared on the chicken which is then left aside for 6–8 hours. It is then cooked in the tandoor. Half way through the cooking time it is removed from the oven and brushed all over nicely with butter or oil and cooked again until the chicken is fork tender. Chicken cooked this way is delicious.

24.5.4 Braising and Stewing The older tougher birds are cooked this way. Disjointed pieces of chicken are generally braised. Generally, they are first browned by frying after which water is added and the bird simmered until it is tender. For stewing, the whole bird or cut pieces are used. They are cooked in water with seasonings and vegetables till they are tender.

25. SEAFOODS

Fish is found abundantly in all natural waters. It is a valuable source of food and has been used by man from antiquity. With mounting population pressure most nations are expanding their fish catching power. In addition to fishing in vast oceans, fish cultivation on a large scale is gaining major significance in many lands. Tapping the wealth of the oceans and inland waters and its efficient utilization have become urgent for the survival of the human race. About 10 per cent of world's fish catch comes from inland fisheries.

25.1 Fish Catch

The total fish catch of the world is of the order of 70 million tonnes per year. India has a coast line of about 5,600 km and the continental shelf bordering the Indian coast has an area of about 2.6 million sq. km. in which infinite varieties of fish are found. In addition, the rivers, reservoirs, lakes and canals in the country have an area of about 1.13 million sq. km. which afford a wide variety of habitats to fishes. In 1981, the catch of fish was 2.6 million tonnes. About 151,000 tonnes of fish are exported per year; the total value of exports of fish and fish products amount to over 300 crores per annum. More than 80 per cent of our exports is frozen shrimp.

The consumption of fish in India is about 2.5 kg per capita per year, which is perhaps the lowest in the world. This may be due to the fact that fish is eaten mostly by people residing in coastal areas. With increased fish catch by the use of modern techniques, the development of fish processing and better methods of storage and transport, there is likely to be an increase in the consumption of fish.

25.2 Types of Fish

It is estimated that there are about 25,000 species of fish living today, varying in size from very small fish to very large sharks. They are second to insects in the largeness of population and outnumber all other vertebrates (back-boned animals), mammals, birds, reptiles and amphibians put together.

About 250 different species of fishes are used for edible purposes. Edible fishes are classified into two major categories based on their anatomical differences. Fishes having vertebrae with fin-appendages, which help balance and steer the body in its movements through water, are termed as finfish. The skin of these fishes is covered with protective scales and is abundantly coated with mucous. Fishes without a skeleton but covered with some type of hard shell are known as shellfish.

The shellfish are of two types; the molluscs and crustaceans. The former have soft unsegmented body while the latter have segmented bodies. The molluscs are either partially or wholly enclosed in a hard shell that is largely of mineral composition. These include oysters, clams, scallops and mussels. The crustaceans are covered with crustlike shells and they include lobsters, crabs, shrimps and crayfish. Edible shellfishes are mainly salt water fishes.

The kinds of finfish available for food are more than those of shellfish and the types differ in different locations. They are found both in salt water and fresh water. Their flavour and quality depend partly on the water in which they are grown. Saltwater fishes have a more distinctive flavour than freshwater fishes. The common sea or marine fishes available in the country are all types of shark, salmon, mackerel, Bombay duck, ribbon fish, pomfret, sole, tuna, etc. Fishes from fresh water include sardine, mullet, catfish, perch, pearlespot, etc.

Fishes are also classified based on their fat content as lean (less than 2 per cent fat), medium (2 to 5 per cent) and fat (more than 5 per cent) fishes. Bombay duck, halibut, cod, perch and sole are examples of lean fish. Fat fish include salmon, sardine, mackerel, tuna, etc. In fish with more than 5 per cent fat in the edible flesh, the flesh is usually more highly pigmented than that of the low-fat varieties which are generally white fleshed.

25.3 Composition and Nutritive Value

The composition of fish varies considerably, amongst other factors, due to variation in fat content. The fat content of fish varies from 0.1 per cent to about 25 per cent. Many factors like the season, sex and stage of maturity determine the fat content of fish. In all cases, the liver and viscera (the pyloric caecum and mesenteria) constitute the location of fat depot. However, fats are also encountered in muscle tissue, skin, mutt and roe (mass of eggs of fish).

The principal component of most fish oils are glycerides of fatty acids which make up 95 per cent of the oil. Fish oils differ remarkably from vegetable oils in containing a great variety of fatty acids, especially highly unsaturated fatty acids having from four to six unsaturated linkages. The fatty-acid composition of seawater fish oil and freshwater fish oil varies, the latter containing smaller amounts of C–20 and C–22 unsaturated acids than marine fish oils, but a greater amount of C–18 unsaturated acids. Fish fat also contains cholesterol, lecithin, waxes and fatty alcohols. The fat from fish eggs is especially high in lecithin (up to 20 per cent).

Fish is an excellent source of protein. The protein content of finfish is, on an average, about 20 per cent. The muscles of some lean fish contain exceptionally high levels of protein when compared to the best meat. As a whole, the protein content of shellfish is lower than that of finfish.

Fish contains some glycogen, shellfish containing a higher proportion; some shellfish have 3 to 5 per cent glycogen. The sweet taste of various shellfish is due to glucose formed from the glycogen by enzymic action.

Fish is a good source of minerals. It contains more minerals than other types of meats. Fish meat is a good source of copper, sulphur and phosphorus. In general, saltwater fishes contain more iron than freshwater fishes, although Indian species of the latter group show high values. Marine fish is a dependable source of iodine. The iodine content of marine fish is nearly 30 times that of freshwater fish. Its content in marine fish varies from 0.01 to 0.5 mg per 100 g of fish meat. Iodine is essential for the prevention of goitre.

Fish oils are the richest known sources of vitamins A and D. However, there are extreme differences in the vitamin reserves of different species. Fish flesh is a fair source of thiamine, being somewhat poorer in the vitamin than most meats. In some raw fish the enzyme thiaminase is present, and this destroys the vitamin and makes it unavailable if fish is held in a raw state or consumed raw. The riboflavin content in fish flesh is as much as in beef. Red flesh has a higher content of this vitamin than white muscle. Both seawater and freshwater fish are good sources of niacin. The vitamin C content of fish is very low and does not have any nutritional significance.

Systematic investigations on the nutritive value of fish have shown that it is equal to that of meat. Fish proteins are also easily digested. The amino acid pattern of fish protein closely approximates that found in any other class of animal protein. Generally, fish meat has lysine and histidine at a high level and, occasionally, methionine and tryptophan on the low side of mammalian meat. Because of their high nutritive value, fish protein concentrates (FPC) have been developed from inexpensive and surplus fishes to combat malnutrition of people around the world (see Subsection 25.8.2).

25.4 Fish Spoilage

Fishes are highly perishable. In India, with its tropical and subtropical climate, the problem of spoilage is more acute as heat and moisture promote deterioration. Fish tissue is generally more perishable than animal tissue and this is true even under conditions of refrigeration. Freshly caught fish at a temperature of 16°C remain good for hardly a day. On ice at 0°C, finfish may remain good for periods of up to about 14 days, but this is not true of all species. In contrast, beef may be stored at 1.7°C for several weeks. The reasons for the spoilage of fish are microbiological, physiological and chemical in origin.

25.4.1 Microbiological Flesh of healthy live fish is bacteriologically sterile. However, there are many types of bacteria on the surface skin, gills, and the digestive tract of living fish. Generally, spoilage takes place shortly after the death of the fish when bacteria attack all the constituents of the tissues. Since these bacteria live on cold-blooded fish at a rather low ocean temperature, they are well adapted to cold and continue to grow even under common refrigeration conditions.

25.4.2 Physiological Bacterial spoilage of fish does not begin until the fish has gone into rigor and passed out of it. For rigor mortis to set in, the glycogen in fish muscle must be converted into lactic acid accompanied by a decrease in pH. However, fish struggle when caught and use up virtually all of the glycogen in their muscles. When killed there is little glycogen left to be converted into lactic acid to slow bacterial growth. Rigor mortis in fish is comparatively shorter when compared to other animals which are rested before slaughter to build up glycogen reserves.

25.4.3 Chemical Fish as taken from water have virtually little or no odour. Yet, virtually all fish products have a fishy odour and this is an evidence of some deterioration. The fishy odour is due to the production of trimethyl amine by the action of bacteria on phospholipids and choline present in fish. Also, the unsaturated fish fats undergo oxidation and become rancid, which also contributes to the smell of deteriorated fish.

25.5 Preservation and Processing

As fish is a highly perishable commodity, various methods have been devised to preserve it. Before preservation, fishes are washed with clean water to remove slime, blood stains, etc. Larger fishes are gutted (i.e., all the internal organs or viscera are removed) and the body cavity washed. The various methods adopted for preservation are drying, salting, smoking, freezing and canning.

Sun drying is the most ancient of methods. Drying removes moisture from tissues and helps arrest bacterial and enzymatic putrefaction. In India, over 35 per cent of the total catch of sea fish is cured in the sun. This method is not hygienic, there is an appreciable percentage of loss due to putrefaction and spoilage, and the dried fish develops a peculiar odour.

Salting (pickling) is also widely used in India. The dry-salting or wet-salting method is used. In the former method, fishes are first rubbed with salt powder and then packed in tubs with dry salt powder sprinkled in between layers of fishes. After a period of about 10–20 hours the fishes are removed, washed in brine and dried in the sun for 2–3 days.

In wet-salting, cleaned fishes are packed in large vats containing concentrated salt solutions and stirred daily till properly pickled. With large-sized fishes, longitudinal slits are made in the flesh to allow penetration of salt. After pickling for 7 to 10 days, the salty water that oozes out from the

fish is allowed to drain off. Wet-salted fish is sold without drying. It does not keep for long and therefore has to be used within 3 to 4 months. In some countries fishes soaked in salt solution are taken out and smoked. Smoked fish is not popular in India.

The above methods employed for curing fish are rather crude and primitive and the products are unattractive. Case-hardening, rancidity development, colour changes, mold growth and attack by insects and mites are some of the common defects of fishes cured by sun drying and salting.

Chemicals, such as acids, sodium benzoate and ethylene oxide and the antibiotic aureomycin can prolong the life of fish. However, many countries do not permit the use of these preservatives. Irradiation of fish by γ-radiations prolongs their storage life by 20–25 days. But the current methods of importance for preserving the quality fish are freezing and canning.

Freezing: Freezing can greatly extend the period of storage and is effective in keeping the fish in a condition similar to that of fresh fish, if the fish is gutted and frozen down to – 29°C within two hours of its catch. In some cases clean whole fish is frozen. Finfish are usually frozen as fillets (lengthwise cuts), steaks (crosscut section) or sticks (lengthwise or crosswise cut from fillet or steaks). Large fish are frozen by the sharp freeze, a comparatively slow freeze. Small fish, fillets and steaks are quick frozen. This type of freezing gives a better produce. The storage life of quality frozen fish, with a low fat content, can be as long as two years.

Some undesirable changes can also take place if proper care is not taken during freezing. Slow freezing can result in protein denaturation. As the water freezes in the fish, the salt concentration of the muscle tissue increases which causes denaturation of the protein, making it tough and rubbery. Another effect of freezing is desiccation or drying. Drying is caused by the transfer of moisture from the surface of the fish to the cold surface of the freezing equipment. Frozen fish undergo oxidative changes, and fatty fish become rancid more quickly than lean ones. Desiccation and oxidation can be prevented by properly protecting fish with suitable wrappers before freezing.

Preservation of fish by freezing is not yet widespread in India. Cold storage facilities are available in areas where fisheries are highly developed.

Canning: While high-fat fish do not store as well as low fat fish in the frozen state, oily fish are the most suitable for canning. Salmon, tuna, sardine, herring, lobster, shrimp, etc., are canned. In the case of salmon, tuna, sardine and mackerel additional fish or vegetable oil is commonly added to the fish prior to can closure; shrimps are canned in brine. Canning retains the natural flavour of the fish. Large quantities of certain types of fish are canned in this country mostly for export purposes.

Shellfish become dark or discoloured during canned storage. This is due to the release of hydrogen sulphide from the sulphur components of the fish, which reacts with the iron in the can to give black iron sulphide. This can be avoided by using an enamel, especially an enamel containing zinc, since the zinc sulphide formed is white in colour.

25.6 Shellfish

Shellfish are even more perishable than finfish. Lobsters and crabs, for example, are best kept alive up to the point of their cooking or freezing; otherwise they deteriorate in quality in a matter of a day or less.

25.6.1 Shrimp India is one of the leading shrimp processing and exporting countries in the world. Shrimp should be conserved or processed within five days of being caught even though they are iced. They contain greater amounts of free amino acids than finfish and also highly active proteolytic enzymes—the cathespins. Iced shrimp darken in colour and may become black due to enzymatic action. They, therefore, require refrigeration on being caught and quick freezing.

25.6.2 Oysters and Clams These, when sold in shell, must be alive. Shell oyster may be held at the refrigerator temperature for only a short time before use. Oyster culture has been developed. Clams are not cultivated as are oysters. Shucked oysters (removed from the shell) are sold fresh, frozen or canned or pressed into blocks and frozen.

25.6.3 Crabs and Lobsters Crabs and lobsters must be alive when cooked. There are many different types of crabs. The meat from cooked crab is squeezed out. Crab meat is canned or pressed into blocks and frozen.

The lobster is dark bluish green in colour when taken from the water but changes to red during cooking. The green colour is due to lobster liver which is considered a delicacy. The red colour of the cooked lobster is due to the eggs of the female. The cooked meat obtained from the shells of lobsters is marketed fresh, frozen or canned, as in the case of crab meat.

25.7 Fish Cookery

Cooking methods adopted for meat are applicable for fish cooking. The muscle fibres of fish are not tough and the amount of connective tissue is small and therefore they are more easily cooked than the meat of warm-blooded animals. When sufficiently cooked, the flesh of fish can be easily separated into flakes. Thus, fish is to be carefully handled during cooking so that it does not break easily. When overcooked, fish meat shrinks excessively and becomes tough and dry. This is true of shellfish also.

Fish is generally cooked by dry heat, such as broiling, baking and frying. Moist heat methods, such as steaming and poaching, are also used. The fat content of fish also determines the cooking method. Fish low in fat is generally fried or basted with fat. Some fishes are rich in fat and such fishes require very little additional fat in cooking.

Whole fish fillets and steaks may be baked. If the fish is thick fleshed it is scored here and there, i.e., little slits are made in the flesh on each side, so that it will hasten the cooking of the fish. The fish is then cooked at 177°C. The fish may be brushed with oil before baking to prevent overbrowning.

Broiling may also be used to cook whole fish or fish cuts. The dressed fish is placed on the broiler rack and cooked at a low broiling temperature. The temperature and time of cooking depend on the thickness of the fish to be cooked. The smaller the fish, the higher should be the temperature used. If the fish is large and thick the cooking should be conducted at a lower temperature so that the heat gradually penetrates the flesh.

Frying is one of the most popular methods of cooking fish. This method is suitable for fillets, steaks and small whole fish. The fish may be shallow or deep fried.

In shallow frying, fish is fried in a frying pan in hot butter. Before frying, the fish is soaked in lightly beaten egg or milk and rolled in flour or bread crumbs and shaken to remove the flour or crumbs not sticking to it. It is then fried till it becomes brown on each side. Next, it is removed from the pan and drained on absorbent paper.

Deep fat frying is similar to shallow frying except that the frying medium is oil. The deep fryer should be no more than half filled with oil and heated to about 195°C to 200°C. Coated fish is plunged into the oil and when cooked it rises to the surface.

Cooking fish by steaming and poaching helps preserve its delicate flavour. For steaming, the fish is kept in a covered pan and placed on a rack over boiling water and cooked until done. In poaching, fish is placed in a kettle and covered with water. It is cooked with the liquid simmering.

25.8 Fish Products

A number of products are prepared from fish. These include fish meal used as animal feed, fish flour used for protein enrichment of human food, fish oils used for feeding and industrial purposes, fish glue, isinglass—a high grade fish collagen used for the clarification of wines, beer, vinegar, etc.

25.8.1 Fish Meal Fish meal is prepared from the parts of fish not used for human food, and sometimes the whole fish of less favoured species, by grinding the material usually with the removal of some oil, followed by dehydration. Fish meal, on an average, is composed of proteins, 55–70; fat, 2–5; minerals, 10–12; and moisture, 6–12 per cent. Fish meal is used as animal and poultry feed. Low grade fish meal is used as manure in plantations of tea, coffee and tobacco. Considerable quantities of fish meal are produced in India.

25.8.2 Fish Flour It is possible to extract oils and fatty substances from ground fish tissues by solvent extraction to such an extent that no fishy odour or flavour remains. The fat extracted tissue, after stripping off solvent, dehydration and milling, gives a bland highly nutritious powder rich in high quality protein and minerals. This product, when produced under

proper bacteriological and sanitary control, is good for use as human food and is known as fish flour or fish protein concentrate (FPC).

Fish flour, properly manufactured and packaged, can retain its bland and nutritive properties almost indefinitely. The flour can be incorporated at 3–10 per cent level into a variety of dishes without adverse effects upon their acceptability. Fish flour contains 85 to 90 per cent of high quality protein. It is estimated that food shortage and high quality protein needs in several areas of the world can be alleviated by fish flour, at very low cost.

25.8.3 Fish Oils Fish oils are of two kinds, liver oils and fish body oil. Liver oil is the principal natural source of vitamin A and, to a lesser extent, vitamin D. Fishes, such as cod, halibut, tuna and shark, are good sources of fish liver oils. The oil and vitamin A content vary in different fishes. Body oil is obtained from fishes, such as sardine, herring and salmon.

Liver oil is obtained by different methods. One common method is by cooking good quality minced fish liver at 85°–95°C. This results in the disintegration of liver cells and freeing of oil. The oil floating on the steam condensate can be skimmed off or separated by centrifugation. About 300 kilolitres of shark liver oil per annum are produced in the country.

Fish body oils are produced along with fish meal. Fishes are first ground to a pulp and steamed. The oil and water get separated from the protein. The cooked flesh is then pressed. The "presscake" is worked up for fish meal. The press liquor or "stick water" is concentrated and oil recovered.

What Is Food Thickener?

A food thickener is a thickening agent that increases the viscosity of a liquid mix without interfering with its other properties. Knowing how to thicken food is essential for preparing many recipes; most sauces, gravies, soups, and even desserts are thickened with some kind of starch. Each thickening agent has properties best suited for specific recipes. One of the most commonly used methods for thickening sauces and other recipes is through the gelatinization of starches.

Pure Food Thickening Starches

Pure starches have greater thickening power and add less color to a final dish, making them ideal for sauces, puddings, and fillings. Gluten-free thickeners have become an **emerging trend for food** allergy-conscious bakeries and restaurants. Thickening starches are particularly important in **gluten-free baking** because they mimic the "sticky" effects of gluten and create a pleasant texture in baked goods. Luckily, many pure starch and leavening ingredients are naturally gluten-free! Just be sure to check nutrition info for ingredients containing these variations of wheat: barley, durum, faro, malt, Matzoh, oats, rye, **seminola**, spelt, and wheat (bran, flour, germ, starch, and hydrolyzed protein).

List of Thickening Agents

1. Corn Starch

The most common of all the starches, **corn starch** is derived from corn, making it vegan and gluten-free, as well as transparent and relatively flavorless. This completely versatile starch is used in savory and sweet dishes alike: gelatinizing fruit pie fillings or thickening your hefty, stick-to-your-bones soups.

- Thickens soups, sauces, gravies, and pie fillings
- Coats foods before frying to create a crispy exterior
- Vegan & Gluten-Free

2. Xanthan Gum

As a plant-based, all-purpose thickening agent and stabilizer, **xanthan gum** is commonly used to thicken sauces and gravies, and it is famous in the gluten-free baking community! Plus, mixing this with yogurt, ice cream, sherbet, and frozen yogurt adds substance and thickness, as well as prevents ice crystals from forming.

- Thickens soups, sauces, gravies, and pie fillings
- Stabilizes ice cream and other frozen treats
- Mimics the elasticity and viscosity of gluten in gluten-free baked goods
- Vegan & Gluten-Free

3. Gelatin

Coming in powder or sheet forms, **gelatin** is made from the collagen that is found in various animal body parts. Gelatin can be used as a stabilizer or texturizer, but it is most commonly used as a thickener for marshmallows, gummy snacks, trifles, aspics, mousse, mirror glazes, panna cotta, and other gelatin desserts.

- Thickens puddings, ice cream, and panna cotta
- Creates a firm texture in gummy candies, marshmallows, and other desserts
- Not recommended for use with pineapple, guava, kiwi, or ginger root
- Gluten-Free

4. Pectin

Pectin is a natural starch that is found in the seeds, rinds, and membranes of citrus fruits, and it is especially high in structured, firmer fruits such as apples and quinces. **Unlike gelatin**, pectin is not made from animal collagen, meaning it's vegan-friendly. Mainly used for thickening jams, jellies, and marmalades, this natural thickener gels the macerated fruits when combined with acid and sugar and cooked at around 220 degrees Fahrenheit.

- Thickens jams, jellies, marmalades, and preserves
- Vegan & Gluten-Free

5. Potato Starch

Potato starch is just as its name suggests: starch that is extracted from potatoes. As an amazing thickening and binding agent, it is ever popular in

many gluten-free recipes. With a low gelatinizing temperature, relatively colorless, odorless, and tasteless, and a strong binding texture, potato starch is used for cooking and baking applications alike.

- Thickens soups, sauces, gravies, and pie fillings
- Coats foods before frying to create a crispy exterior
- Not recommended for use in dishes with a long cooking or baking time
- Vegan & Gluten-Free

- ## 6. Tapioca Starch

  Extracted from the cassava plant, **tapioca starch** is a very fine, starchy, white powder that is a great thickening agent for food. Slightly sweet, tapioca starch is sometimes used in place of cornstarch, potato starch, and even wheat flour in gluten-free baking! Tapioca starch gives baked goods a crispy crust and chewy center, and is superior to arrowroot starch and potato starch.

- Thickens soups, sauces, and desserts
- Creates a crisp, chewy texture in gluten-free baked goods
- Vegan & Gluten-Free

7. Arrowroot

Derived from various tropical plants such as arrowroot plant, tapioca, and cassava, **arrowroot powder** is a colorless and flavorless thickener that has twice the thickening power of flour, and stands up against acids that normally break down other starches.

- Thickens soups, sauces, gravies, and pie fillings
- Coats foods before frying to create a crispy exterior
- Vegan & Gluten-Free

8. Agar-Agar

Made from red algae, this thickener is a jelly-like substance that is perfect for substitution with gelatin when making vegetarian and vegan foods. Agar-agar, often referred to as "kanten" or "agar", is odorless, flavorless, and colorless, keeping your recipes to their tried-and-true perfection.

- Used in Asian desserts as a plant-based substitute for gelatin in vegan recipes
- Utilized in preserves, jellies, and jams