CHAPTER 6: FARM PRODUCTS PROCESSING/PROCESS FARM PRODUCTS

6.1 Introduction

This unit specifies competencies required to process farm products (value addition). It involves identification of products for value addition and determine technology or machines/equipment to use to process flour to flour products, vegetables into juice and vegetable products, fruit into juice, herbal products and animal products which include milk, pork, beef, chicken, fish, rabbit, and bee products and package processed products. The significance of the unit constitutes an important role for increasing Gross Domestic Product through provision of additional goods and new processed products as well as creating a source of export and foreign exchange. It also provides employment and increased income for farmers.

The critical aspects of competency to be covered include; ability to identify products for value addition, determine technology/machines and equipment to use, processing products to flour and flour products, processing vegetables into juice and vegetable product, processing fruit into juice, wine and products processing herbal products and processing animal products.The basic resources to be used include; mills, cereals, fruits,herbs juicers, blenders, sieves, hides and skin,dust coats, meat,tannery chemicals and milk among others.

The unit of competency covers seven learning outcomes. Each of the learning outcome presents; learning activities that covers performance criteria statements, thus creating trainees an opportunity to demonstrate knowledge and skills in the occupational standards and content in curriculum. Information sheet provides; definition of key terms, content and illustration to guide in training. The competency may be assessed through written tests, demostrations, practical assignments, interview/oral questioning and case study. Self assessment is provided at the end of each learning outcome. Holistic assessment with other units relevant to the industry sector workplace and job role is recommended.

6.2 Performance Standard

The competency of farm products processing includes; Select products for value addition and determine machines and equipment to use in value addition as per perishability and consumer preference. Process vegetables into juice and vegetable products, fruit into juice products as per technology of value addition. Process products to flour, herbal products and animal products as per technology of value addition used.

6.3 Learning Outcomes

6.3.1 List of learning outcomes

a) Identify products for value addition

b) Determine technology/machines and equipment to use

c) Process products and flour products

d) Process vegetables into juice and vegetable products

e) process fruit into juice, wine and products

f) Process herbal products

g) Process animal products

6.3.2 Learning Outcome No 1: Identify products for value addition.

6.3.2.1 Learning Activities

Learning Outcome No 1: Identify products for value addition	
Learning Activities	Special Instructions
1.1 Choose products for value additions as per perishability and customer preference 1.2 Source products for value addition as per product value requirement.	Group Discussions

6.3.2.2 Information Sheet No6/LO1: Identify products for value addition

Introduction

This learning outcome covers: types of value addition products, perishability, harvest timing, preservation method, packaging methods, transportation methods, customer preference and nutritional/medicinal value.

Definition of key term

Customer preference: These are expectations, motivations, dislikes and inclinations that drive customer purchasing decisions.

Perishability: It is used in marketing to describe the way in which service capacity cannot be stored for sale in the future.

Nutritional value: Refers to contents of food and the impact of constituents on body. It relates to carbohydrates, fats, proteins, minerals, additives, vitamins, sugar intake, fat and cholesterol content.

Content/procedures/methods/illustrations

1.1Products for value additions are chosen as per perishability and customer preference.

Value added products is defined as change in the physical state or form of the product such as milling wheat into flour or making strawberries into jam. Or the physical segregation of an agricultural commodity or product in a manner that results in enhancement of the value of that commodity or products. The value of farm products can be increased in endless ways by cleaning and cooling, packaging, processing

distribution, cooking, combining, churning, culturing, grinding, hulling, extraction, drying, smoking, handcrafting, spinning, weaving, labeling or packaging commodities versus products.

The produce and the sell mentality of the commodity business is being replaced by the strategy of first determining what attributes consumers want in their food products and then creating or manufacturing products with those attributes. Market forces have led to greater opportunities for product differentiation and added value to raw commodities because of:

a. Increased demands regarding health, nutrition and convenience.
b. Efforts by food processors to improve their productivity.
c. Technical advances that enable producers to produce what consumers and processors desire.

There is no longer content to sell raw commodities hence some producers are striving for a larger share of the food dollar. These projects range from;

a. Adding value to hogs, cattle, bison fish and eggs.
b. Producing specialty cheese and even alfalfa-based biomass for a local power plant.
c. Marketing crops like organically grown grains, potatoes, carrots, beans, and corn for sweeteners and fuels.

Producers have a challenge to be responsible to customers' demands by producing what is desired. Attentiveness to consumer demands in quality, variety and packaging are important because demographic trends slow growth in the convenience-oriented, health conscious and environmentally concerned sectors where price is not an important quality. Value added research is important, producers examine competitive advantages obtainable with processed products compared to raw commodities.

Approaches to adding value

Adding value to agricultural products can be accomplished in a number of different ways, but generally fall into one of the two main types, innovation or coordination. Generally, the problem is to evaluate what, where, how and who can efficiently perform the market functions.

Innovation

Innovation focuses on improving existing processes, products and services or creating new ones. Often successful value-added ideas focus on very narrow, highly technical geographically large market where competition is spare.

Industrial innovation: Specific type of innovation which is processing of traditional crops into nonfood end uses. These values adding innovative activities use the research and emphasis that has been placed on finding industrial nonfood uses for common agricultural products for example producing ethanol from corn.

Coordination

Coordination focuses on arrangements among those that produce and market farm products. Fundamental changes through coordination are altering traditional marketing relationships that link consumers, food retailers and whole sellers, food processors and producers. Few individuals possess all the business management for processing, marketing and business management as well as staying efficient with their production enterprises.

Vertical integration

Complete vertical integration is to align and control all of the segments of production and marketing system under single ownership. The factors aligned and controlled are: price, quantity, quality and transactional terms of exchange. producers who invest in value added products past the farm gate cause the market to become more vertically integrated.

Importance of minimizing cost in value-addition

Before producers examine value added processing and marketing, cost minimization in production must be achieved. Only low cost and efficient producers will be able to survive and compete in production agriculture.

Consumer not only want food products to be of high but also to meet health, safety and environmental attributes. Income increases, food consumption also changes and consumer become more demanding in terms of quality and safety of the products. The range of choices of food product for the modern consumers are literally unlimited hence very often than not their expectation regarding the value or quality has raised a great deal. Events that occur when the food is in the distribution system can adversely impact quality.

These could be the result of random shocks such as power outages or negligence on the part of the employees who improperly store, refrigerate or handle food products in distribution. Perishable goods marketing, according to the needs demands of the customers have become the colossal task of the marketers because if its inherent features. Approximately 15% of perishable goods spoil before they can be sold. Retailers could reduce food wastage and keep food prices by using the freshness indicator help and monitor inventories.

Consumers attitude towards perishable food

The consumers response to perishable food is the primary driver for establishing and delivering acceptable quality Agri-products to the market. One useful measure to establish whether the appropriate quality has been adopted and what criteria are playing the crucial roles. The actual value that they are getting, what they expect and the relative importance of what they receive can be considered as basic information required.

Not all factors are equally important for all kinds of perishable food. Some are highly important as a criterion, whereas some others are to be expected at the best level of availability. Example: Factors that are vitally important while consumers are taking decision of buying leafy vegetables, fruity vegetables, fish and meat.

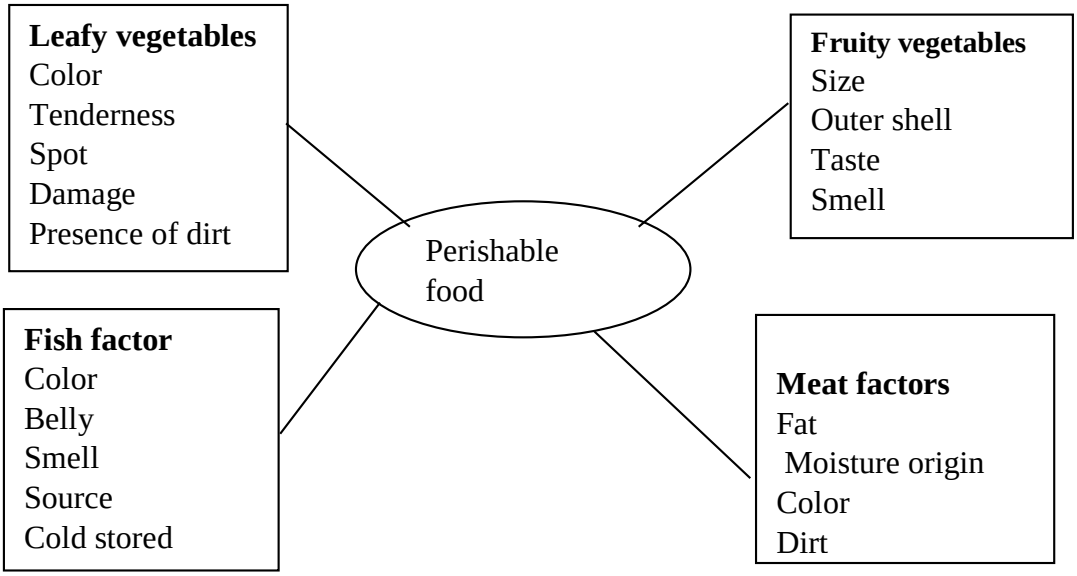

Figure 32: vitally important factors

Benefits of value addition on perishable products.

- Increased shelf life. The longer the product can stay without getting spoilt, the more the guarantee one has of a product selling at their preferred price and time. Milk for instance, hardly last over 24hrs but with boiling it can last more days, while with further processing into ghee, the same milk can last for months.
- Increased bargaining power of the value-added products in the market.
- Value addition allows the farmer to focus on the consumer while producing and through meeting the expectations he can create a loyal market around the product.
- Increased revenue. Any addition adds a percentage of increased financial value to the produce and has the effect of improving the incomes of the local farmers.

1.2 Products for value addition are sourced as per product value requirement.

Agriculturally producers have explored ways to add value to crops and livestock including creating business to capture higher profit margins by further processing or creating specialty market for their products. Value added agriculture focuses on the production or manufacturing process, marketing of services that increase the value of primary agricultural commodities perhaps by increasing appeal to consumer and consumer willingness to pay a premium over similar but unidentified products. Value addition is a worthwhile investment because it generates higher returns, allow penetration of a new potentially high value market, extend the production season or perhaps create brand identity or develop brand loyalty.

What drives value addition?

Agribusiness particularly the food sector is rapidly consolidating and increasingly responding to consumers' tastes and preferences. Consumers have higher income than before therefore focusing on more convenient, quality variety, services, health and social consciousness. They are also faced with increasing value of their time.

Factors that creates added value

Value is usually created by focusing on the benefits associated with the agribusiness products or services that arise from;

- Quality: Does the product or service meet or exceed customers' expectations.
- Functionality: Does the product or service provide the function needed of it.
- Form: It is the product in useful form.
- Place: It is the product in the right place.
- Time: It is the product in the right place at the right time.
- Ease of possession: It is the product easy for the customer to obtain.

Creating a value-added product.

Any agricultural enterprise can be thought of as a value to the product. To do this one must control the activities of each step in the value chain: Procurement of inputs, converting inputs into products, marketing and sales supply chain logistics and customer service activities.

A new value-added business should focus on the product uniqueness which ultimately attracts customer.

Commodity-oriented strategy A producer focuses on costs of production with an aim of being a low-cost producer.

Value added strategy involves a demand side focus on determining who the customers are and what they want. After assessing available resources and source of uniqueness provide and cost a service or product that curbs production costs while meeting needs of the potential market.

Steps to success in value-added business

The key factors in a detailed business plan are operations plan -flow of the business, quality control.

i. Sales plan: Including challenging but realistic goals.
ii. Personal plan: Needs skills and training.
iii. Investment and financial plan. Cash flow planning.

Examples of value-added agricultural product

In the beef industry a rancher can add value by having a cow-calf operation or retaining ownership of his cattle through a feed yard. Another option is producing speciality products such as sausage and tamels.

Example: Wheat grain can be added value in many ways. One of the ways is for farmers to produce wheat grain for use in feed or food products.
Wheat straw a waste product can be harvested, processed then turned onto building materials.

Principles that apply to adding value to farm products.

- Start small and growing naturally.
- Make decisions based on good records.
- Create a high-quality product.
- Follow demand driven production.
- Get the whole partners involved.
- Keep informed.
- Plan for the future.
- Evaluate continuously.
- Persevere.
- Capitalize adequately
- Focus.

To capitalize on value added opportunities farmers can adopt one or more of the following approaches.

- Performing activity that is traditionally done in another stage down the agricultural supply chain, which changes the form, space and time characteristics of the raw agricultural commodities.
- Vertically integrating several stages in the supply chain or horizontally coordinating with other farmers, or bypassing stages in the supply chain in order to create closer or direct connection between farmers and consumers.
- Performing an activity or adopting a production practice at the growing stage that changes the identity or quality characteristics of raw products to characteristics consumer value higher in the market place. These practices establish and preserve customer preferred characteristics along the supply chain using labels and other segregation technique. For example, organic product identity is obtained through organic practices at the growing stage, can be certified and can carry a price premium over non organic products of the same type regardless of the products distribution channel.

Storage of farm produce

The principle underlying food preservation are:

- Destruction of microorganism.
- Prevention of their entry into food.
- Arrest or preservation of purely chemical reaction.
- Arrest the action of food enzymes.

Reasons for preserving food

- To prevent spoilage
- To be able to take care of emerging situations
- To prolong its shelf life
- To avoid wastage, especially when they are most expensive
- To introduce a variety in the family menu

Causes of food spoilage

Food spoilage is undesirable changes taking place in the place in the food which eventually leads to its spoilage. Food spoilage is caused by:

- Actions of insects
- Physical changes
- Action of microorganism
- Purely chemical reaction in the food
- Action of microorganism e.g. bacteria, yeast and molds
- Physical changes in the food

Preparation of food preservation

Some of the preparation that should be embarked upon before preserving our foods are:

i. Clean the food thoroughly
ii. Cut the food into desired sizes
iii. Ensure that the food is of good quality
iv. Package food correctly and label if need be

Various methods of preserving food

People have various methods of preserving food, this include
Drying, frying, bagging, fermentation, smoking, salting, heating, blanching, canning or bottling, refrigeration and freezing and irradiation.

Blanching: Is a method of preserving food. It inactivates enzymes and minimizes changes leading to deterioration in the sensory and nutritional qualities.

Canning and bottling: This process requires canning equipment and the ability to use a heat source. Foods preserved by this method are sealed in a closed container, such as a can, glass or bottle. Such tools are stored for up to a year. The cost of canning or bottling can be expensive after purchasing the equipment and of heating fuel and is a fiddly process requiring sterilization and knowledge of the temperature involved.

Irradiation: Physical method of preserving food has the potential both of disinfecting dried food to storage losses and disinfecting fruits and vegetables to meet quarantine requirements.

Conclusion

This learning outcome has covered types of value addition products, perishability, customer preference and nutritional value.

Further Reading

1. Kilkeny, M, and G.E Schluter ,2001." Value added Agriculture policies across the 50 states "" Rural America" 16(1) 12:18
2. Journal on choices, what do we mean by value added agriculture.

6.3.2.3 Self-Assessment

Written assessment

1. The following shows the principle that apply to adding value to farm products except?
    a) Evaluate continuously.
    b) Follow demand-driven production.
    c) Low cost production.
    d) Keep informed.
2. Market forces have led to greater opportunities for product differentiation and added value to raw commodities because of the following except?
    a) Increased consumer demands regarding health nutrition and convenience.
    b) Technological advances that enables producers produce what consumers expect.
    c) Effort by producers to improve their productivity.
    d) Marketing agricultural products such as organically grown crops.
3. Two of the following are approaches of adding value. Except?
    a) Innovation.
    b) Revenue.
    c) Coordination.
4. To capitalize on value added opportunities, farmers can adopt two of the following except?
    a) Performing activity that is traditionally done.
    b) Innovation.
    c) Vertically integrating several resources.
5. What do you understand by the term perishability?
6. Differentiate between consumer preference and value addition.
7. What is vertical integration in relation to value addition?
8. Give the importance of minimizing costs in value addition.

Oral Assessment

1. Explain the approaches to value addition.
2. Explain how a value-added product is created.

Case Study Assessment

A certain horticultural company has been producing vegetables, and flower for the local market. The company wishes to expand its premises and export the commodities to a foreign country. What advice are you going to give the company on consumer preference, perishability, cost of production and transport in order for the company to avoid incurring losses and instead reap maximum returns.

Practical Assessment

1. Collect several varieties of vegetables or flower and using the learnt knowledge and available facilities, increase the shelf life of the cut flower and vegetables for a period of one week.
2. Using the available perishable products such as milk, flowers or vegetables, survey the customer choice of preference and market the products in your local area and make a brief report on the carried-out activity.

6.3.2.4 Tools, Equipment, Supplies and Materials

- Fruits and vegetables,
- Milk
- Cereals

6.3.2.5 References

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Sanni A.I (1993) The need for process optimization of African fermented foods and beverages int.J. food.

Watanda, A. E and Minnot, D. A 1996.Factors Affecting Quality of fresh cut horticultural products. Postharvest biology Technology 9.115-125

6.3.3 Learning Outcome No 2: Determine technology/machines and equipment

6.3.3.1 Learning Activities

Learning Outcome No 2: Determine technology/ machines and equipment to use	
 Learning Activities	Special Instructions
2.1 Identify products to be processed as per client requirement 2.2 Determine technology used as per product type. 2.3 Determine the machines or equipment to be used as per technology of value addition.	Group instructions on various technologies and machines used in value addition.

6.3.3.2 Information Sheet No6/LO2: Determine technology/machines and equipment

Introduction

The learning outcome to be covered include; Choice of equipment and machinery Type of technology equipment and machinery maintenance.

Definition of key terms

Equipment: It is a type of fixed asset used by a company in its business operations and reported on the long-term assets section of the balance sheet.

Machinery: Mechanical device or the parts that keep something working.

Technology: Refers to methods systems and devices which are the result of scientific knowledge being used for practical purposes.

Content/procedures/methods/illustrations

2.1 Products to be processed are identified as per client requirement.

Agricultural product processing and storage plays an important role in the food and feed preparation for the continual survival of man. Through development of modern storage facilities, food crop preservation becomes easy and simple to follow.

Agricultural product: processed agricultural produce which has been turned into finished goods either for human/animal consumption or for industrial use.

Processing: In agriculture, it involves biological, physical, mechanical and biochemical manipulation of agricultural produce in order to preserve it for further use. It involves the series of operations taken to change agricultural products into consumer-finished products.

Agricultural processing involves both scientific and traditional manipulation of agricultural produce so as to make more useful and be able to store them for future uses.

Reasons for processing food crops

- Processing helps make food available even during the off season.
- When food is processed it tastes and looks very attractive.
- Processing helps in the durability of food crop products. When food crop is being processed like in dehydration of food of a food crop, micro-organisms become absent thereby preventing spoilage.
- It adds value to the agricultural produce.
- It creates room for commercial agriculture, thereby promoting agricultural activities.
- By processing of food regularly, more food will be in our food reserve which will aid in adaptation and mitigation of climate change.
- Processing provides raw materials for further studies and industrial uses.
- Through processing, some materials are produced (by-products) which can be used for formulation of animal feed.
- Science of processing can aid in drugs and mechanical purposes.
- Agriculture produce processing gives income to a farmer and improves his living standard.
- Exportation is high when food is processed thereby improving her foreign exchange earnings.
- Processing provides employment for individual and the masses.
- Through agricultural processing of crops like sugarcane, bio-fuel and power is produced which is used for generation of farm or industrial power.

Processing Techniques

There are different techniques involved in processing of agricultural produce. The different machines used in processing are hammer mill, roller mill and bore mill.

a) **The hammer mill**

This machine is used in processing agricultural produce that is dry. The hammer mill is made up of a hammer with a roller with pulleys. The blocks contain hammers. As the hammer rotates, the block rotates as well then, the product will be mill by pressure of the hammer. It is used to mill crops whose moisture content is reduced e.g. rice

b) **The bore mill**

It has two plates, rough and smooth plates, enclosed in a structure. The auger pushes the produce into the collection point. It is used to process agricultural produce that are wet oily and dry.

c) **Roller mill**

Consist of two rollers that are cylindrical in shape, connected to pulley or sheath in between the rollers. There are spaces between the two cylinders so that when rollers rotate, they will rotate in two directions and merge the produce into small particles.

Categories of agricultural products to be processed

Agricultural products are derived from cultivated plants or animals to sustain or enhance human life. Food is the most widely used agricultural product. Agricultural products fall into one of the four groups: Foods, fuels, fibres and raw materials

- **Food**

Grains and cereals crops are grown on more than half of the world's farmed acreage. Food products encompass more than just cereals like wheat and corn, meat and dairy products like milk, honey and farmed fish.

- **Fuel**

Ethanol produced from corn, sugarcane or sorghum is the agricultural fuel product in the widest use. However agricultural byproducts like straw sugarcane are also burned to produce power.

- **Fiber**

Fiber crops include cotton, wool and silk. Agricultural producers also hemp to make rope and flax for linen.

- **Raw materials**

Those agricultural products used to make other agricultural products e.g. livestock feed considered an agricultural product. It is used to provide nourishment to the animals that produce dairy products.

2.2 Technology used is determined as per product outcome.

Integrated processing technologies for food and agricultural by-products. Some by-products have found use as animal feed or are combusted for energy; new technologies which integrate conversion of production and processing by products into higher value food or non-food products, nutraceuticals, chemicals and energy resources will be a critical part of the transition to a more sustainable food system. Below are technologies related to agricultural and natural manufacturing under four key areas of accelerating change: sensors, engineering, food and automation.

i. Sensors

Sensors help agriculture by enabling real-time traceability and diagnosis of crop, livestock and farm machine states.

a) **Air and oil sensors:** Involve fundamental additions to the automated farm. These sensors would enable real-time understanding of current farm, forest or body of water conditions.
b) **Equipment telematics:** Allows mechanical devices such as tractors to warn mechanics that failure is likely to occur soon. Intra-tractor communication can be used as a rudimentary 'farm swarm' platform.
c) **Livestock biometrics:** Collars with apps and biometrics and can automatically identify and relay vital information about the livestock in real-time.
d) **Crop sensors:** Instead of prescribing field fertilization before application high application equipment of correct amounts needed. Optical sensors/drones are able to identify crop health across the field.

e) Infrastructural health sensors: Used for monitoring vibrations and material conditions in buildings, bridges, factories, farms and other infrastructure. Coupled with an intelligent network such sensors could feed crucial information back to maintenance crews or robots.

ii. Food

Food may benefit directly from genetic tailoring and potentially from producing meat directly in a lab. Genetically designed food is a creation entirely new strains of food, animals and plants in order to better address biological and physiological needs. In-vitro meat, also known as, cultured meat or tube steak, is a flesh product that has never been part of a complete living animal. There is no meat which has been produced for public consumption.

iii. Engineering

Engineering involves technologies that extend the reach of agriculture to new means, new places and new areas of the economy. Of a particular interest will be synthetic biology, which allows efficiently reprogramming unicellular life to make fuels, by products accessible from organic chemistry and smart devices.

iv. Automation

Automation will help agriculture via large scale robotic and micro robots to check and maintain crops at the plant level.

Variable rate swath control: Building on existing geolocation technologies, future swath control could save on seed, minerals, fertilizer and herbicides by reducing overlapping inputs.

Rapid iteration selective breeding: The next generation of selective breeding where the end result is analyzed quantitatively and improvements suggested algorithmically.

Agricultural robots (agbots): They are used to automate agricultural processes such as harvesting, fruit picking, ploughing, soil maintenance, weeding, planting, irrigation

Precision Agriculture: Farming management based on observing intra-field variations with satellite imagery and advanced sensors farmers can optimize returns on inputs while preserving resources at larger scales.

Factors affecting adoption of technologies

Diffusion is the process of by which a new idea, practice or technology spreads in a given population. The characteristics of technologies, such as relative advantage, complexity, divisibility, observability and compatibility affect their diffusion. Farmers will be encouraged to adopt new technologies for sustainable farming systems if the dissemination of information is efficient. It is important to facilitate the dissemination of improved farming system technology to farm households through farmer participation methods and to strengthen existing resource planning capability and improve research extension policy. Several 'barriers' have hindered the assimilation of new technology through:

- Perceived fundamental inability to demonstrate a linkage between profitable technology adoption and sustainable production at farm level.

- Failure to recognize and address the psychological component of technology adoption as part of the educational process, because generating knowledge is not always synonymous with diffusing and adopting knowledge.
- Instruction and demonstration of new technology within the controlled setting of a university research farm may not encourage farmers to adopt the technology for their own farms which have distinct and different resources.
- Limited movement away from a discipline-based or anti-dimensional approach to a broader system may have reduced ability to evaluate the economic and environmental components of technology uptake.

Development in the processing and retail sectors

Food processing occurs in three ways:

a) The classical way: Farm products are combined with processing.
b) Organic way: Significant market share in some cases
c) Functional convenience way: Farmer acts as a supplier of ingredients. The food industry is the effective creator of food.

Strategy recommendations for processing types

a) Classical way: Classical vertical cooperation including communications.
b) Organic way: Generally, entails an increase cooperation (labelling conditions and communication).
c) Functional convenience way: The only strategy for farmers is production of commodities.

2.3 The machines or equipment used are determined as per technology of value addition used.

Types of equipment used for material handling in food and processing industries include: conveyor systems and fluid transport devices e.g. pumps, hoses, tubes and piping. Additional equipment includes: timers, thermometers, scales, weighing systems, pressure gauges and precision controls.

Food processing machines and equipment refers to component processing machines and systems used to handle, prepare, cook, store and package food and food products.

Although this equipment is primarily aimed toward the transformation i.e. increasing the palatability, consumability and digestibility or preservation i.e. (extending the shelf life of food), some pieces of equipment are also employed to perform preliminary or auxiliary functions such as handling, preparation and packaging. Employed for food and product, applications ranging from bakery goods to beverages and dairy to produce, a wide range of food processing equipment is available to execute the various unit operations necessary during a complete production cycle such as washing, mixing, baking, freezing and sealing.

Depending on the demands of the operation, this equipment can be designed and constructed to handle solid and semi-solid or liquid food products by batch or continuously. Some other design considerations include: the food grade materials used for construction, hygienic and governmental standards, sizing, cost and integration of automation or analytical components.

Types of food processing equipment

Wide range of processing equipment can be classified and categorized in several different ways for example end product form, mode of operation, application, etc. Some of the most common functions by which food processing equipment are grouped include: Preparation, mechanical processing, heat processing, preservation and packaging.

i. Preparation equipment

The initial preparatory operations focus on preparing the raw food material for subsequent processes – typically mechanical or chemical processing by separating the desirable material from the substandard or undesirable material. It ensures production of uniform and high-quality food and food products, as well as remove foreign matter and contaminants which may degrade or damage the food material or equipment. Some of the unit operations and equipment which manufacturers employ during raw material preparation include: cleaning, grading, peeling and sorting.

Table 10: Preparation Equipment

Unit Operation	Equipment applied
Cleaning	Wet processes • Soak/floatation tanks • Spray washers • Washing systems • Sterilizers • Ultrasonic cleaners
Grading	Tungsten lights(candling) Image processors Laboratory equipment
Peeling/Skinning	Pressure vessels (flash steam peeling) Stationary/rotating blades Carborundum abrasive rollers/bowls Conveyors and furnaces
Sorting	See dry processes • Sorting machinery • Disc separators • Sieves/screens (size sorting) • Machine vision sorting systems • Sorting conveyors

ii. Mechanical processing equipment

Mechanical processing operation are employed without the application of heat or chemicals to reduce, enlarge, homogenize or otherwise change the physical form of solid, semi-solid and liquid food matter. By altering the size and form of the food matter, manufacturers can facilitate and increase the efficiency and effectiveness of

subsequent processes, improve the overall quality and edibility and allow for a greater range of food products to be produced.

Table 11:Mechanical food processing equipment

Unit operation	Equipment employed
Size reduction	Grinding/crushing • Impact mills • Pressure mills • Attrition mills • Jaw crushers • Roll crushers • Stainers/Pulpers
Size enlargement	Agglomeration • Rotating pans • High speed agitators • Tableting equipment • Pelletizing equipment Forming • Bread molders • Pie & biscuit formers • Confectionary molders • Enrobing machines
Homogenization	Homogenizers • Emulsifiers • Colloid mills • High shear mixers Fluid mixers • Agitated tanks • Paddle mixers • Anchor mixers • Turbine mixers
Mixing	Dough/paste mixers • Horizontal dough mixers • Sigma blade mixers • Cutter mixers Solid mixers • Diffusive (passive) mixers • Convective mixers • Drum blenders

iii. Heat processing equipment

Depending on whether the application and the specific unit operation is aimed towards heating or cooling the food material, heat transfer equipment can be used to direct heat towards or away from material respectively. The unit operations employed during the heat processing stage include: baking, blanching, roasting and frying.

Heat processing equipment by unit operation

Unit Operation	Equipment employed
Baking	Baking ovens • Direct heating ovens • Indirect heating ovens • Batch ovens • Continuous & semi-continuous ovens
Blanching	Blanchers • Steam blanchers • Hot water blanchers
Dehydration	Dryers • Convective dryers • Contact(conductive) dryers • Vacuum dryers • Freeze dryers

Table 12:Heat processing equipment

iv. Preservation

The preservation stage of the food processing production cycle ultimately aims to prevent or inhibit spoilage and increase shelf life of food products. Preservation methods include refrigeration and irradiation.

Food Preservation equipment by method

Preservation method	Equipment used
Chemical	Natural • Salt • Smokers • Acids such as vinegar Non-natural • Sorbic acid • Sulphur dioxide • Benzoic acid
Irradiation	Irradiation equipment such as isotopes and electron accelerators
Refrigeration	Chilling (-1^{0}C - 8^{0}C) • Chillers • Mechanical refrigerators • Cryogenic systems Freezers (below freezing point) • Mechanical refrigerators • Cryogenic systems

Table 13:Food Preservation equipment

Machinery and equipment maintenance

Machinery maintenance means mechanical assets in a facility are kept in working order. It involves regular servicing of equipment, routine checks, repair work and replacement of worn or non-functional parts.

Conclusion

This learning outcome has covered choice of equipment and machinery to use, technologies used as per the product and maintenance of equipment and machinery.

Further Reading

1. US Department of Agriculture, Food Safety and Inspection service 2015
2. Basics for Handling Food Safely webpage
3. Cold storage chart www.fsis.usda.gov

6.3.3.3 Self-Assessment

Written assessment

1. Food Processing equipment include the following except?
    a) Preparation
    b) Storage
    c) Mechanical processing
2. Processing Occurs in two of the following ways except?
    a) The classical way
    b) Organic way
    c) Operational convenience
3. The following technologies are used in agricultural and natural manufacturing. Except?
    a) Biometrics
    b) Automation
    c) Precision
4. The following categories of agricultural products to be processed except?
    a) Food
    b) Machinery
    c) Fuels
5. Agricultural robots automate the following agricultural activities. Except?
    a) Irrigation
    b) Harvesting
    c) Temperature regulation
6. Differentiate between machinery and technology.
7. What do you understand by the term agricultural product?
8. Give the functions of the following processing technologies:
    a) Hammer mill
    b) Bore mill
9. Give two reasons for processing food crops.
10. Give the function of equipment telematics.

Oral Assessment

1. Explain the various processing techniques.
2. Explain the reasons for processing food crops.

Case Study Assessment

A certain farm carrying out irrigation on production horticultural crops would like to adopt new technologies to manage crop diseases on time and manage soil nutrients with an aim of increasing their production. Which technologies would you advise them to use and why?

Practical Assessment

Using precision agriculture identify and observe changes in an agricultural farm. Give a brief report on the same.

6.3.3.4 Tools, Equipment, Supplies and Materials

- Tannery chemicals
- Tannery equipment
- Blenders
- Juicers
- Mixers
- Sieves

6.3.3.5 References

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6.3.4 Learning Outcome No 3: Process products to flour and flour products

6.3.4.1 Learning Activities

Learning Outcome No 3: process products to flour and flour products	
Learning Activities	Special Instructions
3.1 Mill products into flour in accordance to miller's association guidelines and KEBS specification. 3.2 Prepare flour products as per recipe manual	Field excursion Illustration of various flour products

6.3.4.2 Information Sheet No6/LO3: Process products to flour and flour products

Introduction

The learning outcomes to be covered include: types of milling technologies, flour products, packaging of flour and flour products and occupational safety standards.

Definition of key terms

Milling technologies: Refers to various ways of machining using rotary cutters to remove material by advancing a cutter into a workpiece.

Flour products: These refers to products such as pan bread made from flour.

Content/procedures/methods/illustrations

3.1 Products are milled into flour in accordance to miller's association guidelines

Flour is a finely ground powder prepared from grain or other starchy plant foods and used in baking. Flour can be made from a wide variety of plants. The vast majority is made from wheat. Dough made from wheat is particularly suited for baking bread because it contains a large amount of gluten, a substance composed of strong elastic proteins.

Raw materials

Although most flour is made from wheat, it can also be made from other starchy plant foods. These include: barley, buckwheat, corn, lima beans, oats, peanuts, potatoes, soybeans, rice and rye. Many varieties of wheat exist for use in making flour. Wheat is either hard or soft. Flour intended to be used to bake bread is made from hard wheat.

The manufacturing process (wheat)

Grading the wheat

Wheat is received at the flour mill and inspected. Samples of wheat are taken for physical and chemical analysis. Wheat is graded based on several factors. The most important is protein content. The wheat is stored in silos with wheat of the same grade until needed for milling.

Purifying wheat

Before wheat can be ground into flour, it must be free of foreign matter. This requires several different cleaning processes. At each step of purification, wheat is inspected and purified again if necessary. Device used to purify wheat is known as separator. This machine passes the wheat over a series of metal screens. The wheat and other small particles pass through the screen while large objects such as sticks and rocks are removed.

Wheat next passes through an aspirator. This device works like a vacuum cleaner. It sucks up foreign matter which is lighter than the wheat and removes it. Other foreign objects are removed in various ways. One device, known as disk separator, moves the wheat over a series of disks with indentations that collect objects and the size of grain of wheat.

Spiral seed separator makes use of the fact that wheat grains are oval while most other plant seeds are round. Wheat moves down a rapidly spinning cylinder. The oval wheat grains tend to move towards the center of the cylinder while the round seeds tend to move to the sides of the cylinder where they are removed. Other methods used to purify wheat include magnets to remove small pieces of metal, scourers to scrape off dirt hair and electronic color sorting machines to remove material which is not the same color as wheat.

Preparing the wheat for grinding

Purified wheat is washed in warm water and placed in a centrifuge to be spun dry. Any foreign matter is washed away. Moisture content of the wheat must be controlled to allow the water layer of bran to be removed efficiently during grinding in a process known as **conditioning or tempering**. Cold conditioning involves soaking the wheat in cold water for one to three days. Warm conditioning involves soaking the wheat in water at a temperature of 46℃ for 60-90 minutes. Hot conditioning involves soaking the wheat in water at a temperature of 60℃ for a short period of time. The method is difficult to control and is rarely used.

Grinding the wheat

Wheat of different grades and moistures are blended together to obtain a batch of wheat with the characteristics necessary to make the kind of flour being manufactured. Wheat is passed through a device with rapidly spinning disks which hurl the grains of wheat against small metal pins. Those grains which crack are considered to be unsuitable for grinding and are removed.

Wheat moves between two large metal rollers known as breaker rolls. They are of two different sizes and move at different speeds. Product of breaker rolls passes through metal sieves to separate it into three categories. Larger pieces, finest material and pieces of interior which are still attached to bran. Middling's purifier moves the middling's over a vibrating screen, air is blown through the screen to remove the lighter pieces of bran which are mixed with the middling.

Processing the flour

Small amounts of bleaching agents and oxidizing agents are usually added to flour after milling. Vitamins and minerals are added as required by law to produce enriched flour. Leavening agents and salt are added to produce self-rising flour. The flour is packed in clothe bags of different quantity.

Corn/maize flour milling

Maize or corn is one of the most widely planted grains in the world. Maize can be processed into flour, grits or even starch.

Corn flour mill process

Impurities discharging process

Maize kernels are fed from material inlet and the flow rate is controlled by a baffle. When maize kernels are transported by the bucket elevator into **de-stoner**, they first go through fine sieve, the sand and other impurities smaller than maize will be screened out and discharged from the tap hole. After sieving corn kernels, enter course screen to screen out impurities that are bigger than corn e.g. corn cob particles.

Above the sieve is a fan which suck light impurities still mixed in maize kernels; such impurities will be eliminated by the function of centrifugal sedimentation.

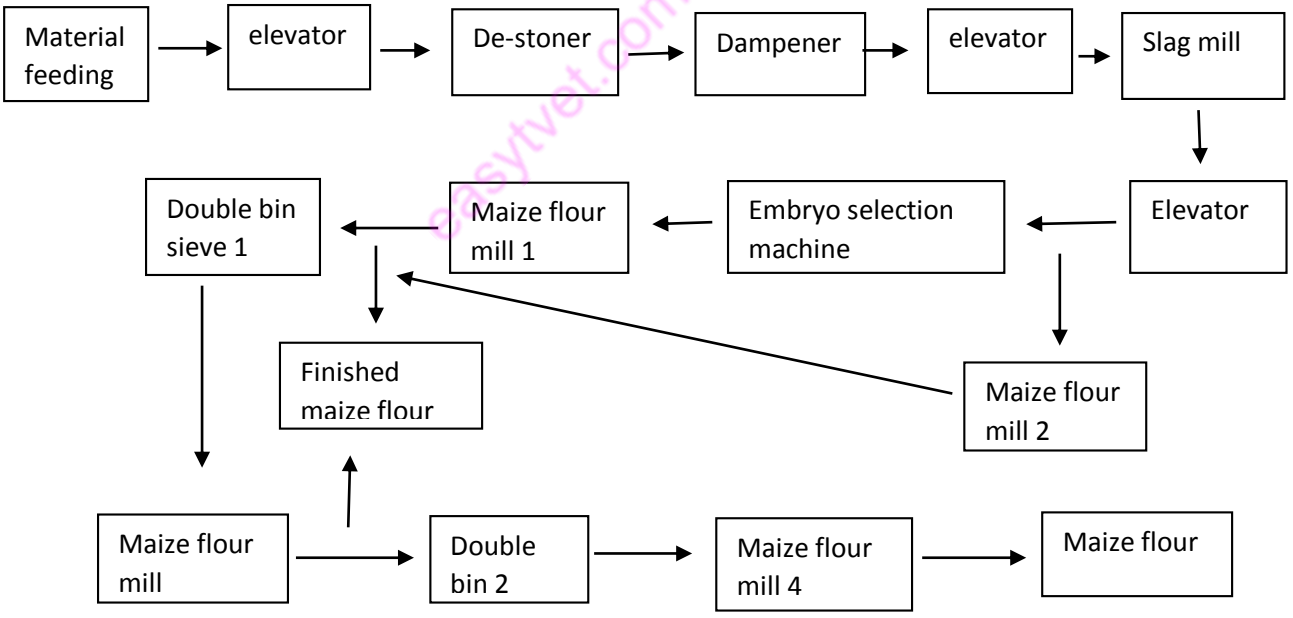

Figure 33: Impurities discharging process

Preliminary breaking and embryo

On the outlet of storage barrel, there is a baffle to adjust discharging flow. When maize kernels get out, they enter slag mill for preliminary breaking, so that some maize skin is separated from embryo. Broken maize is delivered by the elevator into embryo selection machine. Inside it, maize skin and embryo are separated and expelled from different outlets.

Finished products classification

Maize flour meets different classification standards depending on maize flour content and particle size. Maize flour is classified into four grades;

- Grade 1
- Grade 2

They are mainly maize skin and small portions of maize flour. They are used for animal feed, while grade 3 and grade 4 are fine maize flour for edible purpose.

3.2 Flour products are prepared as per recipe manual

Flour is finely ground cereal grains or other starchy portions of plants used in various food products and as a basic ingredient of baked goods. Flour made from wheat grains is the most satisfactory type of baked products that require spongy structure. Several flour products can be prepared. For example; from wheat flour the following products are obtained.

Wheat flour products

Pan breads

Most pan breads produced are white pan bread. Whole wheat and multigrain breads are a significant but smaller percentage of pan breads produced in large commercial bakeries. Pan breads produced in retail, supermarkets and in store bakeries are similar with regard to flour quality requirements but typically use a straight dough process and make up a much smaller percentage of total pan bread production. Several processes are used for producing pan breads through sponge and dough and liquid ferment systems are by far the most commonly used. The processes produce superior bread compared with straight dough and continuous mixing processes.

Flat breads

Tortillas are simply flour, water shortening and salt formulas. Chemical leavening or baking powders are sometimes added to improve the extensibility of the dough to facilitate high speed production and mould inhibitors have been added to increase mould free shelf life.

They also include chapatis which are made in a manual process which require flour that forms dough easily and that is reasonably easy to sheet and hand stretch.

Buns

Buns are basically bread dough with more sugar and shortening than typical pan breads. The process of dough mixing and fermentation are the same as for pan bread with sponge and dough and liquid ferment process. However, there is a preference for liquid ferments in buns. The superior flavor of sponge and dough is less valued because bun is consumed with meat and other condiments contributing flavor to sandwich.

Deep fried pastries

There are two types of deep-fried pastries;

- Yeast raised doughnuts
- Cake doughnuts

Since cake doughnuts have a longer inherent shelf life, they are mostly produced in commercial bakeries. Due to consumer preference yeast raised, doughnuts are produced in retail bakeries, supermarkets and doughnut shops.

Cake doughnuts

Cake doughnuts are similar to cakes in that they are rich, sweet batters produced with chemical leavening. However, their formulas are rather different from baked cakes due to deep fat frying of the batter. Flour quality influences the performance of the batter at several critical points during frying. Proper control of flour quality is important to end product quality. Flour used to make doughnuts are a blend of soft wheat flour and hard wheat flour.

Cookies, crackers, biscuits and wafers

Cookies are made with dough containing higher sugar and shortening levels and often low in water content. They range from dry crunchy cookies to chewy intermediate moisture varieties, most typically produced in retail bakeries or at home. Both are mass produced in retail bakeries or at home

Crackers

They are generally unsweetened to slightly sweet but often salty and made with fermented or enzyme modified dough. Common added flavors are cheese, sour cream, spice and various savory flavors.

Wafers

They are flat and hollow, rolled and soft wafers. The batters for flat and hollow wafers are liquids containing basically flour, water, enzymes, fat and sodium bicarbonate. To enhance quality and produce variations, it is possible to add egg powder, cocoa and powder.

Products of maize flour

Maize flour is used to make pancake mixes, infant foods, breakfast cereals and breadings and as a binder and carrier in meat products. Maize flour is also used in small holder houses to make maize meal such as porridge and ugali.

Importance of flour milling

- Many grains produced, consumed in a variety of different forms such as bread loaves, pancakes and muffins are made available through milling.
- It adds value to flour hence fetching higher market prices.
- Increase of product shelf life.

Conclusion

This learning outcome has covered types of milling technologies, flour and flour products and packaging of flour. Roller milling of maize produces maize flour with different organoleptic characteristics from flour milled in hammer mills.

Further Reading

1. Pomeranz Y 1988. Wheat chemistry and technology vol.1 and 2 AACC, St. Paul, MN, USA.
2. Prasher, C.L. 1987. Crushing and grinding process handbook John Wiley, London.

6.3.4.3 Self-Assessment

Written assessment

Multiple choice questions

1. The following are raw materials for making flour, which one is not?
    a) Lima beans
    b) Carrots
    c) Potatoes
    d) Barley
2. Which one of the following devices makes up part of purification of wheat?
    a) De-stoner
    b) Fan
    c) Disk separator
3. Which one of the following does not show the process of preparation of wheat for grinding?
    a) Purified wheat washed in warm water
    b) Sieving wheat kernels to enter coarse screen
    c) Controlling moisture content of wheat
4. Which one is not an example of deep-fried pastries?
    a) Cake doughnuts
    b) Yeast doughnuts
    c) Wafers
5. Which one is not an example of product from maize flour?
    a) Breakfast cereals
    b) Pancakes
    c) Mixes
    d) Flat breads

6. Categories of product from beaker mills include the following except?
    a) Pure pieces
    b) Finer pieces
    c) Interior pieces still attached to barn
7. Wheat flour product include —— and ——
8. Name two processes used in making plan breads
9. Differentiate between flour products and milling technologies
10. Give two agents added to flour after milling
11. What do you understand by the term flour and product processing?

Oral Assessment

1. Explain preparation of wheat for grinding
2. Explain the corn flour milling process

Case Study Assessment

Visit a flour milling industry to ascertain the various flour milling processes and write a brief report.

Practical Assessment

Visit a milling industry and grade the various quality of maize/wheat.

1. Participate in the milling process
2. Package the flour in various grades and quantity packages.

6.3.4.4 Tools, Equipment, Supplies and Materials

- Mills
- Cereals
- Hides and skims
- Textbooks and manuals

6.3.4.5 References

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6.3.5 Learning Outcome No 4: Process vegetables into juice and vegetable products

6.3.5.1 Learning Activities

Learning Outcome No 4: Process vegetables into juice and vegetable products.	
Learning Activities	Special Instructions
4.1 Identify vegetables to process into juice as per horticulture technical manual 4.2 Process vegetables into juice and products as per juice making recipes manual 4.3 Dry and ground vegetables into powder as per value addition manual	Demonstration on vegetable processing. Field Excursion.

6.3.5.2 Information Sheet No6/LO4: Process vegetables into juice and vegetable products

Introduction

The learning outcomes to be covered include: types of vegetables for value addition types of technologies used in vegetable processing, packaging of processed vegetable products, occupation safety standards and Standardization requirements.

Definition of key terms

Vegetables: A plant that is eaten raw or cooked such as cabbage, carrot or peas.

Products: Refers to something that is made to be sold, usually something that is produced by an industrial process or less commonly something that is grown or obtained through farming safety standards.

Safety standards: Refers to standards designed to ensure the safety of products activities of products, activities or products. These standards are prescribed by a regulatory body and be adhered by all stakeholders.

Content/Procedures/Methods/Illustrations

4.1 Vegetables to process into juice are identified as per horticulture technical

Vegetables consist of a large group of plants consumed as food. They are perishable when fresh but able to be preserved by a number of processing methods, they are excellent sources of certain minerals and vitamins are often main source of dietary fiber.

Structure and composition of vegetables

Vegetables can be classified by edible parts into:

Root (potatoes and carrots)

Stem (asparagus and celery)

Leaf (lettuce and spinach)

Immature flower bud (broccoli and Brussels sprouts)

Fruit (tomatoes and cucumbers)

Factors to consider in selection of vegetables for processing

Aging and spoilage

Depending on the class of vegetables there are differences in the structure, size shape and rigidly of the individual cells. The fresh market shelf life and processing requirements are also different. vegetables cells have rigid cell walls and are glued together by various polysaccharides saccharine such as cellulose, hemicelluloses and pectin.

Aging

Most noticeable structural change in senescent vegetables is softening or loss of texture. Softening is caused by natural enzymatic reactions that degrade the plant cell walls. Enzymes break open the cells leading to chemical oxidations and the vegetables develop off flavors and loss of nutritional value.

Spoilage

Occurs when broken cells are subjected to microbial attacks. Respiration leads to loss of quality, so that eventually the products are unsuitable for human consumption.

Nutritional value

Quality factors of vegetables are

- Colour
- Flavor
- Texture
- Nutritive values

Fresh vegetables are purchased on the basis of color and texture but repeated purchase is made on the basis of flavor and nutritional content.

Good quality

The vegetables for processing should not be rotten and should appear good. If the vegetables are rotten, they are not fit for processing.

Freshness of the vegetables

The vegetables to be processed should be fresh. The vegetables may not be the ones directly bought from the market but they should not lose their structure and appear stale. Stale vegetables are rougher and reduce the quality of the end product.

Quantity available

Before processing the vegetables, the quantity should meet the economies of scale. The cost of production should be reasonable compared to output to avoid incurring losses.

The price of the vegetables

Price is an important consideration before processing the actual market price of a particular vegetable should be known to avoid spending too much on purchasing. The price and the output prices of processed vegetables should meet the economies of scale. The other factors which determine whether the vegetable is worthwhile processing include: the demand of a particular vegetable

The quality of the raw material i.e. whether it can withstand processing.

Regular supplies of the raw materials

Processing requires frequent handling, high temperature and pressure. For example, many of the ordinary table varieties of tomatoes are not suitable for making paste or other processed products. Even when a variety can be processed, it is not suitable unless large and regular supplies are made available. An important processing centre or a factory cannot be planned just to rely on seasonal gluts it will not run economically unless regular supplies are guaranteed.

Location of the processing unit

The main objective of choosing the location is to minimize the average production cost, including transport and handling. It is an advantage, all other things being equal to locate a processing unit near the fresh raw material supply. It is a necessity for proper handling of the perishable raw materials. It allows the processing unit to allow the product to reach its best stage of maturation and lessens injury from handling it and determination from changes during long transportation after harvesting.

4.2 Vegetables are process into juice and products as per juice making recipes manual

Significant quantities of juice are produced from vegetable sources such as carrot celery, beetroot and cabbage. In general, the fresh vegetables are first washed and sorted before being coarsely milled and pressed to extract the juice, most vegetables have low acidity and therefore require a full sterilization process or freezing to be rendered safe.

Various ways in which vegetables are processed

Vegetable- pickling

In a typical pickling process, raw vegetables are delivered and subjected to washing and screening operations to remove extraneous matter such as stones, depending upon the vegetables, the raw material might be steam cooked and then cooled. The product is then peeled (typically using steam) and re-inspected before being cut to the required dimensions for example sliced/diced and transported to filling line. The chopped vegetables are filled in a containers and acidifying liquor mixed with spices and transferred to the filling line to be used in the pickling sauce.

Heat treated and frozen

After washing vegetables are peeled and trimmed. After peeling the vegetables may be left whole or cut in a number of ways such as sliced or dices. Some vegetables are

washed after slicing to remove surface starch. Most vegetables require blanching; steam or water blanching are the most common methods. After cooling the product is re-inspected and screened before being quick frozen or filled into cans or glass jars usually with a hot brine (sugar, salt acid) and then heat processed vegetable undergo a full sterilization process as the pH is high to inhibit microbial action.

Processing of vegetables flow chart

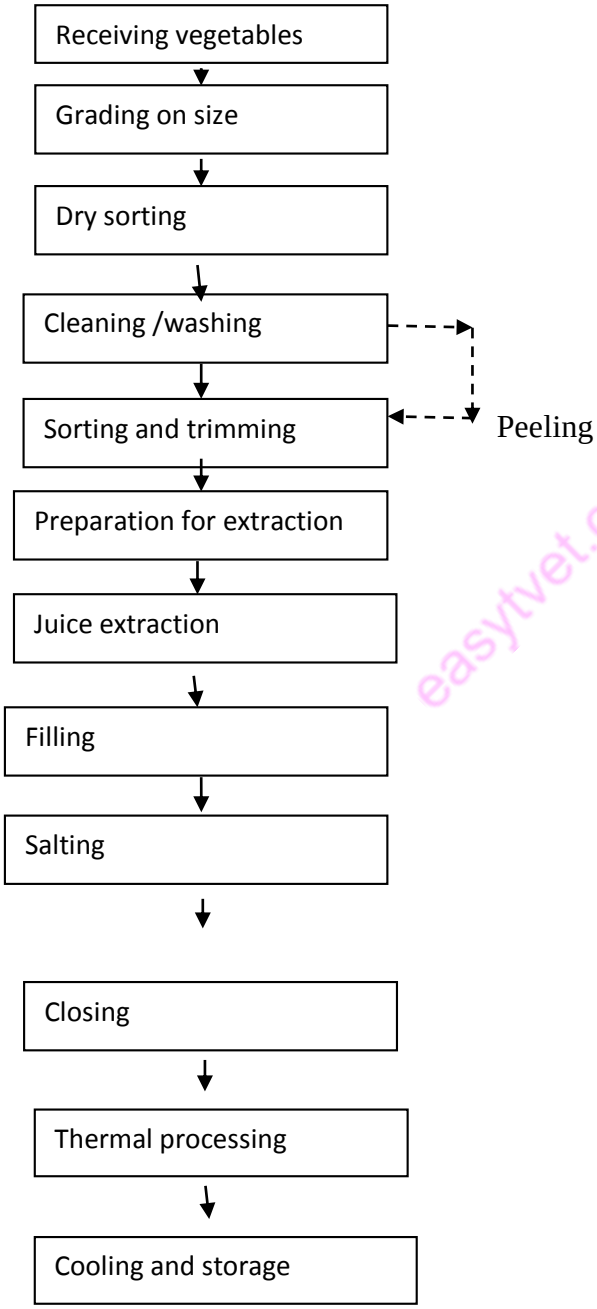

Figure 34:Processing of vegetables flow chart

4.3 Vegetables are dried and grounded into powder as per value addition manual

Drying of vegetables is a widely used food preservation process in which water removal minimize many reactions impacting the bio product quality. Dried vegetables and their application in powder form have gained interest in the food industry. Drying and grinding conditions during powder processing greatly influence the quality attributes of biological materials. It implies not only nutritional changes but also physical, textual sensorial and functional changes. Vegetables are dried until they are brittle.

Preparing vegetables for drying

To prepare vegetables for drying wash in cool water to remove soil and chemical residues. Trim peel, cut, slice or shred vegetables according to the directions for each vegetable. Remove any fibrous or woody portions and core when necessary, removing all decayed and bruised areas.

Pretreating vegetables

Blanching is a necessary step in preparing vegetables for drying; blanching is a process of heating vegetables to a temperature high enough to destroy enzymes present in tissue. Blanching stops the enzyme action which could cause loss of color and flavor during drying and storage. It shortens the drying and rehydration time by relaxing the tissues walls so moisture can escape and later re-enter rapidly. Vegetable can be water blanched or steam blanched. Water blanching usually results in a greater loss of nutrients but it takes less time than steam blanching.

How to prepare vegetable powders

1. Clean the items selected for dehydration cosmetic perfection is unnecessary but trim off any damaged or browned area.
2. Blanch the items to preserve color
3. Shred rather than chop shredded vegetable matter is far easier than hard chunks to grind into powder.
4. Spread the shreds unto a lined dehydrator shelf. Follow manufacturer's directions for drying times.
5. When dehydration is complete allow the shreds to cool before grinding them in a coffee bean grinder.
6. You may find it useful to shake the material from the grinder through a sieve put the larger pieces left behind through a second grind.
7. Store in sealed jars.

Methods of drying vegetables

i. Convective drying

It is the most economical and widely adopted technique in the food industry, although requiring long drying times and high air temperatures, in air drying the heated air meets the surface of the wet material that transfer heat into solid primarily by conduction. The liquid migrates then onto the materials surface and is transported away by air convection.

ii. Vacuum drying

Vacuum drying is a process in which moist material is dried under sub- atmospheric pressures. During vacuum drying water molecules diffuse to the surface and evaporate into the vacuum champers, heat is usually supplied by conduct in to the system at a partial vacuum of about 50-100 M bar to achieve the best product quality.

iii. Microwave drying

Microwave drying is an alternative drying method gaining popularity in recent years for a wide variety of industrial food products; it can be regarded as a rapid dehydration process significantly reducing the drying time.

Benefits of drying vegetables

Dried vegetables are high in fiber and carbohydrates and in fat making them healthy food choice. It increases the shelf life of vegetables.

Conclusion

This learning outcome has covered identification of vegetables to be processed and technologies used in fruit processing, occupational safety standards and standardization requirements.

Further Reading

1. Journal on preserving food; Drying fruits and vegetables, university of Georgia Cooperative extension service.

6.3.5.3 Self-Assessment

Written assessment

1. Two of the following shows methods of drying vegetables except?
    a) Convective drying
    b) Conductive drying
    c) Vacuum drying
2. The following shows the ways in which vegetables are processed. Which is not?
    a) Vegetable pickling
    b) Vegetable crushing
    c) Heat treating and freezing

3. The following factors determine whether the vegetable is worthwhile processing except?
    a) Demand of a particular vegetable
    b) Regular supply of raw materials
    c) The tenderness of picking the vegetable
4. The quality factors of vegetables include the following except?
    a) Colour
    b) Nutritive value
    c) Flavor
    d) Size
5. Which one is not a classification of vegetables?
    a) Root
    b) Leaves
    c) Stem
    d) Texture vegetables
6. The following are factors to consider in selection of vegetables except?
    a) Quantity available
    b) Freshness of the vegetables
    c) Size of the vegetables
7. Which of the following is a process of preparing vegetables for drying?
    a) Washing
    b) Grinding
    c) Filling
8. Differentiate between vegetables and products.
9. Give two nutritional value of vegetable to be considered in selection of vegetables for processing.
10. Blanching is?
11. Give four various classifications of vegetables.
12. Differentiate between vegetables and fruits

Oral Assessment

1. Explain the steps of preparing vegetable powders.
2. Explain the various factors to consider in selection of vegetables for processing.

Case Study Assessment

A certain company has just started its operation of processing vegetables. They would like to have their products compete favorably in the market. You are an agricultural consultant and have been contacted to advice the company. What key sections should the company put into consideration from selection to processing and packaging to even marketing to ensure their products become renowned and best-selling?

Practical Assessment

1. Using the steps to prepare vegetable powder, prepare a carrot powder following the outlined steps.
2. Using a vegetable processing plant participate and identify various ways of selecting processing, grounding, packaging and labeling of the final products. Give a brief report.

6.3.5.4 Tools, Equipment, Supplies and Materials

- Trays
- Juicers
- Blenders
- Sieves
- Mixers,
- Fruits and vegetables

6.3.5.5References

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6.3.6 Learning Outcome No 5: Process fruit into juice, wine and products.

6.3.6.1 Learning Activities

Learning Outcome No 5: Process fruit into, wine and products	
Learning Activities	Special Instructions
5.1 Identify fruits to process into juice as per horticulture technical manual 5.2 Process fruits into juice and products as per juice making recipes manual 5.3 Slice and dry fruits made as per value addition manual 5.4 Process and ferment fruits into wine as per SOPs	Group discussion on ways to identify fruits for processing. Demonstration on processing fruits into juice.

6.3.6.2 Information Sheet No6/LO5: Process fruit into juice, wine and products.

Introduction

The learning outcomes to be covered will include; types of fruits for value addition, types of technologies used in fruit processing, packaging of processed fruits products according to occupation safety standards and standardization safety standards.

Definition of key terms

Fruit processing: Refers to the preparation of fruits for human consumption

Safety standards: Refers standards designed to ensure the safety of products, activities or processes.

Content/Procedures/Methods/Illustrations

5.1 Fruits to process into juice are identified as per horticulture technical manual

Fruits is grown as it has many vitamins and necessary for nutrients for human body. Fruits commonly consumed in daily diets, are a major source of anti-oxidants. Processed from include; jam, paste and juice. In order to get good quality of processed products the quality of fruits should be good. Identifying good and bad quality fruits in the industries manually is the main obstacle as it is time consuming and for high labor cost.

Therefore, it is very important to identify the quality of fruits for processing by using automatic sorting machine for various necessities in industries. Image processing method in industries is used to identify quality fruits. It uses MATLAB software as a tool in image processing, to find the quality of vegetables using various algorithms.

The steps involved in identification of good and bad quality fruits are: image acquisition, processing, segmentation, feature segmentation, feature extraction, feature training and feature matching, finally the quality of fruit is identified.

Image acquisition

An image is analyzed as it is checked. The user is tools to discard that he considers as noise. Image acquisition is done using digital camera and it is loaded and saved using MIL software, the input image got is an RGB image.

Pre-processing

Basically, the images which are obtained during image acquisition may not be directly suitable for identification and classification purposes because of some factors such as: noise, weather conditions and poor resolution of an image and unwanted background. The steps involved in pre-processing are:

i. Input image
ii. Background subtraction
iii. Converting RGB to gray
iv. Converting gray to binary
v. Filtering's

These steps are easily and efficiently done using basic command MATLAB toolbox

RGB image

RGB is one of the formats of color images. Here the input image is represented with three matrices of sizes regarding the image format. The three matrices in each image corresponds to the colors red, green and blue and also says that of how much each of these colors a certain pixel should have.

Background subtraction

It's a process of extracting foreground objects of a particular scene of an image.

Gray image

Gray scale images have one color which is a shade of gray in various ranges in between. Monochrome image is another name of gray image. This denotes the presence of only one (mono) color (chrome). To convert any color image to a gray scale representation of its luminance.

Binary image

Binary image is a digital image which has two assigned pixel values. Two colors used for a binary image black and white. Binary images used in digital image processing as masks or as result of some frequent operations such as segmentation, thresholding and dithering.

Filtering

The purpose of filtering is to smooth the image. This is done to reduce nose and improve the visual quality of the image. Often, smoothing is referred to as filtering.

Segmentation

The purpose of image segmentation is to divide an image into meaningful regions with respect to particular application. Segmentation is based on measurements taken from the image. It may be: gray level, color, texture, depth or motion. As edge detection is a necessary to point out true edges to get the best result from matching that is why it is

important to choose edge detectors that fit the best application canny, edge detector is chosen.

Feature extraction

This is grouping the input data objects into a set of features. The features extracted carefully will help to extract relevant information from the input data in order to perform the feature matching.

Feature matching

Feature matching method essentially consists of identifying features in images that can be matched with corresponding features in the other images from which transformation model can be estimated. Feature matching is an important task in the area of image processing. Here correlation method is used for feature matching. The clustered values of good and bad fruits are taken more in number with extracted features. Each value is correlated with one another with specific value for good and bad fruit is obtained.

5.2 Fruits are processed into juice and products as per juice making recipes

The most important steps involved in processing of fruits are:

i. Selection and preparation of the fruit
ii. Extraction of juices
iii. Straining, filtration, clarification
iv. Blending, pasteurization
v. Filling, sealing and sterilization
vi. Cooling, labelling and packing.

For juice concentration, vacuum evaporation is another step-in fruit processing line. The final concentrate can be filled in aseptic bags in drums for export purpose. Clear juices can be formulated, blended and spray dried at best conditions to convert them into readily soluble powders. The types of drink made from fruit can be separated into two basic types.

- Those that are drunk straight after opening.
- Those that are used little by little from bottles which are stored between them.

Different types of drinks are classified according to the following criteria.

Table 14: Criteria for classifying drinks

Type	Description
Juices	Pure fruit juice with nothing added
Syrups	Concentrated clear juices. Normally have a high sugar content
Cordials	Crystal clear squashes
Nectars	Contain 30% fruit solids and are drunk immediately after opening
Squashes	Contain at least 25% fruit pulp mixed with sugar syrup. They are diluted to taste with water and contain preservatives.

Stages of fruit processing

Preparation of raw material

Select mature undamaged fruits. Any fruits that are moldy or under-ripe should be stored and removed. Wash the fruits in clean water. Peel the fruit and remove stones or seeds

Juice extraction

There are several methods to extract juice depending on the type of fruit. Some fruits such as papaya are steamed to release the juice. Apples are pressed and fruits such as mango and guava you extract juice. Fruit pieces are pushed through a perforated metal plate that crushes and turns them into a pulp.

Filtering

To make a clear juice, the extracted juice or pulp is filtered through a muslin cloth or a stainless-steel filter. Although juice is a naturally cloudy, some consumers prefer clear product. It may be necessary to use pectin enzymes to break down the pectin and also help clear the juice.

Batch preparation

When the juice pulp has been collected it's necessary to prepare batch according to chosen recipe. This is very much a matter of choice and must be done carefully to suit local tastes. Juices are sold either pure or sweetened. All fruits contain sugar, usually around 8-10%. The actual levels vary from fruit to fruit and with the stage of ripeness of the fruit.

Pasteurization

All juice products end to be pasteurized a 80-85 degrees Celsius for 1-10 minutes prior to hot filling into the bottles. At the simplest level, this may be carried out in a stainless steel enameled or aluminum saucepan over a gas flamer, but this can result in localized overheating at the base of the pan with consequent flavor changes. It is best to use stainless pans to heat fruit juice once they have been bottled. The bottles are placed in hot water bath which is heated to 80degrees Celsius.

Filling and bottling

In all cases, the products should be hot filled into clean, sterilized bottles. A stainless-steel bucket, drilled to accept a small outlet tap, is a very effective bottle filter.

Quality control

Freshness and quality of the expressed fruit juice is central to the quality of the final product. As soon as the juice is expressed from the fruit, it starts to deteriorate, both as a result of chemical activity and bacterial spoilage. Extracted juice left to stand for long periods of time will start to ferment and may start to discolor due to enzyme activity.

5.3 Fruits are made into slices and dried as per value addition manual

Dried fruit is a good source of nutrients and is filed with vitamins and minerals. Also, it is rich in natural sugar. A variety of fruits to be dried can range from grapes, apples, apricots, pears, peaches, figs, dates, plums and bananas.

General procedure for drying fruits

i. Select firm ripe fruit
ii. Wash the fruits in clean water
iii. Peel and remove damaged and discolored parts
iv. Slice/cut into thin uniform slices or sugar solution
v. Spread on trays and load into drier
vi. Control the temperature by opening the dryer door
vii. Pack the dried product in moisture proof packs
viii. Store in a cool, dry, well ventilated place.

Practical's aspects of fruit drying

To acceptable for both export and local consumption, there are several factors to consider.

- Purchase of quality fresh produce
- Carefully transport and storage
- Proficient preparation of produce
- Correct loading and operation of the drier
- Proper packaging and storage of the dried product
- Achieving good product quality

There are various ways of drying fruits as follows:

Sun drying

This should be avoided as it is very difficult to control the quality of the product. When sun drying is used, the fruit should be dried on the meshed trays or racks that are raised above the ground so that the air can circulate around them. The fruit slices should be turned or removed every hour during the first during the first drying to improve quality.

Shade drying

It is more dependent on movement of the fruit. The drying rack should be placed in apposition that can take advantage of any wind and dry air circulates with ample circulation. Cabinet drier can be used most fruits. Solar drying is dependent on the sun or storing. There is no dry cloudy or rainy condition overnight. This prolongs the drying period and can reduce the quality of small business.

Artificial drying

This is the most controllable method of drying. It is also the most expensive it requires drying cabinet that is heated by electricity, gas or biomass. The advantages are that the drying rate can be carefully controlled regardless of external climatic conditions to make a high-quality dried product.

5.4 Fruits are processed and fermented into wine as per SOPs

Fruit wines are fermented alcoholic beverages made of fruits than grapes. They may also have additional flavors taken from other fruits, flowers and herms. Fruit wines can be still or sparkling. Different types of fruit wines are produced worldwide and include: low alcohol cider style, dry or off-dry fruit wines sweet fruit wine and cryo extracted fruit wine.

The main steps of fruit wines technology include the following:

i. Fresh or frozen fruit reception
ii. Fruit extraction and preparation by crushing, pressing, clarifying and amending.
iii. Fruit fermentation conditioning and conservation and aging

The fruits should be having high sugar and low acidity characteristics which should be adjusted when needed. The fruits are normally delivered to the distillery depending on the season that they are most ripe for example, apples are picked in autumn while strawberries in midsummer.

Determining the process of partial or total removal of stems from the fruit is the next step in fruit formulation. The fruits are then crushed mechanically fermentation stage can be done. Either on the juice or on the solid parts depending on the solid parts on the type of wine desired and fruit used. After fermentation, decanting takes place during this process the supernatant wine is separated from the produced wine lees and is fed by pumps to empty tanks filled with 100% for further stabilization. The next stage is maturation, where decanted wine is kept in maximum capacity filled vessels. After maturation and stabilization, wine is fitted for quality improvement and then decanted into empty tanks.

Wine making multiple step process

(Determining, crushing, fermentation, pumping over and pressing. After the desired timed period for settling, wine is bottled for transportation tanks and distributed to the contact points.

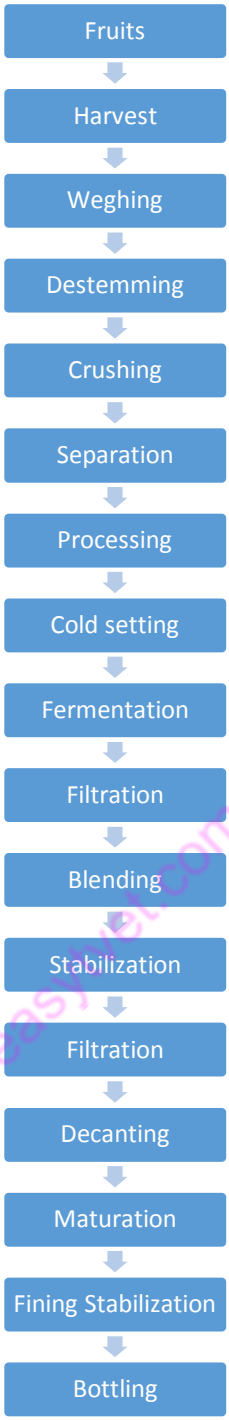

Figure 35: Wine making multiple step process

Conclusion

This learning outcome has covered types of herbs for value addition, technologies used and packaging of the processed fruits products. Occupation safety standards and standardization requirement.

Further Reading

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6.3.6.3 Self-Assessment

Written assessment

1. The various types of drinks include the following except?
    a) Juices
    b) Syrups
    c) Nectars
    d) Filters
2. Stages of fruit processing include the following except?
    a) Filtering
    b) Pre-processing
3. The following are steps of identification of good and bad quality fruits except?
    a) Feature training
    b) Image acquisition
    c) Safety standards
4. Main steps of fruit wines technology include the following except?
    a) Fresh/frozen fruit reception
    b) Fruit extraction and fermentation
    c) Image acquisition
5. Steps involved in processing contain?
    a) Cooling, labelling and packaging
    b) Segmentation
    c) Feature matching
    d) Filtering
6. Differentiate between fruit processing and fruits?
7. The purpose of image segmentation is to
8. Feature extraction involves
9. Give two stages of fruit processing?
10. Name four ways of drying fruits.
11. Explain the various stages of fruit processing.
12. Explain the main steps of fruit wine fermentation.

Case Study Assessment

Most companies that produce the ready to drink juices in Kenya operates at medium-scale level and do not procure the fruits directly to the market. The equipment they need mostly is storage tanks, cold rooms and mixing tanks. The challenges faced by these medium-scale enterprises are the shortage of the juice concentrate high distillation costs and high cost of packaging how can these companies can solve this problem?

Practical Assessment

Using mango fruits select the best quality for drying, dry the fruits as per the drying steps of artificial drying.

6.3.6.4 Tools, Equipment, Supplies and Materials

- Juicers
- Mixers
- Blenders
- Fruits and vegetables
- Deep freezers
- Text books and manuals

6.3.6.5 References

Ahvenainen, R. (1996). New approaches in improving the shelf life of minimally processed fruit and vegetables. *Trends in Food Science & Technology*, *7*(6), 179-187.

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6.3.7 Learning Outcome No 6: Process Herbal products

6.3.7.1 Learning Activities

Learning Outcome No 6: Process Herbal products	
Learning Activities	**Special Instructions**
6.1 Identify herbs as per small scale horticultural development programme manual 6.2 Process herbs into herbal products.	Group discussion Illustrations of various herbs

6.3.7.2 Information Sheet No6/LO6: Process Herbal products

Introduction

This learning outcome will cover on types of herbs for value addition, types of technologies used in herbs processing, Packaging of processed herbal products, Occupation safety standards and standardization requirement.

Definition of key terms

Standardization: The process of making things of the same type with standards to guide the creation of a good service based on conscious of all parties in the industry.

Value addition: The process of economically adding value to a product by changing its current place, time and form, to a more valuable state.

Content/procedures/methods/illustrations

6.1 Herbs are identified as per livestock production manual.

Herbs refer to any plant with leaves, seeds or flowers used for flavoring, food, medicine or perfume. Examples of herbs include: rosemary, basil, bay laurel, chervil, cilantro, chives, oregano, dill, sage, and thyme and wheat grass. The recommended practice for plant identification is focused strictly on the establishment of a practical, effective model for proper plant identification. It does not cover sustainable or ethical harvesting process concept as ethics relate to providing the proper plant material buyers nor does it address toxicity issues or good manufacturing practices as they relate to activities further up the value chain.

Plant herbal identification

i. Propagation material

Botanical identity of the herbs must be verified WHO also calls for the name of the supplier of the material to be recorded.

ii. Personnel and education

The growers and collectors need to have education training or experience necessary to properly identify the plant materials they are producing.

iii. Harvest/collection/acquisition of material from third party

Material should be verified at harvest/collection acquisition, being careful to watch for contamination with non-target species. If more than one identification method is used the results should be consistent before assuming accurate identification has taken place

iv. Primary processing

World health organization recommends re-confirmation of identity prior to any processing given the additional challenges involved in identifying material post processing. One person should take responsibility for verification as the product moves through the primary processing step; labels should be carefully stored to avoid any potential for misidentification of material.

v. Packaging

Control must be in place to avoid contamination with foreign material; labeling must be clear and contain the scientific name of the plant

vi. Storage and transport

Care must be taken in storage to prevent the mix-up of material. The lot/batch/shipment should be with a unique number.

Recommended practices for plant identification establishment, growth and harvest stage

For herbs plants under cultivation: The producer must have utilized authenticated or certified seeds, transplants seedlings or cutting. He or she must:

a) Retain documentation of authenticity.
b) One crop is grown, conduct visual inspection pre-during and post-harvest to re-confirm correct identity.
c) If produced from seed retain seed sample for each authenticated seed source and crop.
d) Retain representative voucher sample of plant at harvest and reproductive stage for each authenticated seed.

For wild harvested plants

The following concepts should be considered in identification.

- If the harvester is qualified through experience education and training to reliably identify the plant species confirm species against reference.

- Create and retain salvage plan consisting of the practices that will be followed to remove unwanted material from a crop and render it homogenous within acceptable limits.
- Raw material stage (both cultivated and wild harvested. If steps have been followed for identification at establishment growth and harvest stages no further verification required.
- If reliable identification has not been achieved at establishment, growth and harvest stages utilize appropriate analytical methods.
- If raw material cannot be reliably identified, take appropriate remedial action to salvage so discard.
- If salvaged, create and retain salvage plan consisting of practices that will be followed to remove unwanted material from the raw material and render homogenous within acceptable limits.
- Collect a retention sample of positively identified material for each shipment, batch, or lot and label appropriately. Samples should be retained for a minimum of 3 years.

6.2 Herbs are processed into herbal products.

The raw material for herbal processes is herbal material which consists of plant parts such as rhizomes, barks, seeds, fruits, leaves, flowers and stems. Value of herbal materials is related to the content of the active ingredient in the herbal preparations.

Herbal products processing involves both farms and processing facilities. The primary herb processing steps include: drying, size reduction, grinding and sieving. The secondary processing involves extraction with aid of suitable solvents concentration and drying. Products of secondary processing are in the form of whole extract, concentrated extract and powdered extract

Steps in herbal processing

Every part of the plant matures at different times which suggest that the harvesting process should be optimized on the basis of the desired plant parts. There are different stages of herbal processing to produce the final herbal products

i. Preprocessing stage

The plants are dried to remove moisture for preservation, preventing bacteria activity and restricting fungal growth. To increase the surface area of the dried herb plant materials for improved contact with the solvent during the sub sequent extraction process, the dried plants must first be ground. An increased surface area of the dried plant material will improve the performance of the extraction process. Particles of the milled plants can affect extraction yield.

ii. Extraction process

Operating conditions can greatly affect the efficiency of a particular technique. For solid liquid extractions, important parameters include an appropriate solvent system,

the solvent to herb ratios; the particle sizes of ground and dried herbs materials, temperature, duration and agitation rate. In some process, solvents are mixed with herbal raw materials normally in the dry powder form and the subjected forces such as heat, pressure or microwave power to enable settle the photochemical to diffuse out of the herb's cells into solvent medium. The solvents are then removed from the mixture, typically via evaporation in a rotary evaporator. Then the crude extract further processed into natural products.

Types of extraction process

i. Supercritical fluid extraction (SFE)

This process is one of the extraction methods in herbal processing due to its ability to extract valuable ingredients from herbs with high yield and good quality. Its favorable features include the ability to perform extractions at near ambient temperatures, which prevents thermal degradation of the substance of interest. Carbon (IV) oxide is one of the solvents which are widely used due to its unique properties such as non-toxicity, no flammability, lack of solvent residue in the final products and lack of reactivity with extraction material and equipment.

One of the advantages of SFE is that the system operates at low temperatures which are ideal technique for studying temperature-sensitive compounds. Possibly lead to discovery of new natural compounds. To minimize waste operation, the spent CO2 can be recycled and reused even for large scales systems. It is very useful in removing pesticides from herbal medicine.

ii. Microwave assisted extraction (MAE)

It is a process that uses a liquid solvent such as water or alcohol, to extract the active ingredients from herbs. The enhanced extraction occurs as the result of changes in the vegetable cell structure caused by electromagnetic waves. The MAE typically results in a short extraction time and high extraction yield. Besides the combination of 2 transport phenomena; heat and mass gradients working in the same direction also contribute to the high yield and short extraction time of the MAE. The microwave assisted extractions has been used to extract the ingredients from the leaves and roots of herbs.

iii. Sonication extraction

In this extraction conditions such as the time and ratio of herbs to solvent share similarities with the MAE process, except the intensity of the ultrasonic equipment which is replaced with microwave power to facilitate the extraction process. The correct choice of solvent coupled with appropriate agitation or heat characteristics are also major factors in optimizing this type of extraction process. The solvent extraction of herbal materials can be through the use of ultrasonic power because of the mechanical effects resulting from ultrasound process. The effect results in improved solvent penetration into the cellular material via improved mass transfer within the herbal ells. In addition; mechanical effects disrupt the biological cell wall, thereby resulting in the release of the cell contents such as herbal oils.

iv. Soxhlet

Soxhlet extraction involves use of a Soxhlet apparatus for the extraction of herbs. The sample is placed in a thimble holder that is gradually filled with fresh solvent from a distillation flask. As the liquid reaches the over-flow level, a siphon aspirates the solute from the thimble holder moving the aliquot back into the distillation flask carrying the extracted analyses into the bulk liquid. The process continues until extraction process has been completed.

Soxhlet extractions are limited by the time required for the extraction process and by the large volumes of extract ant (solvent) required. The solvents can be expensive to remove and can cause environmental problems.

v. Marinated extractions

Marinated extractions method conducted at room temperature. For this technique, the parameters to be considered include the type of solvent, the ratio of dried herbs to solvent and the extraction time. This method requires prolonged, extraction time because it does not use heat or other forces. The extraction of products is obtained by filtering the extracts first.

The advantage of this method is that it requires neither special equipment nor a special location such as a laboratory. The main disadvantage is the long extraction time.

vi. Hot water extraction

It uses hot water for extraction instead of organic solvent. The use of water as a solvent result in lower operating costs for the HWE method because water is a cheaper solvent. As solvent water is relatively cheaper and relatively easier to treat and recover and poses relatively has less environmental issue. The hot water extraction is efficient in extracting essential oils from coriander seeds.

vii. Steam distilled extraction

Steam distillation includes a stem generation apparatus to supply steam to the mixture of solvent and plant raw material. Steam may be supplied at a pressure and the corresponding saturation temperature that is sufficiently higher than the boiling point of the mixture in order to allow evaporation to take place at lower temperatures. Next the evaporated mixture of water and compound flows into a condenser where it is condensed into a liquid mixture and later collected in a separator. The solvent is finally evaporated and separated from the compound using a rotary evaporator.

viii. Packaging herbs

Suitable packaging can slow the deterioration rate and may extend product shelf life. Demand for medical herbs and spices have increased and their derived products has a variety of functions such as herbal medicine, food flavorings and cosmetics in forms of tea, tablet, capsule, tincture, cream, syrup and liquid. If drying is not performed properly it can compromise on the quality of herb products. Variety of packages and approaches has been employed to interact with the food and provide desirable effects. Examples of

these include incorporating oxygen moisture and ethylene scavengers for these are ethane-sensitive food and use of carbon.

ix. Oxide of ethyl emitters

Flavor imparting or scavenging chemicals and antimicrobial agents for microbiological safety of food. This approach designed to perform desirable functions other than providing an inert barrier is called active packaging, interactive packaging and intelligent packaging. The use of plastic in the packaging of foods has been increasing at an accelerated rate, because of reduction in the cost of packaging materials due to technological innovations and the inherent properties of plastic films which make them very well suited to food packaging. Labeling of the herbal products is necessary for safety use of herbal formulation by people when they buy it.

Conclusion

This learning outcome has covered identification of herbs and processing of herbs into herbal products.

Further Reading

1. Journal on herbal processing and extraction technologies.

6.3.7.3 Self-Assessment

Written assessment

1. Three of the following are types of extraction process in vegetables. Which one is not?
    a) Sonication
    b) Soxhlet
    c) Marination
    d) Blanching

2. Which one of the following is not a plant herb identification process?
    a) Use of personnel and education.
    b) Propagation material
    c) Supercritical identification.

3. Which one is not a step-in processing of herbs?
    a) Pre-processing stage.
    b) Post-processing stage.
    c) Extraction processing.

4. Which of the following is not a use of herbs?
    a) Medicinal purpose.
    b) Preservative purpose.
    c) Spices.

5. Packaging of herbs involves the following approaches except.
    a) Incorporating oxygen.
    b) Use of carbon(iv) oxide emitters
    c) Five short answer questions

6. During pre-processing stage plant herbs are dried for the following reasons except?
    a) Removing moisture.
    b) Preventing bacterial activity.
    c) Safety of the herbal formulation.
7. What do you understand by the term herbs?
8. Give 2 types of extraction process of herbs.
9. Differentiate between value addition and standardization.
10. Give 2 primary herb processing steps.
11. Name the plant herb parts which are processed to obtain the final herb products.

Oral Assessment

1. Explain any 2 processes of extraction of herbs.
2. Explain how plant herbs are identified.

Case Study Assessment

A certain organic farm is specializing in production of herbs for export and local market as well. Their herbs are mainly used as spices in food. Recently they would like to produce more herbs and diversity the types of herbs being processed and exported, as an extension officer you have been contacted to give advice on how to identify other herbs not found in the farm and how to process.

Practical Assessment

1. Identify various herbs by visiting a botanical garden and note down what you found out.
2. Visit a nearby supermarket or a local market and identify various fresh and processed herbs and note down the names of the herbs.

6.3.7.4 Tools, Equipment, Supplies and Materials

- Herbs
- Clean water
- Sieves
- Buckets
- Solar driers
- Electricity
- Text books and manuals

11.3.7.5 References

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6.3.8 Learning Outcome No 7: Process animal products

6.3.8.1 Learning Activities

Learning Outcome No 7: Process animal products	
Learning Activities	Special Instructions
7.1 Identify animal products as per livestock production manual. 7.2 Process animal products as per livestock products value additional manual. 7.3 Process and package products and label as per standardization requirement.	Group discussion and presentation Field Excursion

6.3.8.2 Information Sheet No6/LO7: Process animal products

Introduction

The learning outcome covers types of animals for value addition, types of technologies used in animal product processing, packaging of processed animal products and occupation safety standards.

Definition of key terms

Value addition: Refer a process of changing or transforming a product from its original state to a more valuable state.

Safety standards: They are standard designed to ensure the safety of products, activities or processes.

Content/procedures/methods/illustration

7.1 Animal products are identified as per livestock production manual

An animal product is any materials derived from the body of an animal. Examples are fat, flesh, blood, milk, eggs and lesser known products. Animal by-products are products harvested or manufactured from livestock other than muscles meats.

General classification of anima products

Animal food: Animal food refers to the edible parts of the animal carcass or those products obtained from the live animal. The animal food comprises of meat, milk eggs

and processed product from these as well as the edible parts of the carcass such as kidney, heart, liver and intestines.

Characteristic to consider in selection of meat for processing

Meat is the compositional quality (lean to fat) ratio and the palatability factor such as visual appearance, smell, firmness, juiciness, tenderness and flavor.

a) Visual identification

Visual identification of meat is based on color, marbling and water holding capacity. Marbling is the small streak of fat found within the muscles and can be seen in the meat cut. Marbling has a beneficial effect on juiciness and flavor of meat. Meat should have a normal color that is uniform throughout the entire cut.

b) Smell

The product should have normal smell. This will be different for each of the species ie. Beef, pork, chicken; but should vary only slightly within the species. Any rancid or strange smelling meat should be avoided.

c) Firmness

Meat should appear firm rather than soft. When handling the retail package. It should be firm not tough. It should give under pressure but not actually soft.

d) Juiciness

Water retention and lipid content determine juiciness. Marbling and fat ground the edge helps hold in water losses from evaporation and drip losses. Meat aging can increase water retention and therefore increase juiciness when processed

e) Tenderness

This is linked to several factors such as animal's age, sex or the muscle location One important factor to tenderize meat is by aging. Carcasses are aged by holding then at refrigeration temperatures for extended period of time after slaughter and initials chilling before processing.

f) Flavor

Flavor and aromas are intertwined to create the sensation the consumer has during eating. These perceptions rely on the smell, sour and bitter on the tongue. Meat flavor is affected by type of species, diet, cooking methods and methods of preservation (smoked or cured).

MILK

Milk quality for processing

High quality milk is crucial for processing high quality dairy products.

Per regulations the milk displaying these following characteristics must be discarded

- Inadequate sensory factor (smell, taste and visual)
- High temperature

- Contamination by antibiotic residue and added water
- High direct microscopic count of bacteria
- Inadequate sensory factors (smell, taste and visual.

Milk quality affects the product's taste and shelf life as well as cost of manufacturing.

- Parameters of milk quality includes;
- Somatic cell count
- Milk solid/fat protein lactose
- Mastitis pathogens (e-coli staphylococcus)

How to achieve high quality milk good for processing

Achieving high quality milk is a joint effort of dairy managers and farm personnel. Milk quality is best controlled by proper milking routine that combine daily practices and training of milkers.

Dairies must observe the following:

i. Contaminated milk: Prevention efforts must be made by dairy personnel. Antibiotics, colostrum, high SCC clinical mastitis in cow must be identified and milked out of the system.
ii. Cleaning system: A good CIP program for cleaning and disinfecting the milking system is critical.
iii. Milking system equipment: Milk tanks and milk cooling devise must be maintained.
iv. Milk components: Milk solid must be controlled and monitored in accordance with their destination for examples cheese industry.
v. Cross contamination: There should be no cross contamination between cows. Milking equipment must always be cleaned after appearance of contaminated milk.

7.2 Animal products are processed as per livestock products value addition manual

Meat processing begins from slaughtering. The slaughtering procedures include the following states:

a. Pre-slaughter handling
b. Stunning
c. Slaughtering

Pre-slaughter handling

Stress applied to livestock before slaughter can lead to undesirable effects on the meat produced from these animals: Pre-slaughter stress can be reduced by preventing the mixing of different groups of animals, keeping livestock cool with adequate ventilation and avoiding overcrowding. Before slaughter animals should be allowed to access to

water but held off fed for 12 to 24 hours to ensure complete bleeding and ease of evisceration (removal of internal organ).

Stunning

Livestock are restrained in a chute that limits physical movement of the animal. Once restrained, the animal is stunned to ensure a humane end with no pain. Stunning also result to decreased stress of the animal and superior meat quality.

The most common methods of stunning are mechanical, electrical and carbon (IV) oxide gas. The end result of each method is to render the animal unconscious.

Slaughtering

After stunning animal are usually suspended by the hind limb and moved by a convoy line for slaughter procedures. They are typically bled by a process called sticking or by the insertion of a knife into the thoracic cavity. This allows for maximum blood removal from the body. At this point, in the process the slaughter procedures begin to differ as per species.

General aspect of processing meat

Processed meats are products in which the properties of fresh meat have been modified by use of procedures such as mining, grinding and chopping, salting and curing, additional of seasonings and other food materials and in many instance heat treatments. Most of these processes extend the shelf life of meat. Their manufacture in most instances depends on the ability of the mixture to retain water since they are emulsions of protein fat and water.

Reasons for processing meat

- Fresh meat has a limited shelf life even under refrigeration at the most about 10 days to close to 12.
- Fresh meat can be frozen to extend shelf life but it is difficult to keep the texture and other acceptance quality of meat.
- Transportation of fresh meat especially for the international, market is quite costly. Therefore, cost can be minimized with processed meat products.
- Processed meat offer consumers is their favorite products which are easily and ready to eat.

For processor the return is more and provides an incentive to venture into many different products especially that are of different countries.

Milk processing

Milk processing is the procedure that includes various steps to start dairy farms like milk collection from cattle, pasteurization, clarification, homogenization, packing of milk and finally transportation to processing.

Pasteurization

Pasteurization is the first step in milk processing; Pasteurization means heating every particle of the milk or milk product to a specific temperature for a specified period of time (63^0C for 30 minutes). This destroys bacteria and other microorganisms that many affect consumers' health. It makes the milk safe and healthy and also improves the keeping quality so that milk and milk products can be stored for longer periods without being spoilt. The three methods of pasteurization include:

i. Batch pasteurization, 63^0C for at least 30 min (suitable for small scale producer and farmer co-operative.
ii. High temperature short time (HTST) pasteurization, 72^0C for at least 15 minutes. This is suitable for processing large qualities of milk. e.g. more than 250 liters at a time.
iii. Ultra-high temperature short time (HTST) pasteurization. This is used in big factories and requires special machinery. UHT milk can be stored for 6 months even without refrigeration.

Cream separation

The first step in making cream, butter and ghee is to separate cream from the fresh milk. This can be done by gravitational separation or centrifugal separation. Gravitational separation allows the milk to settle. The cream is lighter than the other milk components. It rises to the top and can be separated. Centrifugal separation requires simple machine like a centrifuge. The centrifuge can be treated by hand or by an electric motor.

7.3 Processed products are packaged and labeled as per standardization requirement

Packaging wrappers and material used must not be a source of contamination. Packaging material should be stored properly so they are not at risk of contamination. Wrap and package the food in a way that avoids contamination of products. Any containers, for packaging must be clean and not damaged particularly cans or glass jars. Processed animal products should be authentic. The products must match is description. Mislabeled food decides the consumer and creates unfair competition with manufacture or traders. The description of food refers to the information given about it;

- Name
- Ingredient
- Origin
- Processing

Factors to consider in packaging

Product packaging plays a huge role in successful and sustainable food industry, operation.

1. **Quality and functionality of packaging material**

Packaging is only effective if it protects the products against damage in transit. High quality packaging material must be used to keep products secure till they reach the end customer or distribution facility.

2. **Size, shape and design**

Standard size and shape for product packaging is a good idea. Not only does this improve flexibility and conveniences during storage, handling and transportation but also reduce production cost for packing.

3. **Pricing and cost saving**

The cost effectiveness of packing materials depends on more than just its price. Some packaging types are lighter than others reducing transportation cost, while other are easier to handle and help boost production efficiency.

Distribution and storage

Understanding how a normal product makes it from a producing unit to a storage and distribution facility retail outlets or customer helps you select the right protective packaging considering the distance of shipment need of travel and model of transportation as well as storage condition.

Long-term sustainability

Material and equipment chosen should comply with industry regulation and legal guidelines.

When labeling the following factors are considered:

- Label material costs
- Printing and converting cost which includes the number of color in-line options, sheet or even web printed options.
- Appearance options: What kind of paper to use and what kind of film used.
- Durability: Scuffing resistance, image deterioration water resistance or heat resistance should be considered.
- Production flexibility: Possible need where ease and speed of label line changes over are concerned.
- Cost of label production
- Information need on the label such as how labeling technology link customer to information on the web.

Importance of packaging and labeling of animal products

- Labeling brings identification to products
- Labeling helps spread awareness among the customers about the items they are consuming and also help mention ingredients
- Packaging protect the products from damage
- Packaging promotes the product and provides customer convenience.
- Packaging helps to differentiate animal products from other products.

Conclusion

This learning outcome has covered types of animals for value addition and types of technologies used in animal product processing. It has also covered packaging and occupational standards.

Further Reading

1. Heinz G $ Haul zinger, P. (2007) Meat processing technology, food and agriculture organization
2. Modern Technology of food processing and Agro based industries by NIIR

6.3.8.3 Self-Assessment

Written assessment

1. The parameters of milk quality include the following except?
    a) Stunning
    b) Sematic cell count
    c) Milk solid fat
2. The following are characteristic to consider in selection of meat for processing except?
    a) Smell
    b) Firmness
    c) Texture
    d) Tenderness
3. Fresh meat can be modified by use of the following except?
    a) Crushing
    b) Mincing
    c) Separation
    d) Salting

4. Milk procession consist of the following steps except?
    a) Pasteurization
    b) Cream separation
    c) Ghee Preparation
5. Slaughtering procedure include all the following excepts handling?
    a) Pre-slaughter
    b) Slaughter
    c) Blanching
    d) Stunning
6. To produce quality milk dairies must observe the following which one is an exception?
    a) Prevention slaughter handling
    b) Slaughtering
    c) Blanching
    d) Stunning
7. Differentiate between value addition and animal product.
    a) Prevention efforts to be made on daily personnel
    b) Milk system equipment should be clean
    c) Milk components should contain solid particles
8. Animal by product is.....
9. Give two characteristics to consider in selection of meat for processing
10. Give two importance of packaging animal products.
11. The parameter of milk quality includes.....
    And.....

Oral Assessment

1. Explain the importance of labelling animal products
2. Describe the steps/ procedures for slaughtering.

Case Study Assessment

A certain beef processing company has been undergoing losses due to unauthentic labelling. They would like to re-label their products and change their packaging. What are the best considerations they should take to ensure good labelling and packaging?

Practical Assessment

1. Visit the school dairy farm and verify the dairy activities. State whether they meet the quality standards.
2. Carry out batch pasteurization of milk-in the dairy farm

6.3.8.4 Tools, Equipment, Supplies and Materials

- Meat
- Hides and skins
- Clean water
- Tanning chemicals
- Tannery equipment electricity

6.3.8.5 References

Ainges, S. (1991) hybrid deer-basis for new animal, the gazette University of Walslia, PTT Wouters and T.T. Geurts dairy science and technology second editions CRC press.

Feainer, G. P (2006), Meat products handbook. Practical science and technology Sawston Wood head publishing.

O'Cannol, C. B (1994), Rural Dairy Technology IIRI Training Manuals. Addis Ababa Ethiopia pp.133.