VALUE ADDITION OF FARM PRODUCE AND NON-TIMBER FOREST FOODS (EDIBLE INSECTS AND INDIGENOUS FRUITS)

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Executive Summary

Insect-based food products represent one of the fastest-growing segments in the alternative protein market, with global market projections of $1.46 billion in 2024 growing to $17.95 billion by 2035—a compound annual growth rate of 25.7%. This training manual provides a practical, accessible guide for entrepreneurs, product developers, and business professionals entering the insect-based food industry. The focus is on demystifying production processes, regulatory pathways, and safety for small- medium scale processors interested in developing insect-based food products.

A guide to the operational standards governing small scale insect food processing activities are presented in this manual. Adherence to these procedures is not merely a matter of compliance; it is the foundation upon which consumer trust, product safety, and commercial success is built upon. In an increasingly competitive market, rigorous application of these standards is essential for meeting consumer demands for superior quality, safety, and nutritional value, and for distinguishing our products from those of larger manufacturers.

The core objective of food processing is the systematic application of methods and techniques to transform raw ingredients into food products that are safe, palatable, and shelf-stable for human consumption. This transformation process is critical for preventing losses, ensuring a wide variety of foods are available year-round, and ultimately improving nutritional standards. The strategic importance of maintaining high operational standards cannot be overstated. These standards are driven by several key factors:

• **Meeting Consumer Demands:** Consistently fulfill consumer expectations for sensory quality (taste, texture, appearance), uncompromising safety, and high nutritional value.
• **Ensuring Commercial Viability:** By adding value to raw agricultural crops through superior processing, presentation, and packaging, products that can compete effectively and secure a loyal customer base.
• **Maintaining a Safe Food Supply:** Providing a nutritious and safe food supply for both urban and rural populations, turning perishable raw materials into stable, reliable food sources.
This commitment to excellence begins with the very first stage of operation: the rigorous control of all incoming raw materials.

Key terms and concepts in edible insect value addition:

Processing Techniques:

- **Blanching:** Briefly boiling insects to inactivate enzymes and improve colour for better preservation.
- **Dehydration:** Removing moisture from insects using techniques like drying to extend shelf life and prevent spoilage.
- **Grinding:** Pulverizing insects into a powder for use as an ingredient in various food products. Grinding insects into an extremely fine powder, increasing surface area and potentially enhancing certain functionalities.
- **Oil extraction:** Separating oil from insects for use in food (e.g., cooking oil) or industrial applications (e.g., biofuels).

Value Addition Techniques:

- **Fermentation:** Using microorganisms to improve the flavour, texture, and nutritional profile of insects. Fermentation can create new taste profiles and potentially enhance digestibility.
- **Flavoring:** Adding spices, herbs, or other ingredients to mask insect flavours and create more familiar or appealing tastes for consumers.
- **Ingredient incorporation:** Using insect ingredients as a protein or nutrient source in various food products, such as snacks, energy bars, pasta, or baked goods.

Key terms and concepts in ground nut value addition

Processing:

- **Shelling:** Removing the outer shell of the peanut to expose the kernels. This can be done mechanically or manually.
- **Cleaning and Sorting:** Separating foreign material like stones, dirt, and damaged kernels from good quality peanuts.
- **Blanching:** Briefly boil peanuts to loosen the skins and improve roasting quality.
- **Roasting:** Dry heating peanuts to develop flavour, aroma, and texture. Roasting parameters like temperature and duration significantly impact the final product.
- **Drying:** Removing moisture from peanuts to prevent spoilage and extend shelf life. Sun drying is common, but mechanical dryers offer better control.
- **Dehulling:** Removing the red skin from roasted peanuts for a more appealing appearance and smoother texture.
- **Oil Expelling/Pressing:** Extracting peanut oil from kernels using mechanical presses. Expelling offers higher yields but lower quality oil compared to solvent extraction.

Value Addition:

- **Peanut Butter:** Grinding roasted peanuts into a spreadable paste. Additional ingredients like salt, sugar, and stabilizers can be added.

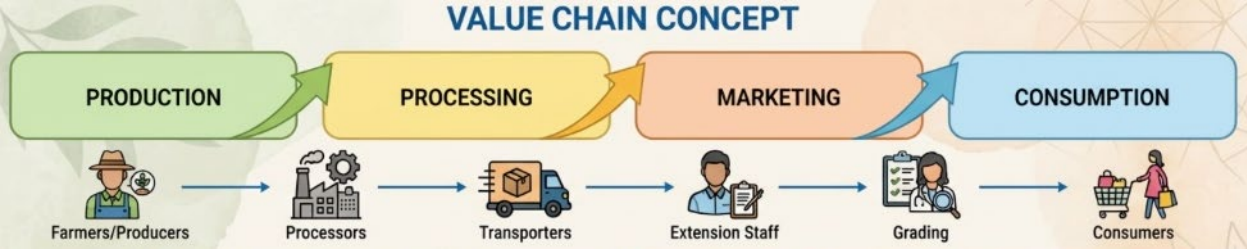
- **Peanut Flour:** Grinding roasted peanuts into a fine powder for use as a gluten-free flour alternative or protein source in various food products like baked goods.
- **Peanut Paste:** A thicker and less processed version of peanut butter, often used as an ingredient in confectionery products.
- **Peanut Butter Substitutes:** Develop peanut butter alternatives using other nut or seed butter for people with peanut allergies.

SESSION 1: VALUE CHAIN CONCEPTS

Content: In this session, participants will be taken through the value chain concept and key technical terms in edible insects, indigenous fruits, and farm produce value chain development.

Time: It is estimated to cover a period of up to 20 minutes

- A value chain refers to the entire system of production, processing and marketing of a particular product, from inception to the finished product.
- A value chain consists of a series of chain actors, linked together by flows of products, finance, information and services.
- At each stage of the chain, the value of the product goes up because the product becomes more convenient for the consumer besides value, costs are added at each stage in the chain.
- The value chain in agriculture refers to the addition of value to preliminary agricultural products by combining them with other resources such as tools, manpower, knowledge, skills, other raw materials or other preliminary products.
- As the product passes through several stages of this chain, the product's value increases.
- A key contribution of value chain analysis lies in the notion of upgrading, the acquisition of technological, institutional and market capabilities for greater competitiveness or movement into higher value activities.



Materials for lessons

- Procure any packaged groundnut products e.g. raw groundnuts (graded and ungraded), cooking oil, packaged groundnut grain, and peanut butter
- Bring the above-mentioned products to a training room but do not show them to participants

1.1 Value Chain Case Studies

Practical understanding of the key players and stakeholders: groundnuts case study

Plenary discussion

- Put a clean flipchart paper and ask the participants to list all the stakeholders involved in the groundnut's value chain i.e. production, marketing, processing, consumption, service provision etc. If possible, allow the participants to mention even the actual/specific names of the stakeholders as per their knowledge of Zimbabwe
- Explain more about processing and ask them what they know about value addition. List down all the suggestions and responses coming from the participants.
- Ask the participants to categorize those stakeholders/players that are critical i.e. if removed from the system, the chain will be incomplete. Similarly, ask them to indicate that do not have a critical role but important in the system.

Observations:

- Participants will easily recognize producers/farmers, processors and consumers. Very few or none will mention service providers like transporters, extension staff, commodity grading agents, private warehouse operators etc.
- On value addition, participants will only recognize raw product transformation such as manufacturing of cooking oil, peanut butter, etc. as value addition

Objective: To help participants understand the stages of value addition.
How to Play:

- Divide participants into small groups.
- Assign each group a stage in the value addition chain (e.g., harvesting, cleaning, processing, packaging, marketing).
- Each group acts out their stage using simple props or gestures.
- The facilitator connects the stages to show how each step adds value to the final product.

Learning Outcome: Participants visualize the complete value addition process and understand interdependence among stages.

Lesson(s) Learnt:

- The value chain has main actors like those that most participants recognized e.g. producers, processors and consumers. But there are also equally important players especially service providers who help in improving the commodity value along the chain.

SESSION 2: FOOD VALUE ADDITION & INNOVATION

Method of Lesson Delivery: By Lecture and Demonstration

Duration: 30 Minutes

Separate the group into 2 teams one team focuses on groundnuts and the other one on insects

- Let the participants list all the products that are prepared for sale on the markets from the raw groundnuts.
- Let the participants exhaust all that they think are the products
- Observe the types of products or by-products that are being presented by the participants
- *After the brainstorming session the answers are presented and discussed by the class.*

2.1 Primary processing steps

Primary processing is the conversion of raw agricultural produce into a commodity that is fit for human consumption. Key steps include ***cleaning, grading, sorting, and packing***. The control of raw materials is the cornerstone of producing high-quality, safe food products. The quality of the final product is fundamentally determined by the quality of its initial ingredients and the hygienic conditions under which it is processed. No amount of processing can improve upon substandard raw materials; therefore, meticulous attention at the reception stage is paramount.
In this context, **Quality** is defined as the extent to which a product successfully serves the purposes of the user. It is the degree to which that product fulfills or meets a consumer's need or expectation.

Quality control processes

The mechanism of quality control is to maintain the desired quality by measuring product properties and processes, comparing actual measurement outcomes with the standard, and taking necessary corrective action to ensure that final quality will meet or exceed customer need and legal requirements.

Measuring

Measuring the product status includes taking a representative sample from a batch and directly measuring the product sample. Measuring can be done visual or using instruments (e.g. pH, temperature).

Testing

Testing is the action of comparing the outcome of measurement or analysis results with the established target or tolerance. When the purchaser receives the order, he/she conducts a visual inspection to ensure the number, quality, size, weight (if applicable). Sometimes a visual inspection is not enough and testing may be conducted.

Types of tests or inspections:

- Visual- look at the product
- Measurement- does it meet requirements or standards laid out in plans
- Functional tests- does it do what it is supposed to do?

Regulating

Regulating is the process of determining which corrective action is required based upon the result of the comparison with the target value and tolerances. Commonly, regulators are employees, like operators, supervisors, etc. they made decisions on what corrective action to take depending on the testing results.

Taking corrective action

Taking corrective action is the actual handling that is carried out as a consequence of exceeding the target tolerances. The corrective action can be, e.g. a temperature increase, or removal of non-conforming products.

2.1.1 Primary processing: crickets

The edible insect cleaning and processing flowchart illustrates the complete transformation from live farmed insects to food-safe products ready for consumption or further processing. This workflow is critical for ensuring both food safety and product quality while maintaining nutritional integrity throughout the operations.

- *Initial Fasting and Selection:* The process begins with a 24-hour fasting period immediately after insect arrival. This crucial step allows insects to empty their digestive systems and reduce gut microbial content, which significantly minimizes potential bacterial contamination and food safety risks. During this period, insects are kept alive but inactive, making them easier to handle during subsequent cleaning stages.

- *Pre-Cleaning and Sorting:* Following the fasting period, insects undergo initial sieving and sorting operations. This stage separates dead insects, shed skin, and contaminated materials from viable biomass. Dead insects are identified visually, as they typically appear darker in color than healthy specimens.

- *Water Rinsing:* Cleaned insects then receive thorough water rinsing in cold or tepid water to remove residual debris and substrate materials.

- *Killing and Thermal Treatment:* Blanching typically occurs at 100°C for 2-5 minutes depending on insect species, with steam blanching being particularly effective for large-scale processing. After thermal treatment, insects may undergo rapid cooling, particularly important for preserving nutritional quality and preventing bacterial regrowth.

- *Optional Anatomical Processing:* For certain insect species such as locusts and crickets, optional removal of legs and wings may occur after killing, depending on the desired final product presentation. This step is particularly important when whole insects are intended for direct consumption versus further processing.

- *Drying Technologies:* Different applications can be used for drying. Oven-drying (60°C for 20-24 hours) represents a conventional, cost-effective approach suitable for large-scale production. Microwave-drying (85°C maximum for 28-65 minutes) offers rapid processing and enhanced energy efficiency with inherent decontaminating effects, making it increasingly popular in commercial settings. The choice depends on desired end-product quality, production scale, and available infrastructure.

- *Size grading and quality inspection:* Manual sieving with calibrated mesh screens remains the traditional industry standard. Sieve sets with progressively smaller hole diameters (typically 4mm, 6mm, 8mm, and 10mm) separate crickets into size categories corresponding to early nymphs, late nymphs, and adults. Manual sieving is labor-intensive but provides reliable separation and allows operators to visually inspect each size fraction for contamination. A final visual quality inspection is performed to ensure no dead insects, contaminated material, or damaged specimens remain in the final cricket lot. This inspection occurs on well-lit surfaces or inspection belts where defects are easily visible. Some facilities employ vibrating screen equipment adapted from grain processing industries, which uses controlled vibration to separate remaining fine particles and frass while gently passing intact crickets through to the next stage.

- *Final Processing and Packaging:* After drying and final quality inspection, the insects may be subjected to comminution (grinding and milling) to produce uniform powders or meals. The final packaging and storage stage emphasizes maintaining low water activity (below 0.60) to ensure microbiological stability and prevent lipid oxidation through protection from light and oxygen.

2.2 Secondary processing

2.2.1 Core principles and value addition operations

Higher levels of processing where new or modified food products are manufactured from primary-processed commodities. Food processing operations are the systematic application of techniques to add value, improve palatability, and enhance the nutritional profile of raw food materials, transforming them into edible products. These operations are essential for preservation, safety, and creating the wide variety of foods that meet modern consumer needs.

Examples of Food Processing

- Fermentation
- Pasteurization
- Roasting (grain/coffee)
- Baking
- Extrusion etc.

Below are the processing methods that are relevant for processing of cricket crackers.

2.2.1.1 Heating/cooking

Heating (thermal processing) is the controlled application of heat to food to inactivate spoilage microorganisms and enzymes, improve palatability, and develop desirable texture and flavour. In small-scale operations this includes boiling, steaming, blanching, roasting and baking using pots, drums, ovens or improved cookstoves. Heating is the first critical step for safety and flavor. For crickets, this involves blanching or roasting to eliminate pathogens.

Benefits:

- Food safety and stability: Destruction or reduction of harmful microbes and enzyme activity extends shelf life and reduces post-harvest losses.
- Product quality and market value: Cooking softens texture, enhances colour and the "nutty" aroma and flavour (e.g. roasted notes, browning) and allows production of ready-to-eat or ready-to-cook products that can be packaged and branded.
- Process flexibility: Blanching before drying or freezing improves drying efficiency and colour retention, while pre-cooking legumes and cereals enables production of instant or fast-cooking products for urban market

2.2.1.2 Drying/ dehydration

Dehydration is the controlled removal of water from food to reduce water activity to levels where spoilage organisms cannot grow, contamination is greatly minimized and so is the safety of the end product. This also preserves the product and reduces weight and volume during

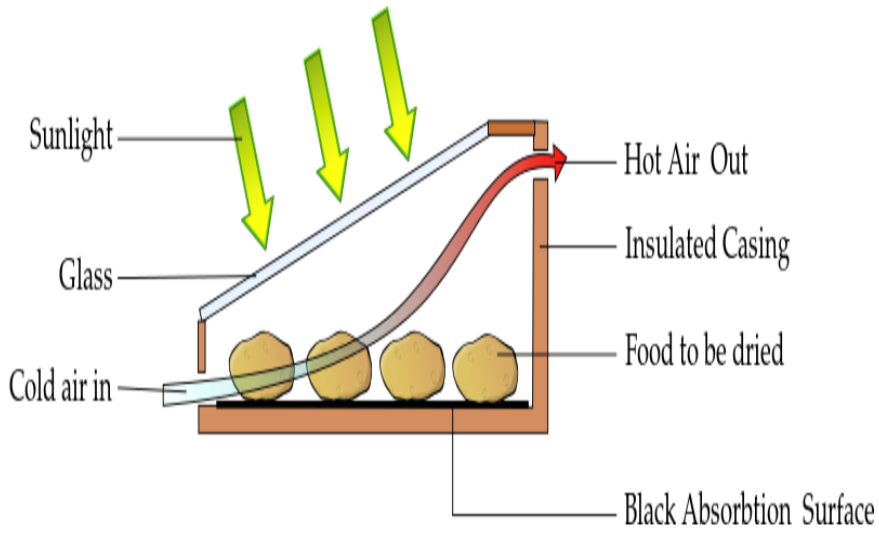
storage and transport. Drying/roasting/dry roasting small grains (millet, sorghum) and crickets separately reduces moisture content to below 5%.

Benefits:

- Shelf-life extension: Proper drying to low moisture (typically water activity below about 0.65 for long-term stability) prevents mould, yeast and most bacterial growth during storage.
- Reduced losses and higher income: Dried products can be stored and sold in the off-season at better prices; lower weight and volume reduce packaging and transport costs.
- Convenience and diversification: Dried slices, powders, teas and snack products create new market lines and can be formulated into composite flours, spice mixes or instant soups.

Sun drying

Sun drying uses direct solar radiation and natural air movement to evaporate moisture from produce spread in thin layers on mats, trays or raised racks. It is widely used because it requires minimal capital investment and relies on freely available sunshine, making it attractive for low-resource settings.



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Benefits:

- Very low operating cost and easy to adopt with locally available materials (racks, nets, plastic sheets).

- Suitable for many insects, fruits, vegetables, grains and fish where climate is hot, dry and relatively dust-free.
- Quality risks include contamination by dust, insects and animals, uneven drying, and dependence on weather; use of raised racks, covers and simple solar dryers can significantly improve hygiene and reduce drying time.

Oven drying

Oven drying (mechanical or cabinet drying) uses a controlled heat source (electric, gas, biomass) and forced or natural air circulation to remove moisture under defined temperature and time conditions. For small-scale processors this can be a modified household oven or a simple locally fabricated cabinet dryer with trays and a thermostat.

Benefits:

- Faster and more uniform drying than traditional sun drying, with reduced risk of microbial growth during the process.
- Better control of product quality: operators can set temperature and air flow to balance drying rate with colour and nutrient retention, producing consistent products that meet buyer specifications.
- Enclosed systems protect product from rain, dust, insects and animals, improving food safety and allowing drying even in humid or cloudy conditions.

Hybrid dryer

2.2.1.3 Baking

Baking applies dry heat to a dough or batter containing cricket flour, causing moisture evaporation, protein denaturation, starch gelatinisation, and Maillard browning. These changes set the structure of the cracker and develop flavour, colour, and crispness.

Benefits:

- Produces a crisp, stable texture suitable for crackers
- Enhances flavour and aroma through browning reactions
- Reduces moisture content, extending shelf life
- Provides a simple, low-cost, and widely accepted processing method

2.2.1.4 Fermentation

Fermentation uses naturally occurring or added microorganisms to transform sugars into acids or gases over time, changing flavour and texture.

Benefits:

- Simple process requiring minimal equipment
- Improves flavour and reduces strong insect notes
- Can improve digestibility and nutritional quality
- Traditional method that adds product differentiation

2.2.1.5 Extrusion

Extrusion pushes a mixed, moistened ingredient blend through a heated barrel and shaped opening. Heat and pressure cook the product, and expansion occurs as it exits the die.

Benefits:

- Makes uniform shapes and textures in a single step
- Allows cricket powder to be added to snack products easily
- Small extruders are available for pilot or artisanal production
- Fast process with consistent results

2.2.2 Primary Objectives of Food Processing

All raw food materials are processed to improve their palatability, nutritional value, and shelf-life. The four major objectives are:

1. **Extend Shelf Life** Processing is the primary method for extending the usability of food. Fresh foods spoil within days or weeks, leading to significant waste. Processing allows for wider, more efficient distribution and reduces the cost associated with spoilage.
2. **Enhance Convenience** Processed foods meet the needs of modern consumer lifestyles, which often demand quick and easy meal solutions. Busy schedules make the convenience offered by processed foods a significant value driver.
3. **Ensure Safety** Specific processing steps are critical for eliminating harmful pathogens. The pasteurization of milk, for example, is a safety-critical process that virtually eliminates the risk of consuming dangerous bacteria.
4. **Improve Taste** Processing can be used to enhance the natural flavors of food or create new and more palatable taste profiles, making certain raw ingredients more enjoyable for the consumer.

2.2.3 Disadvantage of Processing

It is important to acknowledge that any processing can affect a food's nutritional density. The amount of nutrients lost depends on the specific food and the processing method used (for example functional compounds and protein may be lost by processing). Our processes must be optimized to minimize such losses.

2.3 Value addition in perspective

The following steps are used to process raw groundnuts into higher-value products:

2.3.1 Groundnuts

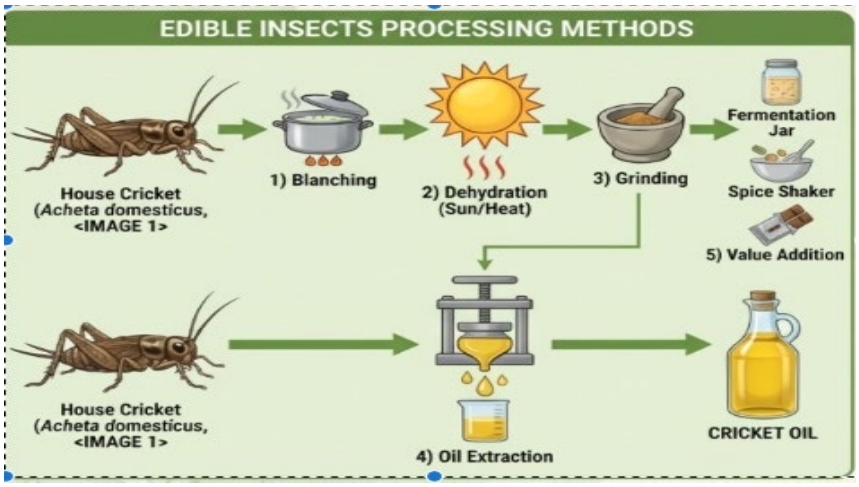
The following techniques are used to transform groundnuts into safe, marketable food ingredients and products:

- **Processing Steps:** Shelling, Cleaning, Sorting, Blanching, Roasting, Drying, Dehulling, and Oil Expelling/Pressing.
- **Value-Added Products:** Peanut Butter, Peanut Flour, and Peanut Paste.

2.3.2 Edible Insects

The following techniques are used to transform edible insects into safe, marketable food ingredients and products:

- **Processing Techniques:** Blanching (to inactivate enzymes), Dehydration (to extend shelf life), and Grinding (to create a powder and oil).
- **Value-Addition Methods:** Fermentation (to improve flavor and nutrition), Flavoring (using spices to create appealing tastes), and Ingredient Incorporation (using insect powder in snacks, bars, or baked goods).



Lessons learnt:

- Value addition is not necessarily raw material transformation only but also aggregating grading or packaging. The simplest value addition that farmers would easily achieve is the one that has nothing to do with the transformation of the raw material.

To determine the level of participant knowledge a 10-minute interactive game will be done at the start the session.

Interactive Team Game: "Peanut Butter Production Race"

Objective: To reinforce understanding of the peanut butter production process.
How to Play:

- F kxkf g r ctvlekr cpvu kpvq gs wcnr gtuqp vgco u
- Rtqxkf g gcej vgco y kvj o qemo cvgtkcnu g i r cr gt ewvqwvu tgr tgugpvkpi i tqwpf pwvu lctu rcdgnu
- Vgco u o wuv cttcpi g vj g uvgr u qhr tqf wevkqp kp vj g eqttgev qtf gt cu s wkemf{ cu r quukdrg
- Vj g hkt uv vgco vq eqo r ngvg eqttgevf{ y kpu Ngctpkpi Qwveqo g Tgkphqtegu ugs wgpekpi cpf wpf gtuvcpf kpi qhgcej r tqeguukpi uvgr

SESSION 3: CREATING A VALUE-ADDED PRODUCT

3.1 Transformation of produce to a value-added product

3.1.1 Pumpkin seeds and peanut snack bars

Ingredients:

¾ cup pumpkin seeds
1 cup peanuts (unsalted)
¼ cup honey
1 ½ tablespoon peanut butter (natural is best)
¼ cup precooked termites or crickets or grasshoppers
¼ cup dried fruit (optional, dried and deseeded masau or raisins)
½ teaspoon vanilla extract
¼ teaspoon salt (if using unsalted peanut butter)

Instructions:

1. **Prepare the Dry Ingredients**:

In a large mixing bowl, combine the rolled oats, pumpkin seeds, peanuts, and dried fruit, if using. Mix well.

2. **Heat the Wet Ingredients**:

In a small saucepan over low heat, combine the honey or maple syrup, peanut butter, vanilla extract, and salt. Stir until the mixture is smooth and well combined.

3. **Combine and Mix:**

Pour the heated mixture over the dry ingredients. Stir well to ensure everything is evenly coated.

4. **Form the Bars**:

Line an 8x8-inch baking dish with parchment paper, allowing some to hang over the edges for easy removal.

Pour the mixture into the baking dish. Use a spatula to press the mixture firmly and evenly into the dish.

5. **Chill**:

Place the baking dish in the refrigerator for at least 2 hours, or until the mixture is firm.

6. **Cut and Store:**

Once firm, lift the mixture out of the dish using the parchment paper overhang. Place on a cutting board and cut into bars or squares.

Store the bars in an airtight container in the refrigerator for up to a week.

Enjoy your homemade pumpkin seed and peanut snack bars!

3.1.2 Cricket crackers

A healthy snack made using finger millet and wheat flour, enriched with cricket flour to boost the nutrient content. The cricket crackers are a fun treat for all age groups and a means to satisfy cravings between meals. They are rich in calcium, iron, B vitamins and dietary fibre.

Ingredients:

50 g millet flour
50 g wheat flour
10 g cricket flour
10 g sesame seeds
10 g butter / margarine
1 tsp black pepper
1 tsp salt
1 tsp mixed herbs
120 – 240 ml water

Instructions:

1. **Prepare the millet flour**:

Dry roast the millet flour in a wok for 4 – 5 minutes on a low to medium flame. This helps to remove its raw muddy aroma and muddy taste. Keep stirring with a spatula, to avoid the flour form burning. Allow the millet flour to cool down.

2. **Mixing of dry ingredients:**

In a large mixing bowl, combine the millet flour, wheat flour, cricket flour, sesame seeds, black pepper, salt and mixed herbs. Stir the mixture well.

3. **Addition of butter/margarine**:

Rub the butter / margarine into the flour mixture, until it resembles breadcrumbs. Add water and knead the dough to form a ball, and set the dough aside for 10 mins.

4. **Moulding**:

Pinch out some of the dough to make a small ball and roll out very thin chapati without using any flour for rolling. Roll directly on parchment paper to avoid them from sticking.

5. **Shaping:**

Once rolled out, poke all over with fork and using a knife/ pizza cutter divide the rolled dough into triangles or squares.

6. **Baking:**

Pre-heat the oven to 190C for 15 minutes. Arrange the cut dough on a greased baking tray and bake at 180C for 8-15minutes. Leave the crackers to cool completely.

7. **Packaging:**

Package the cooled crackers in khakhi paper with plastic lining ziplock packages.

Interactive team game: Innovation challenge

Objective: To encourage creativity and teamwork in product development.
How to Play:

- F kxkf g r ctvkekr cpvu kpvq uo cmi tqwr u
- Gcej i tqwr f guki pu c pgy upcemdct tgekr g wukpi nqecnkpi tgf kgpvu g i dcqdcd r qy f gt f tkgf htwkvu gf kdng kpugevu
- I tqwr u r tgugpv vj gkt r tqf wev eqpegr v pco g cpf r cemci kpi kf gc
- Vj g hcekkvcvqt cpf r ctvkekr cpvu xqvg hqt vj g o quv kppqxcvkxg cpf o ctngvcdng r tqf wev
  Ngctpkpi Qwveqo g Rtqo qvgu etgcvkxkv{ vgco y qtm cpf wpf gtuvcpf kpi qh r tqf wev f kxgtukhkecvkqp

SESSION 4: FOOD SAFETY

4.1 Definition of Food Safety

- Food safety can be defined as the assurance that food will not cause harm to the consumer when it is prepared and/ or eaten according to its intended use (Codex Alimentarius (2003); ISO 22000:2005).
- Food safety is the assurance that food will not cause any harm to the consumer when it is prepared and/or consumed according to its intended use (FAO/WHO, 1997).
- Food safety refers to all those hazards, whether chronic or acute, that may make food injurious to the health of the consumer. It is not negotiable.
- It implies absence or acceptable and safe levels of contaminants, adulterants, naturally occurring toxins or any other substance that may make food injurious to health on an acute or chronic basis**.**

4.2 Importance of Food Safety

Food safety is of vital importance to the global food supply chain.

The management of the safety of food has become increasingly important for several reasons, including the following:

- The increasing globalisation of the food supply chain.
- A consumer population that is far more knowledgeable and discerning on issues associated with the food production chain and particularly those related to food safety.
- Highly sophisticated innovations in product development, which have come to rely increasingly on adherence to strict product and process controls.
- People have the right to expect the food they eat to be safe and suitable for consumption.
- Outbreaks of foodborne illness can damage trade and tourism, and lead to loss of earnings, unemployment and litigation. Food spoilage is wasteful, costly and can adversely affect trade and consumer confidence.
- Consumers everywhere view foodborne disease outbreaks with ever-increasing concern.
- Foodborne diseases not only significantly affect people's health and well-being, but they also have economic consequences for individuals, families, communities, businesses and countries.
- Food and feed are distributed over far greater distances than before, creating the conditions necessary for widespread outbreaks of foodborne illness.
- Hazards can enter the food chain on the farm and can continue to be introduced or exacerbated at any point in the chain.

4.3 Food Hazards

A hazard can be defined as a biological, chemical or physical agent in food (or condition of food) with the potential to cause an adverse health effect (Codex Alimentarius). Can also be defined as a potential source of danger, risk and can be described as a measure of the probability and severity of harm to human health. Food can be contaminated by physical, chemical and biological hazards

A. Biological agents

- Bacteria and their toxins
- Parasites
- Viruses

B. Physical Objects

- Jewellery
- Stones
- Glass
- Bone and metal fragments
- Packaging materials

C. Chemical Contamination

- Natural plant and animal toxins
- Unlabeled allergens (allergen-causing protein)
- Nonfood-grade lubricants
- Cleaning compounds

Biological Hazards

- Involve mainly living organisms
- These hazards induce acute symptoms, which make them noticeable by the consumer. E.g diarhea – salmonella, cholera – *E.coli*
- Can affect the food chain at any step
- They may be macro or microbiological hazards
    - Macro: seen without the aid of a microscope – insects or small mammal

How do biological hazards enter the food the chain?

1. Contamination of raw material – water contamination, air contamination
2. Contamination during food processing – hygiene
3. Contamination during distribution

Chemical Hazards

- Chemical hazards are also a significant source of foodborne illness, although the effect is often difficult to link to a particular food and may occur long after consumption.
- In particular, there have been long-standing concerns about the chemical safety of food due to misuse of pesticides during food production and storage, resulting in the occurrence of undesirable residues.
- Similarly, heavy metal contaminants can enter food through soil or water or food contact material, as can other environmental contaminants such as PCBs.
- All can lead to acute or chronic illness.
- Mycotoxins are another group of highly toxic or carcinogenic chemical contaminants of biological origin produced by certain species of fungi.
- While the importance of chemicals hazards is well recognized, our understanding of the effect of chemicals in food intolerances and allergies, endocrine system disruption, immunotoxicity, and certain forms of cancer are incomplete.

Physical Hazards

Definition: Physical contaminants are additional matter or alien objects normally not existing in food that could cause injury, disease or psychological trauma to the organism. Physical hazards can be classified into 3 groups according to their nature:

- E.g. Mineral (soil, stones, dust, metal, glass, fibre etc.)
- Plant (weeds, leaves, stems etc.)
- Animal (mites, insects, rodents etc.)

*4.5 **G**ood **M**anufacturing **P**ractices*

Good Manufacturing Practices ensure that food products are safe, consistent, and of high quality. They help prevent contamination and maintain consumer trust. The entire process should operates under GMP and strict hygiene standards and when possible, Hazard Analysis and Critical Control Point (HACCP) protocols that parallel conventional animal protein processing, ensuring consumer safety while maintaining the nutritional profile of these sustainable protein sources.

4.5.1 Key Principles of GMP

- **Personal hygiene:** Wash hands regularly, wear clean clothing, and cover hair.
- **Clean environment:** Keep processing areas clean and free from pests.

- **Equipment sanitation:** Clean and sanitize all tools before and after use.
- **Water quality:** Use clean, potable water for all processing activities.
- **Waste management:** Dispose of waste properly to prevent contamination.
- **Record keeping:** Maintain records of production, cleaning, and storage activities.

4.6 Safety Management in Small-Scale Processing

- **Hazard identification:** Recognize potential biological, chemical, and physical hazards.
- **Safe storage:** Store raw materials and finished products in dry, cool, and clean conditions.
- **Temperature control:** Avoid exposure to excessive heat or moisture.
- **Packaging integrity:** Use food-grade materials that protect products from contamination.
- **Traceability:** Label products clearly with batch numbers and production dates.

Critical Control Points for Food Safety

Examples of CCP:

1. Throughout the cleaning process, multiple critical control points require strict adherence to established standards. The 24-hour fasting period eliminates the primary source of intestinal microbial contamination.
2. Heat treatment during blanching or boiling effectively eliminates Enterobacteriaceae and pasteurizes the product.
3. Drying to final moisture content below 8% ensures long-term stability without refrigeration.
4. Regular sanitation of all food-contact surfaces and equipment is essential to prevent cross-contamination.

Interactive team game: "GMP Detective"

Objective: To help participants identify good and bad manufacturing practices.
How to Play:

- Vj g hcekkvcvqt f guetkdgu qt uj qy u r kevwtgu qhf khhgtgpv r tqeguukpi uegpctkqu
- Vgco u o wuvkf gpvkh{ y j gvj gt gcej uegpctkq hqmqy u qt xkqncvgu l O R r tkpekr ngu
- Vgco u gzr nckp vj gkt tgcuqpkpi cpf uwi i guvko r tqxgo gpvu
  Ngctpkpi Qwveqo g Uvtgpi vj gpu wpf gtuvcpf kpi qhj {i kgpg uchgv{ cpf s wcnkv{ eqpvtqnkp r tqeguukpi

SESSION 5: PACKAGING AND LABELING STANDARDS

Packaging and labeling serve a critical dual purpose. The technical function of packaging is to protect the food from hazards during storage and distribution, thereby extending its shelf-life. The presentation function is a vital marketing tool used to create brand identity, appeal to customers, and provide essential product information. A high-quality product in unattractive packaging is unlikely to succeed against well-presented competition. It also aims to appeal to the customer in terms of shape, size, colour, convenience, etc.

5.1 Quality control for packaging material

Incoming packaging

There is need to ensure that the packaging materials are food-grade and prevent contamination. All incoming packaging materials should be inspected for defects. The defects can be classified into the following categories:

- critical fault
- major fault
- minor fault

The importance of the label should not be underestimated by small-scale. Consumers all over the world are becoming increasing affected by advertising and media and more conscious of what they perceive as 'quality'. This perception, at least at the point of first purchase, is based largely on the appearance of the food they are buying and the message it gives. Nowadays a high quality product that does not look attractive and professional is unlikely to survive against what may well be inferior competition.

- A label is the primary point of contact between the producer and the purchaser and should be thought of as an integral part of the producer's marketing plan.
- It is not just a piece of paper stuck onto the container, but should be an expression of a number of important decisions that have been made about marketing.
- Good labels are not just for large producers, but can be used by small enterprises as well.
- If producers have confidence in their products that confidence should show through at the selling point.

5.1.1 The importance of packaging label

1. Persuading the buyer to purchase the product without tasting or smelling it, rather than that of a competitive brand which may be next to it on the shelf.
   - For the first-time buyer the appearance of the food, including the label, is the most influential factor that attracts the customer. If a first-time buyers find nothing wrong with the product they will buy again and quickly develop a loyalty to the brand.
2. Informing the customer clearly about the product; its contents, ingredients, its weight. The label must also comply with any local labelling regulations.
3. Increasingly the label is required to inform the customer about the shelf-life of the food - its 'use by date'.
4. In some cases the label needs to inform the buyer about storing the food. Examples include frozen foods or foods that need refrigeration after opening.
5. Sometimes the customer may need to be told how to use the food product and recipes are commonly included on products that are used as ingredients in cooking.

There are two distinct categories of labels:

1. *Direct printed labels*: These are printed directly onto the container which may be a box, bottle, tin or plastic bag which is then filled and closed.

2. *Applied labels*: Those that are attached or glued to the container, generally after filling and closing. Such labels are attached, most commonly by sticking them on to the package.

5.1.2 Information on the label

The information that needs to be given on a label varies depending on the country and the product. Most countries now have some form of food labelling laws and the manufacturer should consult the relevant local standards authority before designing any label.

General information

- the name of the product,

- the net weight,
- the ingredients, in order of amount,
- the name and address of the manufacturer,
- the Brand name.

Other information such as a sell-by date may be required.

Nutritional information

Providing clear and accurate nutritional information is essential. This typically involves a nutrition facts table (or equivalent format depending on the region) that includes:

- Serving size: clearly defined and consistently applied
- Calories: Total calories per serving
- Macronutrients: Fta, carbohydrates and protein content
- Micronutrients: Vitamins and minerals, as required by local regulations

Allergen declarations

Allergen labeling is critical to protect consumers with food allergies. Common allergens must be clearly declared on the label. Key considerations:

- **Common allergens:** Identify and declare all regulated allergens (peanuts, tree. Nuts, milk, eggs, soy wheat, fish and shellfish
- **Cross contamination:** If there is a risk of cross contamination, include a “may contain” statement.
- **Clear language:** Use clear and easily understandable language for allergen declarations.

Marketing claims

Any marketing claims made on the packaging must be truthful, substantiated, and compliant with regulations. Examples:

- **Health claims:** Claims about the health benefits of the product must be scientifically supported and approved by relevant authorities.

- **Nutrient content claims:** Claims like 'low fat' or 'high fiber' must meet specific criteria.
- **Origin claims:** Claims about the origin of ingredients or the product must be accurate and verifiable.

Quality control

Major faults:

- information on label wrongly printed, mis-spelt,
- incorrect colors used,
- major error in size,
- major print quality errors,
- no glue, if applicable.

Minor faults:

- strong but acceptable color variations,
- size error, but label usable,
- minor error of registration of colors.

CONCLUSION: FOOD PROCESSING BEST PRACTICES

Navigating food processing, safety, packaging and labelling regulations requires careful attention to detail and a commitment to accuracy. By adhering to the guidelines outlined in this document, food businesses can have a starting point to ensure creativity/innovation, regulatory compliance, build consumer trust, and avoid costly penalties. The following is recommended for food processers and any entity that enters in the food processing environment:

1. **Stay Updated:**
   Regulatory requirements change frequently. Subscribe to industry updates and consult with food and regulatory experts.
2. **Accurate Information:**
   Ensure all information on the labels and packaging is accurate, truthful, and easy to understand.
3. **Regular Audits:**
   Conduct regular internal audits to ensure compliance with all applicable regulations.
4. **Documentation:**
   Maintain thorough documentation of your labeling processes, including ingredient information, nutritional analysis, and allergen assessments.