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Research Article

Industrialization of Indigenous Food (Kurkufa and Qitta) Preparation

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Abstract:

This project can cover some of the basic principles needed for a successful food processing implementations, as well as some of the most important features of industrialization of indigenous kurkufa and qitta processing operations. It includes both the physical facility, that is, the structure and supporting utilities, as well as the process. In light of the variety found in the food processing industry, it is necessary to consider the general principles that might apply across the potential range of applications. The instruments for the product industrialization which can be implemented in phases, depending on the experience of trained professionals, are the means for putting these concepts into practice. The focus of the industrialization of indigenous kurkufa & qitta manufacturing is mostly on sanitary sanitation design because it has consumer drive power, environmental petition control mechanisms & production equipment & procedures that are feasible. Once a process has been designed, it is frequently mathematically & physically simulated to study parameters & define operating conditions. The capacity to effectively replicate a process indicates that it is well understood, which is especially comforting when implementing a new or current process at a larger scale. Kurkufa & qitta processes must always be carefully monitored & documented, even if it is not mandated by law. Computer automation is now commonly used to support HACCP programs & to combine manufacturing with quality controls. The processing, industrialization & distribution of indigenous kurkufa & qitta via the OHS management system is another key working principle option of safety & quality controls. Kurkufa & qitta are indigenous products both made from maize flour which is binded with cassava root flour during dough development, were being popular traditional dishes among the Alle people of Ethiopia's Southern region's Alle zone. Moreover, qitta which is a traditional Ethiopian bread, is a basic nutritional item that dates back to the Ethiopian people's history & is created by baking on a clay pan. It is one of the most widely consumed foods in human history & for some, it is sole source of nutrition. However, the boost & control of kurkufa & qitta production & distribution via tracking & traceability mechanism has not been employed as a tool in food manufacturing systems. Therefore, kurkufa & qitta are among Ethiopia's traditional foods that should be upgraded to industrialization in order to increase supply in response to rising food demand owing to population growth.

Key words: indigenous foods; kurkufa; qitta; steps, flow chart; equipment; industrialization

1.Introduction

Kurkufa and qitta were being among the indigenous food of Ethiopia those which they should be upgraded to industrialization improving to the abundant supply for the high increment of food demand due to population growth [1-11]. Kurkufa and qitta, both made from maize flour, were being popular traditional meals among the Alle people of the Alle zone in Ethiopia's Southern region as per indigenous foods [2, 12-14]. Qitta which was being traditional bread is a basic dietary item dating back to the history of Ethiopian people which is prepared by baking that is carried out on clay pan [15, 16]. It is one of the most consumed food products known to humans, and for some is the principal source of nutrition. Control of the production and distribution of qitta has been not used as a means of exercising political influence over the populace for millennia as well as no real utilization as food and business product by Ethiopian people who lacked boosting as Ethiopian indigenous food product worldwide [16]. Traditional kurkufa and qitta were being prepared from different staple crops of the tropics such as sorghumn, maize, finger millet, teff, with different vegetables and tree leaves including moringa leaves in the form of Ethiopian dishes [1, 2, 17-24]. Both kurkufa and qitta were being mainly prepared from sorghum (Sorghum bicolor) and maize (Zea mays) and vegetables such as leaf cabbage (Brassica spp.), moringa (Moringa stenoptella), edible cucumber plants and decne (Leptadenia hastata) in Alle zone [2, 4, 16, 25-30]. Cassava root flour was being used as binding agent of maize flour during kurkufa and qitta preparation [31-34]. In addition, in some of the Alle zone localities, few of households also use dried or preserve morninga leaves for qitta or kurkufa dish preparation. Moringa plant leave is used in preparation of kurkufa and qitta in the diet in a region of Southern Ethiopia in relation to the other regions of Ethiopia. One of the most serious in Ethiopian face is a lack of scaling up traditional food preparation with its basic nutrients [12-14]. This particular project paper is mainly focusing on the way how the traditional kurkuafa and qitta were being produced and getting the aim of industrialization to meet the need of population looking for the sufficient food in time being [1-6, 16, 18, 29, 35-45].

Objective

- To scale-up Ethiopian indigenous kurkufa and qitta preparation
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2.Indigenous Kurkufa and Qitta Industriliation

Although there are many similarities between indigenous kurkufa and qitta, there is one important difference that affects the way that these two types of dish are processed. Hence, the project requirement, basic demand of equipment, processing steps, production methods and packaging systems are the major areas of this project [15, 46, 47].

2.1. Project requirement

Indigenous preparation of kurkufa and qitta need facility (infrastructure) and the production planning as per discussed as follows [2, 26, 27, 32, 48, 49].

2.1.1. Production facility

The production facility for the industrialization of the indigenous kurkufa and qitta manufacturing are mainly based on the focus of the hygienic sanitation design, environmental petition control mechanisms and the feasibility production equipment and methods [22, 42, 50-52]. Once a process is devised, it is often simulated mathematically, and sometimes physically, to investigate parameters and determine operating conditions. The ability to simulate a process accurately is a good indication it is well understood, which is particularly comforting when installing a new or existing process at a new scale. It is always expected, even required legally, that food processes be under careful control, and well documented. The modern practice is to use computer automation to support Hazard Analysis and Critical Control Point (HACCP) programs and to integrate manufacturing with marketing, shipping, and logistics in as seamless a fashion as possible [51]. Sanitary design is an underlying principle of food plant design. Maintaining sanitary conditions is a constant challenge in operations, due to production requirements, low skill and motivation level of available labor, and inherent characteristics of foods and processing conditions [53]. Food processing produces food waste, which typically is biodegradable, but can be in relatively high concentrations. Recovering values from food waste is always a high priority after a reduction in quantity, but ultimately, disposal is required for some amounts. Access to a convenient and economical means of disposal for liquid and solid food waste can be a factor in plant location [51]. Hence, the production facility under this topic include within: site selection and appearance of buildings beyond the requirement of the equipment and processing operations [51, 53-57].

2.1.1.1. Site selection

Markets or raw resources may dictate the location of food plants, which is normally determined by the relative density of products and raw materials. Additional factors include labor and utility expenses, taxes, environmental laws, and community, state, and regional incentives [51]. In order to produce bulky kurkufa and qitta food products rapidly, it is better to locate a processing unit in the area where maize grains, halego and cassava plants are grown or sustainable supply. This reduces transport costs and also reduces the amount of handling, which means that crops are more likely to be in good condition when they arrive at the processing unit. Too much handling and long transportation cause losses on raw materials. On the other hand, processed kurkufa and qitta products are likely to be sold in different markets and there is less reason to locate the unit near to customers. However, kurkufa dish may need some advanced handling and packaging techniques. It may also familiar to few customers relative to qitta products in Ethiopia until the eating habit adoptions among the many other customers. An ideal processing site should close or near to a main road leading to an urban center. The location of the processing unit in a rural area means that there may be problems with: reliable electricity, adequate supplies of potable water, contamination of supplies, access for workers and staff (public transport, distance down an access road), quality of the road (dry season preferences, potholes that may cause damage to containers), absence of other facilities (e.g. handling, medical facilities, shops and entertainment) that make working there less attractive than an urban location. Each of these should be assessed before choosing a site. In rural locations there is usually more land available for waste disposal compared to urban sites, but there may be problems caused by insects and birds or straying animals getting into the building. It is therefore important to have a site with cleared and fenced land, preferably having short grass, which helps to trap airborne dust [29, 51, 58, 59].

2.1.1.2. Building

There are three traditional plant layout options such as straight-through, U-shaped (180°), and L-shaped (90°). The simplest design is the straight-through, which has the advantage of being relatively easy to expand by adding lines in parallel. To take use of this benefit, a plant's architecture must allow for expansion and not obstruct it. Offices, labs, and locker rooms, for example, must be given. It's ideal to put things together on a side that isn't going to be expanded. One downside is that shipping and receiving are on opposite sides of the facility, necessitating two clerks, two driving facilities (usually modest), and two storage areas. Since it's usually advisable to keep raw and finished goods separate in storage, this is a good idea [51]. This determines how the intended products in a plant are actually made. From this flow the material and people patterns, utility requirements, environmental conditions, and all other requirements to determine a facility design [51]. The design of food plants can help to defend against such hazards. Architectural characteristics that make plants easier to clean and less likely to contaminate food make up the majority of sanitary design components. As a result, if the native environment of a plant is dry, keep it that way. Clean and sanitize utilizing wet processes if the typical environment is moist. The occupation health and safety (OHS) of hazard controlling mechanisms and sanitarian hygienic principles should be applied to indigenous kurkufa and qitta manufacturing to assure quality and safety of the final products [46, 60, 61]. Both kurkufa and qitta processing businesses should have a hygienically designed and easily cleaned building to prevent contamination of products. Buildings in rural areas may cost more to construct because of higher transport costs for building materials, but rents in rural areas are usually lower than urban centers. The investment in construction or the amount of rent paid should be appropriate to the size and expected profitability of the business. Within the building, food should move between different stages in a process without the paths crossing (figure 1). This reduces the risk of contaminating finished products by incoming, often dirty, crops, as well as reducing the likelihood of accidents or of operators getting in each other's way. There should be enough space for separate storage of raw materials, away from ingredients, packaging materials and finished products [37, 46, 51, 60, 62-64].

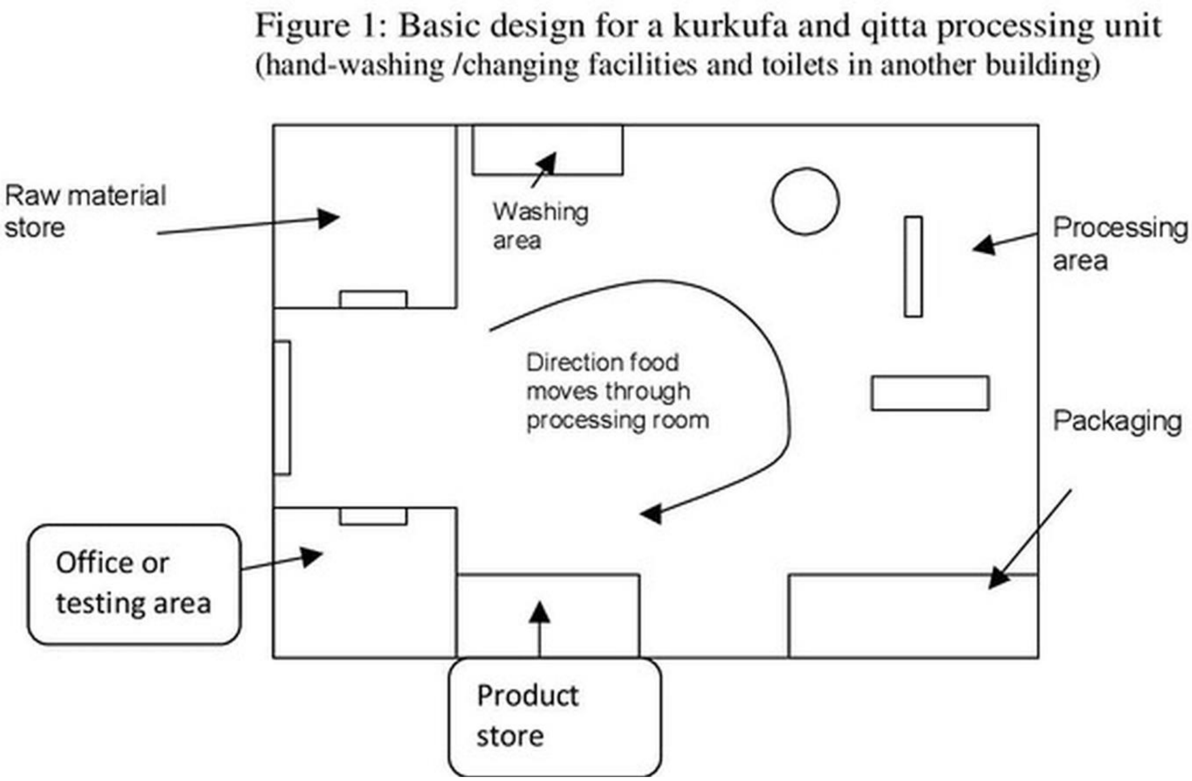


Figure 1: Basic design for a kurkfa and qitta processing unit

2.1.1.2.1. Roofs and ceilings

Overhanging roofs keep a building cooler, which is especially important when processing involves heat. Fibre-cement tiles provide greater insulation than galvanized iron sheets against heat from the sun. Roof vents allow heat and steam to escape and create a flow of fresh air through the processing room. The vents must be screened with mesh to keep insects and birds out of the room. If heat is a serious problem, electric fans or extractors can be used if they are affordable [51]. A panelled ceiling should be fitted in processing and storage rooms, rather than exposed roof beams, which allow dust to accumulate and fall off in lumps and contaminate products. Beams are also paths for rodents and birds, creating contamination risks from hairs, feathers or excreta. It is important to ensure that there are no holes in the panelling or in the roof and no gaps where the roof joins the walls, which would allow birds, rodents and insects to enter [51, 58].

2.1.1.2.2. Washing area

Washing area is where the water supply deliberately released. It is with direction food moves through processing room [51, 58].

2.1.1.2.3. Walls, windows and doors

All internal walls should be plastered or rendered with concrete. The surface finish should have no cracks or ledges, which could harbour dirt or insects [51]. The lower parts of the walls are most likely to get dirty from washing equipment, product splashing etc. They should either be tiled, or painted with waterproof white gloss paint to at least one and a half meters above the floor. Higher parts of walls and the ceiling can be painted with good quality white emulsion paint. Natural daylight is preferable to and cheaper than, electric lighting in processing rooms. The number and size of windows depends on the amount of money that a processor wishes to invest and the security risk in a particular area (windows are more expensive than walls, especially when security bars or grilles are needed) [58]. Storerooms do not need to have windows. Open windows let in fresh air, but this also provides easy access for flying insects. All windows should therefore be screened with mosquito mesh. Windowsills should be made to slope to prevent dust accumulating and to prevent operators leaving cleaning cloths or other items lying there, which can attract insects. Storeroom doors should not have gaps beneath them and should be kept closed to prevent insects and rodents from getting in and destroying stocks of product, ingredients or packaging materials. Processing room doors should be kept closed unless they are fitted with thin metal chains, or strips of plastic or cloth hung from door lintels. These keep out insects and birds, but allow easy access for staff. Alternatively, mesh door screens can be fitted [29, 51, 58, 59].

2.1.1.2.4. Floors

Floors in processing rooms and storerooms should be made of good quality concrete, smooth finished and without holes or cracks. Paints can protect floors, but vinyl-based floor paints are expensive. Red wax household floor polishes should not be used because they wear away easily and could contaminate products or spoil the appearance of packages. The best way to protect floors is to clean up spillages as they occur and make sure that the floor is thoroughly washed after each day's production. Dirt can collect in corners where the floor and the walls join. To prevent this, the floor should be curved up to meet the wall. The floor should also slope to a drainage channel. Proper drainage prevents pools of stagnant water forming, which would allow insects to breed [51]. The drainage channel should be fitted with metal gratings that are easily removed so that the drain can be cleaned. Rodents and crawling insects can also get into the building through the drain and a wire mesh cover should be fitted over the drain opening. This too should be easily removed for cleaning [29, 51, 58, 59].

2.1.2. Production planning

Good Manufacturing Practices (GMPs) are a combination of manufacturing and management practices aimed at ensuring that the indigenous kurkufa and qitta food products are consistently produced to meet specifications and customer expectations [22, 45, 50, 52, 65-67]. The indigenous kurkufa and qitta production planning involves: raw material preparation, the number of staffs required and the record keeping of the industrialization implementation [22, 50, 51]. Production planning entails thinking ahead to ensure that all of the necessary components are in place to generate the desired quantity of output. Inadequate planning causes production to halt because as not enough raw materials are purchased, an ingredient is depleted, or there are insufficient personnel to generate the needed amount of product in the time allotted. Because many raw materials (grains and cassava root) have a short harvest season, everything must be in place and running effectively at the start of the harvest in order to process enough crop to make enough product in a sustainable way [32, 68]. The amount of less perishable commodities like salt and spices, as well as packaging materials that are kept in stock is determined by a number of factors. Decisions on stock levels therefore depend on the cost and reliability of supplies, their shelf life and the amounts that are used each day. If production stoppages happen too frequently, the amount of product available for sale falls to a level where the business cannot afford to pay the bills and it fails. Successful business people manage their cash flow, so that enough money is available to buy the inputs needed for production, before income is received from the sale of products. To do this they plan their production carefully. Careful production planning is used to find the: (1) number of workers required and their different jobs (2) equipment needed to achieve the planned production level (3) weights of raw materials and ingredients to be bought (4) number of packages required (5) It can also identify any 'bottle-necks' in the process. Production can be planned using the calculations below. The information required to do this includes: how much product (kg) is sold (not made) each month?, how many hours are worked per day? and how many days are worked per month?

This information is first used to calculate the daily production rate, so that ingredients and packaging can be ordered. Then the average amount of production per hour (termed the 'product throughput') can be calculated to find the size of equipment and numbers of workers required [58]. The daily production rate is calculated as follows:

$$Production\ rate\ \left(\frac{kg}{day}\right) = \frac{amount\ of\ product\ sold/month\ (kg)}{number\ of\ production/month}$$

Hence, this number is used to determine how much raw material, ingredients, and packaging should be purchased or harvested. Overestimating the number of working days is one of the most common sources of inaccuracy, especially if there are frequent power outages or if employees are frequently absent [58, 69].

2.1.2.1. Raw material preparation

The flow of material (mainly raw material), work during the process, and completed items are the guiding concepts in industrialization of indigenous kurkufa and qitta dishes [51]. The flow of packing materials and waste disposal, as well as the people who generally carry the material, are all critical considerations [51]. The guiding principle is to reduce the distance that material is transferred while maintaining some rationality in the direction and sequence of activities [51]. Having decided how much product to make, a processor needs to calculate how much maize grains or cassava plant roots to buy. This is based first on the recipe for the product and secondly on the likely levels of wastage and losses during the process. For instance, if a single qitta package should contain 200g, then typical estimation of the weight of ingredients for the qitta production can be calculated as:

Recipes or ingredients	Calculation	Amount needed to make 200g
200g cassava root flour	(200/801) x 200	49.94g
600g maize grains flour	(600/801) x 200	149.81
1 g salt	(1/801) x 200	0.25g
Total = 801g		200.0g

Table 1: Raw material estimation and planning

However, the amounts of raw material and ingredients that are calculated from the recipe sometimes are not the amounts that can be used. Losses arise from peeling, from spoiled raw materials that are thrown away during sorting of the cassava roots, from spillage during filling into sacks and other handling materials, or from food that sticks to equipment and is lost during washing. Typical losses are can be involved, but it is important that processors should measure these in their own process so that accurate figures can be used in the calculations [58]. The amount of usable food after raw materials are prepared for processing is known as the yield and is calculated as follows:

$$Yield\ (\%) = \frac{weight\ of\ raw\ material\ actually\ used\ in\ the\ process}{weight\ of\ raw\ material\ that\ is\ bought}\ x\ 100$$

The true cost of raw materials depends on the yield and can be calculated as below:

$$True\ raw\ material\ cost = \frac{supplier\ cost}{\%\ yield}\ x\ 100$$

2.1.2.2. Staff

The number and types of people required to run an indigenous kurkufa and qitta processing firm are determined by the volume of product produced as well as the degree of mechanization. Temporary workers can be used during in some occasions like during harvest season for the staple crops. Machines for kurkufa and qitta processing or machines for packages can minimize the number of workers required dramatically. To determine which option is the most cost-effective, a processor must weigh the cost of labor against the costs of maintenance, spare parts, and even loan repayments from purchasing the equipment. The process charts are used to determine the number of employees required to manufacture a specific amount of goods [51, 58].

2.1.2.3. Record keeping

Record keeping was being the basic and essential technique to manage overall activities, processing unit operations and equipment for food processing systems of indigenous kurkufa and qitta preparation [2, 16, 44]. Record keeping enables the processors to implement the kurkufa and qitta processing procedures and overall equipment in production operations. There are varies sets of records that should be kept by the processors and managers of kurkufa and qitta processing units [1, 15, 38, 48]. As with other inputs to a business, keeping records is an investment of time and money and this must be related to the scale and profitability of the business (the benefits must outweigh the costs) [58]. This means that the processor must understand why the information is collected and what it can be used for. Processors should also put in place a system of checks to ensure that one person does not have responsibility for a whole area of record keeping. For example the person who keeps records of purchases should be different to the person who records levels of stocks and manages the storeroom. Both kurkufa and qitta industrialization implementation can be according to the transformational activities from traditional systems to the modern way of manufacturing [2, 44]. These were presented in the following table 2 and 3.

Unit operations and equipment for traditional and modern kurkufa making (Industrialization)				
No	Unit operations or processing technology		Processing equipment or storage units	
	Traditional	Modern	Traditional	Modern
1	Receiving cassava root independent with visual inspection	Receiving cassava root independent with scientific quality evaluations	Animal skin or sacks	Stainless steel storage silos
2	Washing by hand	using machine	Washing by hands & fibrous grasses	hydrologic washers
3	Traditional peelers	Peeling machines	Knife, ax	Peeling with peeler, blender
4	Size reduction before drying traditionally	Size reduction using mechanical devices	knife or ax	Commercial cutter
5	Sun drying	Mechanical drying	Open air or at ambient condition	Driers as per availability
6	Grinding manually by hand	Grinding using commercial millers	using traditional millers (stones)	Commercial millers
7	Receiving maize grain with visual inspection	Receiving maize with quality evaluations	Animal skin or sacks	Stainless steel storage silos
8	Sun drying	Mechanical drying	Open air or at ambient condition	Driers
9	Cleaning with traditional sieving (sifitea)	Cleaning with modern sieving procedures	Cleaning with traditional sifitea	vibrating sieves
10	Grinding manually by hand	Commercial milling	Grinding using two stones	Commercial roller millers
11	Mix cassava root flour with maize flour manually by hand	Mix cassava root flour using mechanical machines	Traditional gebetes (with different shapes used)	Mix flours using mixers
12	Dough making by kneading the flour with water by hand	Machine mixing	Purely by human force or by hand	Dough mixers
13	Rolling the dough by hand	Machines	Traditional gebetes	dough rolling machines
14	Make small agglomerates by taking pieces from dough rolling by hand to small parts	Mechanical dough cutting machine	Splitting the dough to smaller agglomerates by hand using gebete	rollers
15	Rolling the small separated pieces using the flat gebete circularly clockwise	Shaking machine to have small pieces of spherical or rolled shapes	Making circular shapes by hand the pieces of dough using gebete	make spherical shapes using rotary rollers
16	Adding small agglomerated and circular shape pieces into the clay pot with cooking halego turn by turn by covering the top of clay pot manually	Continuous or batch type Steam cooking the agglomerated pieces or rolled dough via electrical energy	Conventional clay pot heated by fire wood	Improved clay or ceramic or metallic continuous or batch type electric or digital steam cookers
17	Removing kurkufa by handling both sides arms of clay pot and upside down to gebete	Commercial or modern way of removing kurkufa from the steam cooker	Removing the kurkufa by holding the clay pot by hand	Modern way of removing device
18	Cooling at ambient condition	Controlled low cooling temperature	On traditional gebetes	cooling devices
19	Stored in traditional equipments	Modern storage system	Storage in a traditional gebetes	Automated storage devices
20	Serve kurkufa dish on separate gebetes which prepared with halego	Modern serving system independently with prepared halego wot which enriched with various spices	Gebetes	Well designed dish serving equipment & take away materials
Source: This transitional table illustrating the typical activities, unit operations, processing and storage equipment shifting the indigenous foods from traditional to modern industrialization were developed based on Hadis and Technologies [44]				

Table 2: The transitional shift from traditional to industrialization of kurkufa

The processor can use the throughput statistic to determine the size and number of pieces of equipment needed [2, 6, 7, 16, 43, 58, 70-72]. In order to do so, judgments must be made about the advantages of hiring a bigger number of humans or purchasing a machine to perform a specific task [8]. Purchasing equipment from local vendors and fabricators is preferred because service and spare parts should be quicker and easier to come by [8, 58, 73]. If equipment must be imported, the following points should be taken into account when placing an order: be specific about what is expected (many manufacturers have a range of similar products) and provide the desired throughput in kilograms per hour [1, 15, 26, 27, 29, 32, 36, 37, 39, 43-45, 47, 48, 51, 52, 55, 57, 58, 61, 73-99].

Unit operations and equipment for traditional and modern qitta making (Industrialization)				
No	Unit operations or processing technology		Processing equipment or storage units	
	Traditional	Modern	Traditional	Modern
1	Receiving cassava root by visual inspection	Receiving cassava root independent with scientific quality evaluations	Animal skin or sacks	Stainless steel storage silos
2	Washing by hand	using machine	Washing using water & fibrous grasses	hydrologic washers
3	Traditional peelers	Peeling machines	Knife, ax	Peelers, blenders
4	Size reduction traditionally	Size reduction using devices	knife or ax	Commercial cutter
5	Sun drying	Mechanical drying	Open air or at ambient condition	Driers as per availability
6	Grinding manually by hand	Grinding using commercial millers	using traditional millers (stones)	Commercial attrition millers
7	Receiving maize grain with visual inspection	Receiving maize grain with scientific quality evaluations	Animal skin or sacks	Stainless steel storage silos
8	Sun drying	Mechanical drying	Open air or at ambient condition	Driers
9	Cleaning using sifitea	Cleaning with modern sieving procedures	traditional sieving (sifitea)	Vibrating screens or vibrating sieves
10	Grinding manually by hand	Commercial milling	gliding one stone on bigger stone	Commercial roller millers
11	Mix cassava root flour with maize flour manually by hand	Mix cassava root flour using mechanical machines	Traditional gebetes (with different shapes used)	Mix cassava flour with maize flour using mechanical mixers
12	Dough making by kneading the flour with water by hand	Machine mixing	Purely by human force or by hand on traditional gebetes	Continuous or batch type mixers
13	Rolling the dough by hand	Machines	Traditional gebetes	dough rolling mechanical machines
14	Make small agglomerates by taking pieces from dough rolling by hand to small parts	Mechanical dough cutting machine	Splitting the dough to smaller agglomerates by hand on gebetes	Cutting the dough to pieces using electrical energy supplied rollers
15	Rolling the small separated pieces using the flat gebete circularly clockwise	Shaking machine to have small pieces of spherical or rolled shapes	Making circular (ball) shapes by hand the pieces of dough on traditional gebetes	make spherical shapes using vibrated or rotary rollers based on size requirement per single qitta
16	Oiling the hot pan	Oiling uniformly with gulo tree seed oil	Hand oiling or manual oiling	Oiling equipment
17	baking on pan manually	Continuous or batch type baking	Conventional pan heated by fire wood	Improved pans
18	Removing qitta by hands to gebete	Commercial or modern way of removing qitta from the clay baker	Removing the qitta by pulling the sides of qitta to clay pan by hand	Modern way of removing device based on their availability
19	Cooling at ambient condition	Controlled low cooling temperature	On traditional gebetes	Controlled cooling devices
20	Stored in traditional gebetes	Modern storage systems	Storage in gebetes, flat shorqa, aqumada	Automated storage devices
21	Serve qitta on gebetes or together with prepared halego	Modern serving system with prepared halego wot enriched with various spices	Gebetes , flat shorqa, mesob, aqumada	Well designed dish serving equipment and take away materials
Source: This transitional table illustrating the typical activities, unit operations, processing and storage equipment shifting the indigenous foods from traditional to modern industrialization were developed based on Hadis and Technologies [44]				

Table 3: illustrating the implementation of transforming traditional preparation to industrialization of qitta

2.2. Processing steps with equipment, production methods and packaging systems

A lot of planning goes into the engineering design and implementation of the indigenous food processing facilities [9, 43, 45, 51, 53, 54]. Information must be gathered from a variety of sources and put into documents that are easy to understand and share [10, 51]. Persons representing all parts of facility activities should participate in planning sessions. Production, maintenance, supervision, sales, accounting, receiving, warehousing, distribution, human resources, management, engineering, research and development, key suppliers (products and services), government agencies, and consultants are all examples of important suppliers. Engineers, lawyers, insurance providers, and other specialists who are not routinely hired by the organization are examples of consultants. It is advised that major projects have scheduled planning sessions in a convenient, distraction-free venue. It is frequently preferable to choose a neutral third party to lead and moderate [56]. The raw materials such as maize grains and cassava roots can processed parallel to parallel or they can processed independently and mix the flours after milling operation for homogenization in dough preparation. If the cassava roots are planned to process independent, then it includes the following processing procedure [32, 51, 69, 70, 100-105].

Figure 2: Cassava root flour production process

2.2.1. Processing procedures (processing flow charts)

The processing steps of traditional kurkufa and qitta are presented using flow charts which show a representation of sequence of operations (unit operations) in a processing plant or in a process [2, 4, 6, 7, 10, 22, 42, 45, 50, 51, 58, 70, 103]. These sequences of operations were being receiving via inventory or sorting, cleaning, washing, peeling, drying, grinding, mixing, kneading, rolling, splitting, agglomerating, flattening (making a sheet), cooking, baking, cooling and packaging [2, 6-10, 16, 45, 58, 70, 71, 73, 106]. Drying can be either under sun or in a mechanical dryer. The unit operations in traditional kurkufa and qitta preparation were mostly similar with some variations [3, 51, 106]. The process flow charts for both indigenous kurkufa and qitta preparation illustrated independently as follows [3, 45, 106]:

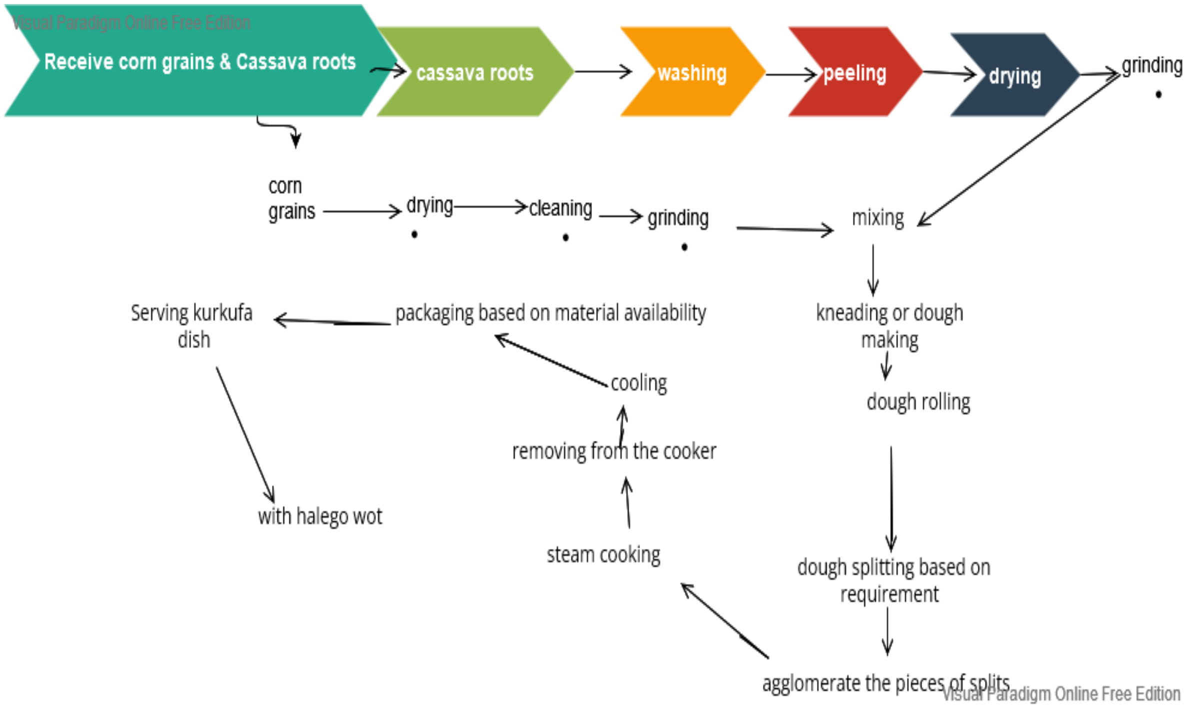


Figure 3: flow chart for indigenous kurkufa preparation

Kurkufa was being the special food of Alle people in Alle zone of Southern Ethiopia region [2]. Mainly it was being cooking based on its own procedures reported previous on reviews [2]. However, the common technical unit operations illustrated in flow chart and the way of incorporating all recipes were reported based on the requirements and validation of equipment' working principles [2, 6-8, 10, 16, 43, 45, 51, 58, 70-73].

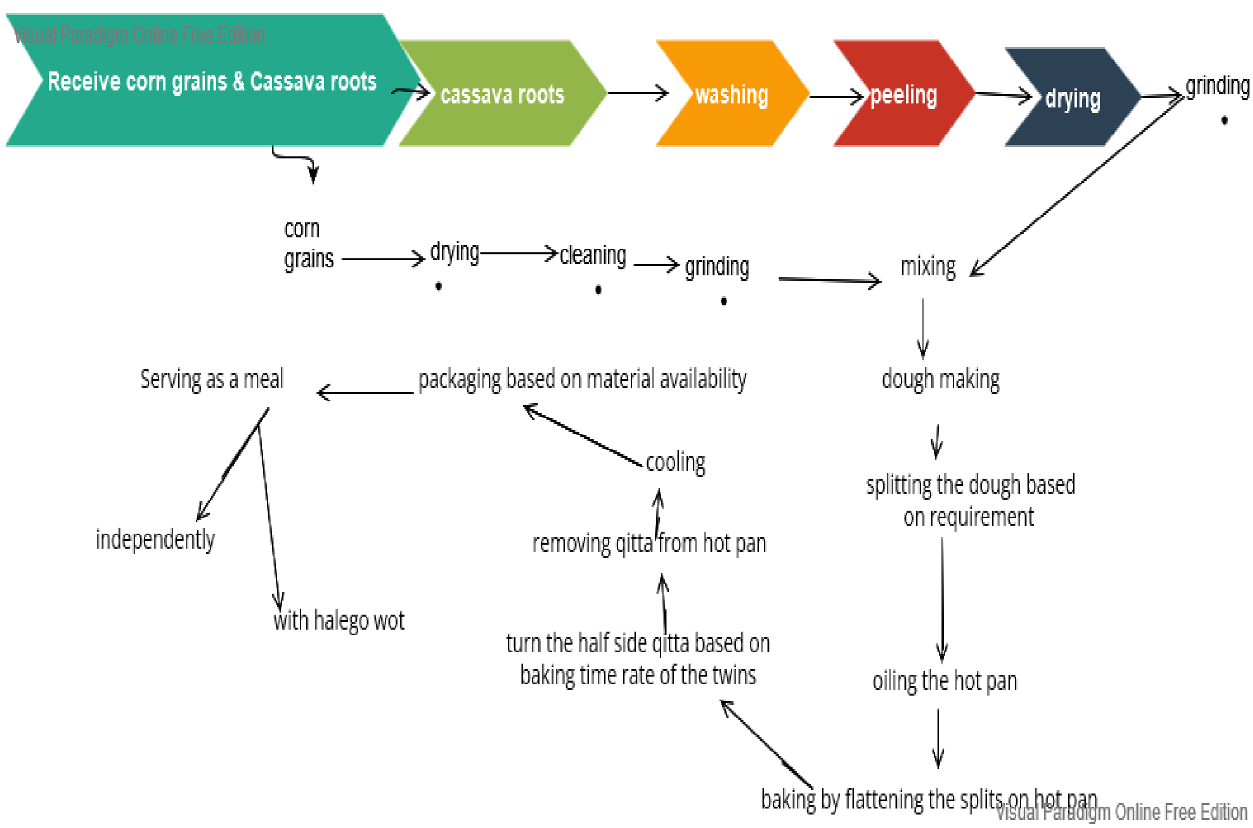


Figure 4: flow chart for indigenous qitta preparation

The flow charts help processers to identify each unit operation in the process which helps in proper selection of equipment and better management of man and machines [8-10, 43, 51, 53-55, 72]. For example, the type of equipment that can be required for the preparation of baked qitta will be as follows.

2.2.1.1. Equipment required for the planning of baking qitta

The requirements of equipment are depend on budget of the investment and availability of the equipment for either continues or batch system of qitta manufacturing [8-10, 43, 45, 58, 72, 73]. The equipment included are: modern beam balances, handling equipment, wash tanks or special washers, knives or blenders, screening materials (with different forms sieves), peelers, small peeling machines, grinders, millers, cutters, rollers, dryers (sun, solar, oven), extensograph, chopping machines or choppers, pulpers, liquidizers, baking paners, bakers, wrapping or packaging materials, mixers, heat or electrical energy suppliers, oiling cabinet or food grade plastic tank, weighing scales or scoops, heater, food grade tank, electric heat sealer for plastic bags as per requirement [3, 8-10, 45].

2.2.1.2. The demand of equipment for the preparation of indigenous kurkufa

As per illustrated various equipment for the baking of qitta, the equipment required for kurkufa processing were also described in the following section. These were: balances, wash tanks or special washers, knives, sieves, peelers, small peeling machines, grinders, millers, dough cutters, splitting machines, liquidizers, steam cookers, wrapping or packaging materials, boiling pan, electrical energy suppliers, wire basket or steamer (automatic steam cooker), weighing scales or scoops, sulfuring cabinet or food grade plastic tank, weighing scales or scoops, boiling pan, heater, food grade tank, dryers (sun, solar and oven), any type of suitable dryer, electric heat sealer for plastic bags based on the requirement and availability [2-4, 8-10, 16, 51, 100].

2.2.1.3. The processing equipment in consideration of both maize grains and cassava roots

If food processor choose a modern appliance wisely and competently, it can make your life 10 times easier. Everyone can save a lot of time and spend it with their family or on self-development thanks to the latest breakthroughs in the field of quality technology [45]. Almost all domestic chores are mechanized and computerized in today's world. Working housewives do not have time for home duties, thus contemporary appliances are provided to assist them. It could include measuring instruments (scales, tonometer, clocks, timers), computers (desktops, notebooks, calculators), kitchen appliances (most kitchen processes are fully automated), housecleaning (vacuum cleaner), clothing care (washing machine, iron), and other household appliances (fan, heater) [2, 3, 51, 63, 64].

2.2.1.3.1. Cassava processing unit operations

Peeling, grinding, drying, screening, milling and mixing are some of the unit processes involved in cassava processing [45, 69]. Because of the many kinds, tuber forms, and sizes of cassava, peeling is a key bottleneck in the processing. These are the most significant obstacles to peeling mechanization [107, 108]. Several attempts have been undertaken in this area, with prototype machines being produced but with minimal performance [68]. Traditional cassava processing methods in Africa are thought to have originated in tropical America, specifically north-eastern Brazil, and may have been derived from indigenous yam processing processes [32]. Cleaning, peeling, slicing, grating, crushing, pressing, drying, milling and mixing are some of the processing procedures of cassava root [32, 69].

2.2.1.3.2. Cassava root processing equipment

Cleaners, washers, peelers, grinders, dryers, and millers are some of the equipment involved in cassava processing [3, 43, 45, 72, 100]. Because of the many kinds, tuber forms, and sizes of cassava, peeling is a key bottleneck in the processing. These are the most significant obstacles to peeling mechanization [107, 108]. Several attempts have been undertaken in this area, with prototype machines being produced but with minimal performance [68]. Traditional cassava processing methods in Africa are thought to have originated in tropical America, specifically north-eastern Brazil, and may have been derived from indigenous yam processing processes [32]. Each processing equipment specifications (size x volume x shape) are depended on size of the indigenous foods processing business, financial feasibilities, the demand of the customers (scale of the production), the availability of the equipment, and skills needed to run the business [6, 7, 16, 31-34, 43, 58, 68-72, 107-109]. Therefore, the standard selection criteria of the overall equipment of indigenous kurkufa and qitta manufacturing starting from their raw materials are based on the specifications and requirements of one particular business in fulfillment of the above factors altogether [43, 72].

(a) Cassava root cleaner and washer

Figure 5: Cleaning and Washing Cassava Roots

The working principle of this machine is centrifugal force and friction. The centrifugal force is outward force acting on the rotating body's outside edge. The centrifugal force created by the rotation of the drum acts on the cassava roots in this machine. Due to centrifugal force, roots move outside on the inner wall of the drum. Because the inner wall of the drum is lined with friction material, friction forms between the roots and the inner wall, resulting in cleaning. It is made up of the above-mentioned mechanically coupled components. There are two shafts on this piece of machinery. An external spline connects the input shaft to the output shaft, and the output shaft is connected to the input shaft via a spline [31-34, 68, 69, 107-109].

(b) Cassava root peeler

Figure 6: peeler

The machine should be designed with the following elements in mind in order to achieve great efficiency and reliability: (i) affordable and within local farmers' purchasing power; (ii) capable of peeling a variety of cassava kinds, shapes, and sizes; (iii) made from widely available materials; (iv) reduce labor input in conventional cassava peeling; and (v) high capacity compared to manual operations. A cassava peeling machine with a single action consists of a roller with a diameter of 200 mm and a length of 900 mm. The shaft travels through the roller and has a diameter of 25 mm. The cutting blades are 70 mm apart, angled at 30°, and fixed on the roller. The roller's auger provides rotary and linear action on the tuber during the process. Remove the outer brown skin and thick cream layer from the rinsed cassava roots. Regularly inspect the water source to ensure it is not unclean or contaminated [31-34, 68, 69, 107-109]. The following formulas were used to determine machine operational factors such as throughput capacity, the effect of individual body mass on throughput capacity, tuber losses, and the safety associated in peeling:

$Througput\ capacity, Tc(kg\ per\ hour) = \frac{WT}{T}$; Where, WT = Mass of sample before peeling (kg) T = Time taken for peeling (s). $Tuber\ losses\ (\%) = \frac{ML1}{MP+ML1} 100$. MP = Mass of tuber flesh peeled with Machine (kg), ML1 = Mass of tuber losses (kg). Whereas tubere losses $(\%) = \frac{ML2}{MM+ML2}$X 100. Where, MM = Mass of peeled cassava manually (kg), ML2 = Mass of tuber losses (kg). The cassava flesh that got stacked in the peel during the course of peeling should be removed manually and weighed and is then recorded as tuber losses [58].

(c) Granting machine

Figure 7: granting machine

While the motor is running, load the grater with washed roots to shred peeled cassava roots into mash. Stainless steel should be used for the grating drum and other food contact locations [34, 108].

(d) De-watering machine

Figure 8: De-watering machine

Load the bags into a hydraulic press directly. Lift and lower the jack handle until it becomes difficult to move. Repeat the process several times a day until there is no more water in the bag, resulting in a firm wet cake [32].

(e) Wet cake breaker machine

Figure 9: Breaker machine

To make homogeneous grits, break the wet cake into small pieces (grits) and remove the lumps (wet coarse cassava flour). Stainless steel should be used in all food contact areas [33].

(f) Wet coarse cassava flour dryer

Figure 10: dryer

Using the principle of heat transfer exchange, effectively dry wet grits into dried coarse cassava flour (HQCF) with low moisture content. The drying process is more dependable and produces better results [34].

(g) Coarse cassava miller

Figure 11: miller

Milling the dried coarse cassava flour into uniformly sized fine cassava flour (HQCF), then pouring the flour onto a plastic lining within a woven polythene sack [33, 34].

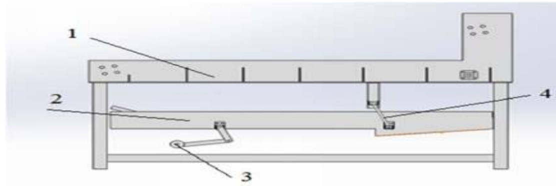
2.2.1.3.3. Maize grain processing equipment

(a) Maize grain dryer

Figure 12: maize grain dryer

Full automatic control system with T-Touch display screen for simple operation that can automatically measure moisture and stop when the present value is reached. Using intelligent drying technology, which adjusts the drying temperature and length automatically to match the needs of different moisture grains. Low-temperature drying produces uniform heat, a low cracking ratio, and a high rate of grain germination. It's perfect for drying seeds, and after drying, the grain particles are full, providing high-quality grains. To ensure that the grains are not contaminated, a hot air stove is installed. In comparison to similar things, this item has low noise, low vibration, is fuel-efficient, has a low cost, and has a long service life. Put the grain in the dryer in batches, then circulate it using the interaction of electric and structural parts [33, 34, 81, 95, 110].

(b) Maize grains screening machine



1. The frame 2.the cleaning sieve 3.the eccentric wheel 4.the hanger

Figure 13: The solid drawing of the cleaning device

Cleaning sieves are divided into two categories: slider cleaning sieves and rocker cleaning sieves. Because of their basic structure, they are suited for small and medium combination screening. The cleaning sieve is generally screened using the idea of different size and material qualities between maize kernels and detritus to achieve clean corn kernels. When there is a proper air field over the top of the cleaning sieve, the cleaning performance can be effectively boosted. As a result, the fan will work in tandem with the traditional combination screener [46, 57, 111].

(c) Maize grains miller

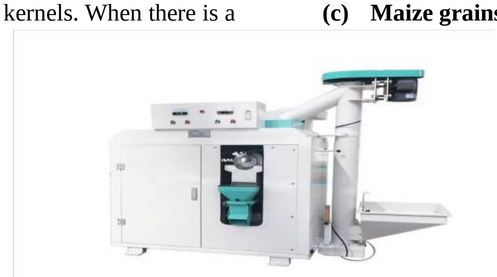


Figure 14: maize grain miller

The maize milling unit consists of a milling system and a wind net dust removal system. Cleaning, degerming, peeling, polishing, milling, and other maize processing steps can be completed quickly and cleanly with this approach. Between 30 and 60 mesh milling intervals are possible. It is suitable for both dry and wet situations, is easy to use, removes impurities rapidly, has a high output, and is electrically driven. Corn processing equipment crushes, classifies, and peels corn before producing low-cost corn meal (30-60 mesh). The maize meal obtained is the best raw material for preparing kurkufa and qitta, and the fineness of the powder can be adjusted to suit the needs [111].

2.2.1.3.4. Powder mixing equipment

A specification for the quality of mixing required should be written out when constructing a process that requires the mixing of particle solids. To accomplish so, three parameters must be specified: the scope of the inspection, the permissible departure from the mean composition, and the frequency or likelihood with which this variation may be exceeded. The scale of scrutiny refers to the smallest amount of material for which mixing quantity is critical. If the mixture is to be used to fill nutraceutical capsules, for example, each capsule must have the required mixture quality. Only the purpose for which the mixture is employed or the frequency with which this variation may be exceeded can determine the permitted variation from the mean composition and the frequency with which this variation may be exceeded [55, 73, 84-91, 112-115].

Batch and continuous mixers are the two types of powder mixers used in the food business, with batch being the most prevalent. Tumbling and convective mixers are the two most prevalent types of batch mixers. Gravity silo mixers and pneumatic mixers are two other types of batch mixers. Weinekötter and Gericke [87] provide a detailed analysis of these mixers. A list of common mixers used in the food business thus can be sued for the industrialization of indigenous kurkufa and qitta manufacturing are shown below.

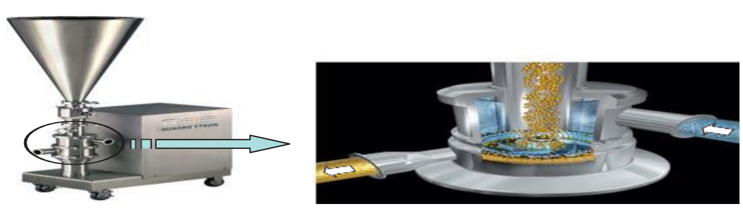


Figure 15: Powder disperser for addition to liquids

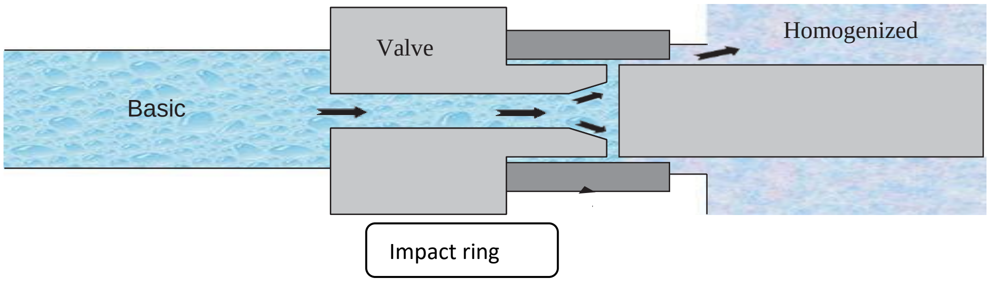
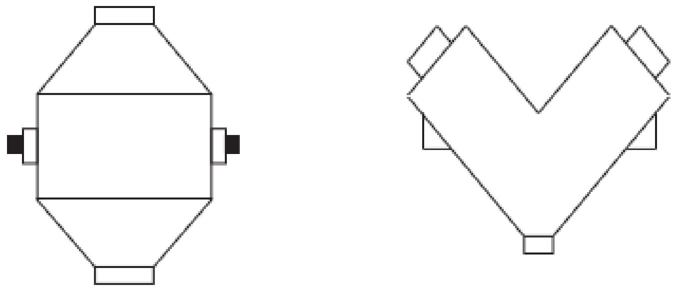


Figure 16: valve homogenizer



(a) Tumbling mixers

Figure 17: Tumbling mixers: (a) double cone and (b) V blender

A tumbling mixer is a closed vessel that rotates on its axis. The double cone and V-shape are two common vessel shapes, as shown in Figure 17. These jars are usually half-filled with particle matter. Mixing is mostly accomplished by random motion, in which particles roll down a sloping surface, and these mixers can produce excellent mixture quality. Low shear environments are created using tumbling mixers. When mixing cohesive powders, this may limit their potential because the shear may not be enough to break up clumps of powder and liberate individual powder particles for mixing. Another issue with these mixers is that if the combination has a tendency to separate, they may not be successful [86].

(b) Convective mixer

Figure 18: Mixing elements in a ribbon convective mixer

Convective mixers have a static shell with spinning blades, paddles, or screws that circulate the powder. In the food sector, these are fairly prevalent. Convective, diffusive, and shear mechanisms all contribute to mixing. The mixing components rotate, causing convective movement of powder pieces around the mixer by the mixing element. As these pieces of powder shear and inter-disperse with one another, individual powder particles move randomly from point to point, resulting in shear and diffusive transport. It's preferable to include parts that can move the powder in a variety of directions so that a random mix can be achieved more simply. These mixers may combine a variety of bulk solids with free flowing material [55, 73, 84-91].

(c) Nauta mixer

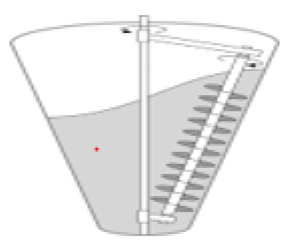


Figure 19: Nauta orbital screw mixer

The Nauta mixer (Figure 19) is a somewhat different sort of convective mixer, in which an orbiting screw lifts powder from the bottom of a conical hopper and moves it around the hopper wall.

(d) Forberg mixer

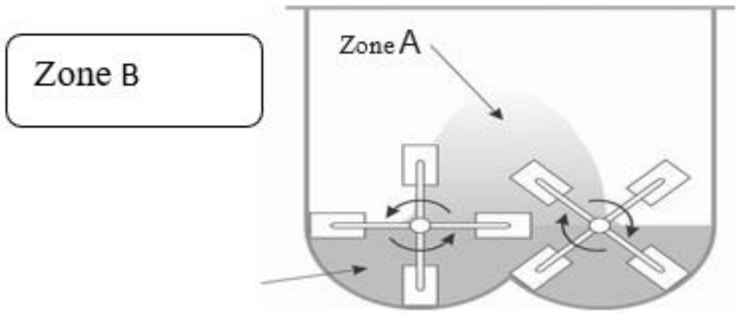


Figure 20: Forberg mixer

Another form of convective mixer that produces a fluidized zone is the forberg mixer (Figure 20), sometimes known as a fluidized zone mixer. It is made up of two counter-rotating mixer drums with specially angled paddles that sweep the entire bottom of both mixer drums [49]. The material in the mixer rotates horizontally in a counter-clockwise motion around the outside, while concurrently moving left and right in the center. As it is transported and dispersed, the material in Zone B is in its typical gravimetric state. A fluidized zone is generated in Zone A, which effectively raises the ingredients to a near-weightless state, allowing them to flow freely and randomly independent of particle size and density. Because of the contact between the two zones, each particle can migrate quickly to a very homogeneous mix in a short amount of time [81, 83, 116].

Mixers with a high shear rate: these are those that have a high shear rate. Extremely cohesive particles are mixed in convective mixers with high shear. They contain particular mixing mechanisms that create significant shear stresses in the powder. High pressures are commonly used to break up extremely cohesive agglomerates, allowing individual particles to be released and mixed with other particles.

Blade mixers (Sigma): Two troughs are used in sigma blade mixers, one with a revolving sigma blade mixing device and the other without. The material is poured into the mixer to a capacity of around 50-60%. Liquid sprayers are positioned above the blades. The blades are counter-rotating and overlapping as they fold and shear the material. Most of the time, these mixers are used to manufacture doughs and other comparable products [89, 95, 112-115].

Continuous mixers: The ingredients are continually delivered into and through the mixer in a continuous mixing process, resulting in a continuously combined product. Continuous mixers are essentially precise ingredient feeders that deliver the ingredients to a compact mixing chamber. The precision of the ingredient feeders is crucial since they will have a significant impact on the quality of the mixture. If the ingredient feeders are accurate enough, the mixing elements in the chamber will just need to provide radial mixing to combine the ingredient streams. This necessitates the use of small mixing chambers and long residence durations. In actuality, feed rate fluctuations occur, hence the mixing elements often impose some axial motion to try to counterbalance any feed rate fluctuations [55, 73, 84-91].

2.2.1.3.5. Dough mixing equipment

Figure 21: Industrial dough mixer

(a) Kneading machine

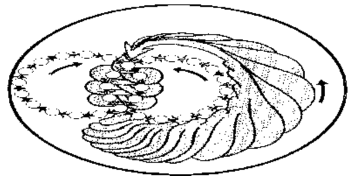


Figure 22: Wendal kneader

Temperature control for dough: As a result of energy being transmitted to the dough during mixing, the temperature of the mixture of elements that make up the growing dough begins to rise. To achieve uniform processing after mixing and to optimize end product quality, cookers and bakers must make dough with a consistent final dough temperature. The heat rise that happens during mixing is accounted for by adjusting the temperatures of the ingredients, most notably the temperature of the water based on standard of the required water temperature for a particular ultimate dough temperature and a given mixer [33, 34, 55, 73, 87-91, 95, 110].

(b) Division of dough to the parts

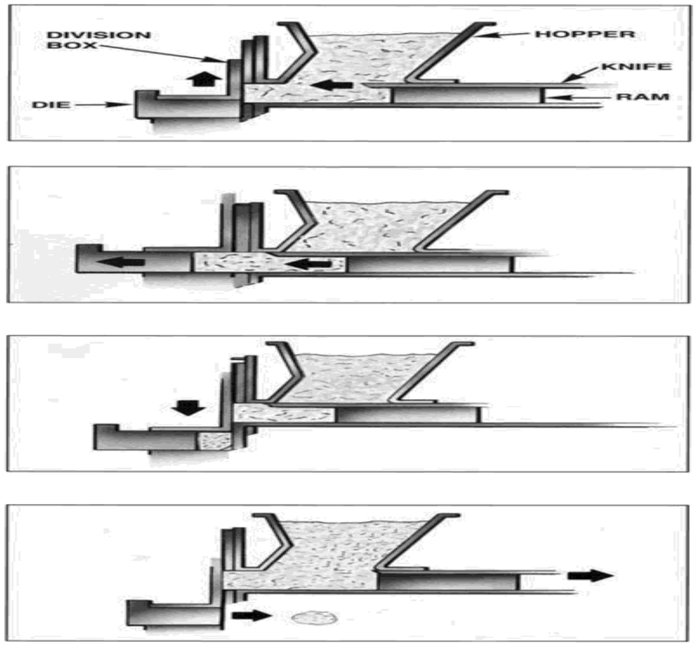


Figure 23: Two-stage oil suction divider

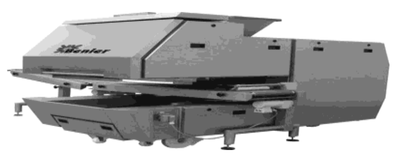


Figure 24: Multi-pocket dough divider

(c) Rolling the dough

Figure 25: Movement of dough around the ball during rounding

Rounder types and shapes: The rotating speed, angle of the cone, angle and form of the track, inclination of the track, and varying surface finishes all affect rounder action on the dough [51].

Rounders with a conical shape: The so-called standard (Figure 26) or inverted versions of rounder are the most prevalent. They are made out of a cone that is rotated around a vertical axis, with the track of the fixed moulding surface running around the outside in a spiral pattern. The rounding effect changes as the dough ball goes up the cone and the differential speeds are lower at the top, where the axial diameter of the cone is shorter, hence the rounding effect changes as the dough ball travels up the cone and the differential speeds are lower [51].

Figure 26: Typical conical rounder, note this model has operator adjustable tracks

Rounders with a cylindrical shape: A track is wrapped around a cylindrical drum in a version of the conical rounder (Figure 27). On this sort of moulder, the track profile and angle of inclination are critical for the final dough shape and driving consistency [95].

Belts that are rounded: These are divided into three types: 'V', vertical, and horizontal. V-types consist of two belts that are oriented in a V and at least one of which is powered. Because there is no cross-drive across the moulding surface, this approach produces the simplest mould with a conical-shaped dough piece. Rounders are similar to cylindrical moulders in that they have a track wrapped around a conveyor belt with the end-roller axis oriented vertically. A horizontal belt rounder is a tool that is used to round the edges of a belt.

Figure 27: Typical conical rounder

Figure 28: Pocket type first prover

Dough balls are transferred in a single stream of pieces into the pocket prover from rounders and pre-moulding devices on qitta production lines, such that at full capacity, every pocket of the prover is filled. The pitch of dough pieces coming from the rounder is not always constant due to rounder slippage, and they must be synchronized to fall properly into the prover pocket. At greater throughputs, this duty becomes more crucial, hence a variety of loading methods are used to accommodate varied dough kinds, sizes, and throughputs. A single-piece in-feed with intermittent prover drives (also known as a 'park and ride' system) receives one dough ball at a time at a single charging point [8, 10, 51, 95].

Figure 29: First prover dough pockets and swings

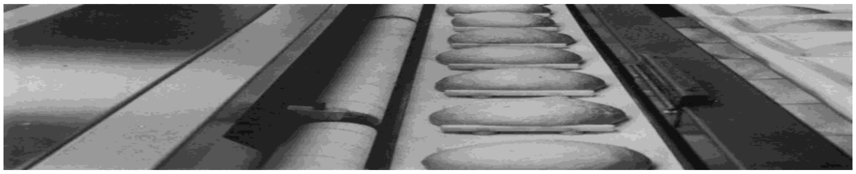


Figure 30: First prover pusher in-feed

d). Moulding

Modern moulding machines mimic the ancient manual technique by sheeting, curling (or rolling) and moulding the dough, including four-piecing and flipping of the dough pieces before to pans for some qitta kinds [8].

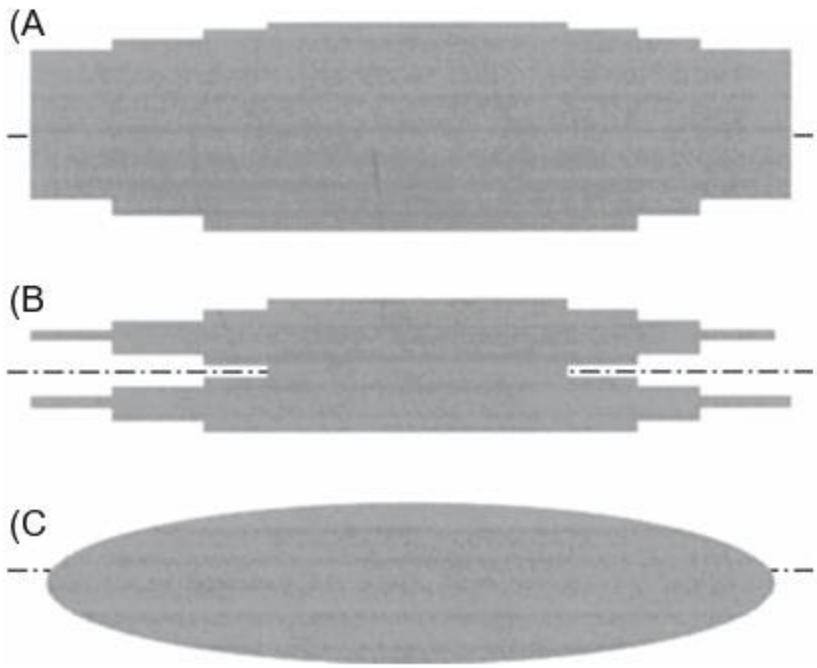


Figure 31: (A) (B) show the theoretical lamination structure of dough in a sheeted and curled piece ((B) being a cross-section of (A)), and (C) showing the final ellipsoid shape achieved

Action of sheeting: In order to reduce the thickness of the dough piece, it must be positioned between pairs of rollers, either a single set of rollers or consecutive pairs of rollers. The thickness of the dough piece can be reduced by up to one-tenth and the surface area increased by more than three times throughout this process. It's worth noting that this is a significant redesign of the dough structure. The main goal is to extend the cell structure and shut the relaxed open cells that the first prover gave. The sheeting action will not be able to degas the dough unless it contains some very large gas bubbles (as opposed to bubbles that will become giant cells) created by a long first proving [8, 10, 51, 63, 64].

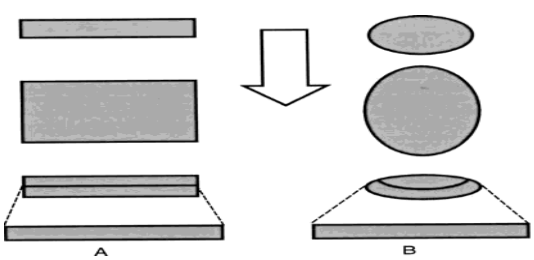


Figure 32: Sheeting, curling and moulding from (A) a dough cylinder and (B) a doughball

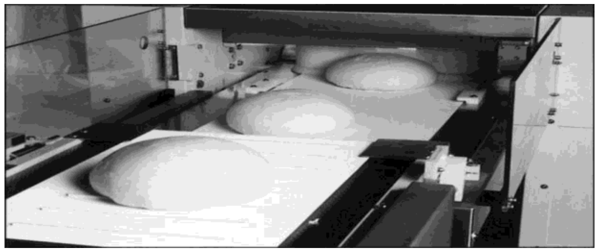


Figure 33: Dough piece being centered before sheeting

Four-piecing: The goals are to cut the dough cylinder into four equal lengths (each just less than the tin width), link each piece with a dough tail to one or more others, and turn each piece through 90 degrees to lie side by side across the tin when panned. In other circumstances, the components are completely disjointed. The dough pieces are cut under or immediately after the moulding board to maintain control. When setting the spacing between cutting blades, dough drag on the side guides should be minimized or taken into account. If dough tails are required during turning and panning, the depth and length of the blades should be appropriate [51].

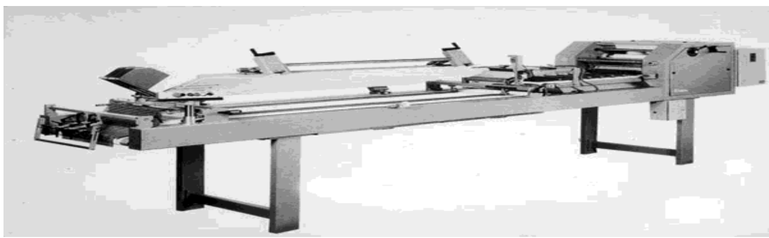


Figure 34: Typical qitta dough moulder for four-piece qitta

Dough pieces move from right to left; the pressure board and dough cutting arrangement are raised for illustrative purposes.

As the pace of baking plants and moulders has grown, panning operations have had to adapt to higher throughput capabilities. The tin or tray is placed under the moulder discharge as each dough piece departs the machine, since most manufacturers offer simple drop systems. Retraction belts are used in faster systems to fill a full stationary strap or tray with enough dimensions to be indexed between fillings. Other methods will synchronize the tin strap/tray and dough product flow so that dough bits can be panned 'on the fly.' The panning process is used in factories where the dough piece has been sliced into multiple items (for example, baguettes strings cut into petit pains) [51].

Figure 35: An automatic bun divider-moulder

(d) Rolling dough to pieces for the sizes of kurkufa

Depending on the number of rows of product being processed and the speed of the machine per row, output capacity range from 4,000 to 36,000 pieces per hour. Processing modules are added to the basic specification according on the type and size of product to be created in order to achieve varied dough cutting, seeding, steam cooking or stamping effects. As previously mentioned for qitta preparation, all such lines for kurkufa production typically include a divider that can use a combination of dividing and rounding. The most frequent dividing method is two-stage dividing, but without the use of oil or a knife, as in the oil suction divider. Extrusion division is expected more widespread, especially in the manufacturing industry [8, 10, 51].

Figure 36: Rolled dough for kurkufa preparation

Rolling to the very pieces circular kurkufa products are more typical on roll lines than on qitta baking prior to the final proof as similar to fish processing sector [14]. As a result, the rolling systems incorporated into steam cooking plants are popular, with the roll dough piece being wetted first and then cooked. Excess kurkufa is collected and stored or packed or wrapped for later use. Typically, steam cooking is done in pressure controlled steamers for kurkufa manufacturing. Row-by-row cooking, similar to that found on qitta lines, where the steam cooking point is in line with the flow of product, or, more typically, a retracting belt that rapidly retracts under the dough pieces to drop up to a tray full of dough pieces every cycle [2, 8, 10, 51].

(e) Rolling and cooking, sheeting and baking combination

Some companies integrate rolling and cooking for the production of kurkufa products in a continues system. Similarly, sheeting and baking qitta manufacture into a single, mostly automated operation. Thus, the dough is automatically taken from the mixing bowl and fed directly into the divider after it has finished mixing. The divided dough pieces are rested before being delivered to the appropriate final roller for rolling the balls or moulder for sheeting, where they are panned or trayed up by the plant's single operator. A computer stores the parameters required for the various product categories. The operator's program controls the machine automatically [2, 3, 8, 10, 51].

2.2.1.3.6. Cooking and baking of indigenous kurkufa and qitta

Steaming is the process in which cooking systems of well rolled dough achieving the aim of prepared kurkufa foods by steam (moist heat) under varying degrees of pressure. The methods are: (a) atmospheric or low pressure steaming: kurkufa food may be cooked by direct or indirect contact with the steam:- direct: in a steamer or in a pan of boiling water (steak):- indirect between two plates over a pan of boiling water. (b) High pressure steaming: in purpose-built equipment which does not allow steam to escape; steam pressure builds up, the temperature increases and cooking time is reduced. Portrays simplified steam circuits typically used for kurkufa cooking process. In diagram 37, condensate is recovered and returned to the boiler for reheating into plant steam [8, 10].

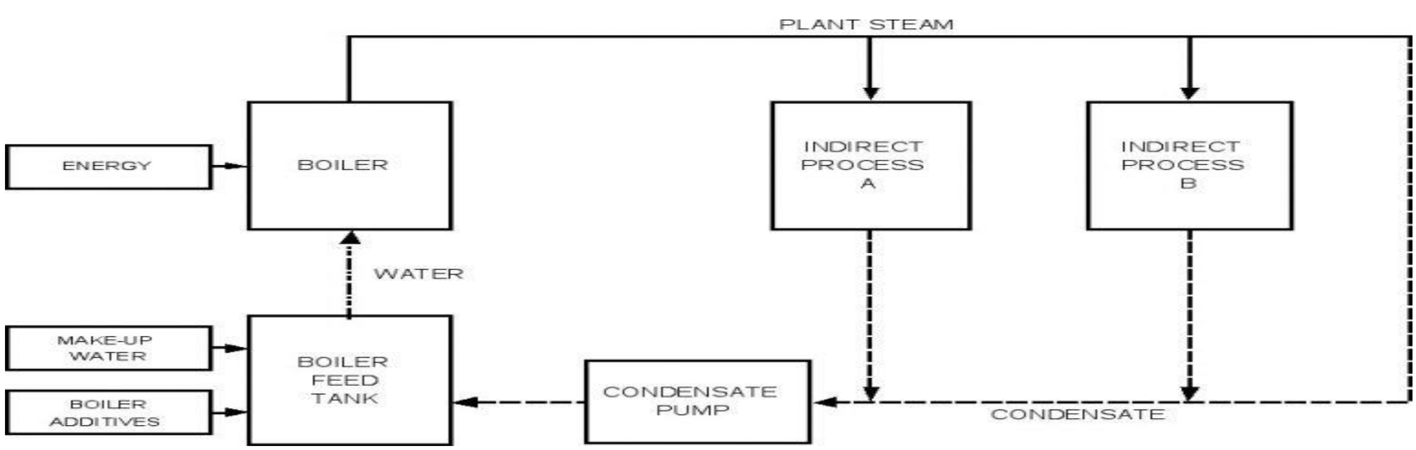


Figure 37: Simplified steam circuit for indirect steam heating processes

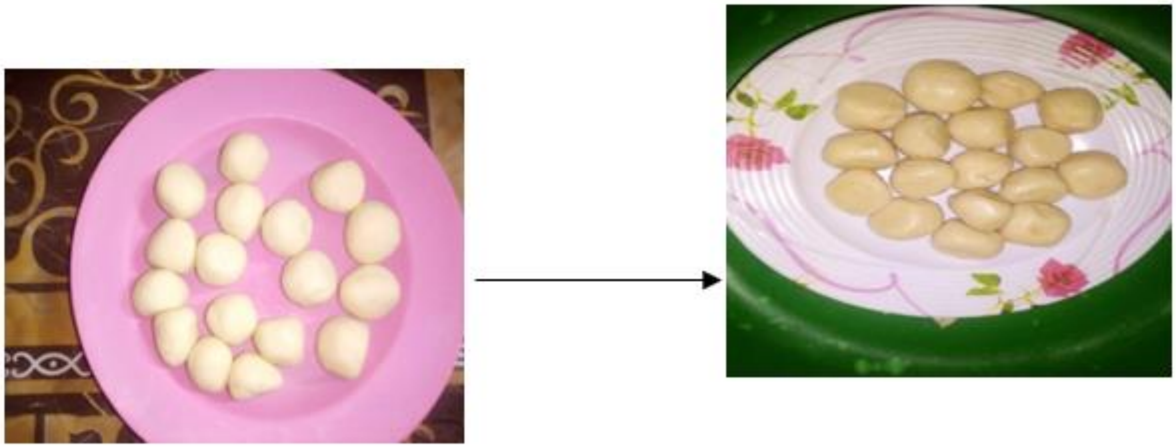


Figure 38: steam cooking of kurkufa product

Baking qitta by dry heat in an oven or surplus number of bakers setted in batches of qitta production (the action may modified by steam). The Dry baking are used that during the baking process steam rises from the water content of the food; it combines with the dry heat of the oven or bakers to bake the qitta foods (sets of qitta batches based on bakers cabinets can produce thousands of qitta once per production time via production lines). The turning of the other side of the qitta can be achieved based on the time requirement rate of heat supply. Hence, the plates which holdes qitta can be shifted based on the given rate of baking time and temperature standards. Moreover, the baking plates may cover the top to control the steam and the qitta can be baked once at a time through the production lines [8, 10].

Figure 39: baked qitta

2.2.2. Products and production methods

2.2.2.1. The indigenous Products

Potentially each of large number of maize crops and cassava plants that are grown in Ethiopia can be used for their respective cooking and baking in kurkufa and qitta industrialization [2, 4, 44]. These enables the processor to make the range of scaling up kurkufa and qitta products as per illustration of process flow charts indicated in figure 3 and 4 respectively. The demand of kurkufa and qitta foods as per the products of staple maize grains in Ethiopia include:

- The indigenous food of Alle people named kurkufa
- Qitta which is the food of Ethiopian people

Processors should therefore try to diversify indigenous foods of Ethiopia into new varieties and experiment with new types of processed kurkufa and qitta via industrialization of these indigenous foods [1, 94]. At present there appears to be no commercial production of kurkufa and qitta from maize grains in considering the natural binders named cassava root flour. Several steps and methods are required to manufacture these indigenous food products [2]. The specific details of each may differ, but the basic principles are the same [1, 4, 8, 10, 94].

2.2.2.2. Methods of industrialization

The production methods of indigenous kurkufa and qitta are related to the unique steps or operations to prepare these products [2, 4, 6, 23, 44, 117]. These operations can stand alone or combine in principles of hurdle technology during the manufacturing of indigenous kurkufa and qitta in Ethiopia [118]. The common unit operations via production methods are: material handling, cleaning, separation, size reduction, flour, fluid & dough flow, mixing (homogenization), heat transfer, concentration, drying, forming, packaging and controlling mechanisms [7-10, 45, 118]. The appropriate and essential equipment for each piece of indigenous kurkufa and qitta industrialization applications play crucial role in manufacturing technologies [2, 4, 6-10, 12, 13, 44, 51, 69].

2.2.3. Packaging systems

The processor should consider the following factors when choosing packaging materials [100-103, 105]: the product's technical needs (for protection against light, crushing, air, moisture etc.), the packaging's design (for promotional and marketing purposes), as well as the relative cost and availability of various forms of packaging [6, 8-11, 58, 70, 101, 102, 104, 106]. Processors may face packaging challenges, and getting support from different food technologists as well as packaging manufacturers' representatives [119, 120]. Packaging can be expensive to transport due to their huge weight, high bulk, and fragility, and breakages can be costly if not carefully packed [69, 70, 100-105]. Minimum order sizes are also required, which may be prohibitively costly for small-scale processors. The throughput is the amount of material that flows through a process every hour [58]. This statistic is critical for determining the proper quantity of equipment and the number of personnel required [51, 58, 69, 70].

$$Throughput\left(\frac{kg}{hour}\right) = \frac{amount\ of\ product\ sold/month\ (kg)}{number\ of\ days\frac{production}{month}x\ No\ of\ \text{hour's}\ worked/day}$$

Conclusion

The guiding elements in manufacturing of indigenous kurkufa and qitta food processing implementation include material flow (mostly raw material), working procedures during the process, and completed items. The flow of packing materials and garbage disposal, as well as the individuals who carry the material on a regular basis, are all important factors to consider. The guiding premise is to reduce material transfer distance while keeping the direction and sequence of activities as sensible as possible. The straight-through form of food plant design is the most basic and has the advantage of being relatively straightforward to expand by adding parallel lines. The architecture of a plant must allow for expansion and not restrict it in order to take use of these advantages. For example, offices, labs, and locker rooms must be provided. It's best to put everything together on one side. This project address some of the fundamental concepts for effective food processing implementations, as well as some of the most significant aspects of industrializing of indigenous kurkufa and qitta processing operations. It encompasses both the physical resources, equipment and the process, which includes the structure and supporting utilities. Because the food processing sector is so diverse, it's important to think about the general concepts that could apply to a wide range of kurkufa and qitta processing applications. The methods for putting these notions into effect are instruments that are implemented in phases based on the experience of skilled professionals. The overall general conclusion of this project is that it is mandatory to apply the principles of HACCP as well as OHS technical safety and quality control system to the industrialization of indigenous kurkufa and qitta manufacturing starting from every single stage to the large scale manufacturing to ensure the ethically approved finished food product.

References

1. Galanakis, C.M., Innovations in traditional foods. 2019: Woodhead Publishing.
2. Glærum, N., Usage and acceptance of Moringa stenopetala in the diet in Ethiopia. 2012, Universitetet i Agder; University of Agder.
3. Lavrenyuk, T. Automated Devices in the Kitchen. in Наукові розробки молоді на сучасному етапі. 2017. Київський національний університет технологій та дизайну.
4. Adam, M., et al., Massive open online nutrition and cooking course for improved eating behaviors and meal composition. 2015. 12(1): p. 1-9.
5. Akyazi, T., et al., A guide for the food industry to meet the future skills requirements emerging with industry 4.0. 2020. 9(4): p. 492.
6. Ibarz, A. and G.V. Barbosa-Cánovas, Unit operations in food engineering. 2002: CRC press.
7. Unit, I. and V. Unit, AG306 Dairy and Food Engineering.
8. Saravacos, G.D. and A.E. Kostaropoulos, Handbook of food processing equipment. Vol. 2012. 2002: Springer.
9. Maroulis, Z.B. and G.D. Saravacos, Food process design. 2003: CRC Press.
10. Maroulis, Z.B. and G.D. Saravacos, Food plant economics. 2007: CRC Press.
11. Graham, R.D., et al., Nutritious subsistence food systems. 2007. 92: p. 1-74.
12. Tarse, D.T.J.I.J.E.S.T.F.T., Effect of Ginger (Zingiber Officinate) on Nutritional and Anti-Nutritionalcontents of Some Varities of Mango (Mangifera Indica) Fruit Preservation in Gambella Region, Ethiopia. 2020. 14(1): p. 1-17.
13. Tarse, D.T. and M.Z.J.B.E. Rick, Fortification Effects in Preparation of Fresh Cheese (Quesoblanco, Gybna beyda & Halloumi) of Zebu Cow Milk Using Citric Acid Solution, Gambella, Godere Woreda, Ethiopia. 2021. 5(2): p. 28.
14. Tarse, D.T. and S.A. Emire, The State of the Art of PH Sensors for Fish Products Safety and Quality Controls. 2023.
15. Neela, S. and S.W.J.J.o.E.F. Fanta, Injera (An ethnic, traditional staple food of Ethiopia): A review on traditional practice to scientific developments. 2020. 7(1): p. 1-15.
16. Statistics, F.J.R., Food and Agriculture organization of the United Nations. 2010. 3(13): p. 2012.
17. Simion, T., et al., Identification and Prioritization of Major Factors that Challenge Crop Productivity and Production System in the Case of Gamo Gofa, Segen Area People Zone and Basketo Special Woreda. 2018. 1(1): p. 10-15.
18. Shin, D.-H., Korean traditional food: status, prospects and vision for globalization. 2004: Food and Fertilizer Technology Center.
19. Mashau, M.E., L.L. Maliwichi, and A.I.O.J.F. Jideani, Non-alcoholic fermentation of maize (Zea mays) in Sub-Saharan Africa. 2021. 7(3): p. 158.
20. Taylor, J. Overview: Importance of sorghum in Africa. in Afripro: workshop on the proteins of sorghum and millets: enhancing nutritional and functional properties for Africa, Pretoria. 2003.
21. Mohamed, M.E., A.H.A.J.S. Eissa, and f.o.f. engineering, Pulsed electric fields for food processing technology. 2012. 11: p. 275-306.
22. Ho, S.K. and S.J.T.T.m. Cicmil, Japanese 5-S practice. 1996.
23. Magzul, L., Indigenous food systems. 2012.
24. Shiferaw, B., et al., Crops that feed the world 6. Past successes and future challenges to the role played by maize in global food security. 2011. 3(3): p. 307-327.
25. DADI, D.W., MICROENCAPSULATED NUTRACEUTICAL PRODUCTS DEVELOPMENT AND MEDICINAL VALUES OF MORINGA STENOPETALA LEAVES EXTRACT. 2019, School of Chemical and Bio-Engineering in Partial Fulfillment of the ….
26. Worku, B.B., et al., Indigenous processing methods of Cheka: A traditional fermented beverage in Southwestern Ethiopia. 2015. 7(1): p. 540.
27. Belay, B.W., et al., Indigenous processing methods of cheka: a traditional fermented beverage in Southwestern Ethiopia. 2016. 7(1).
28. Dadi, D.W., et al., Effects of spray drying process parameters on the physical properties and digestibility of the

microencapsulated product from Moringa stenopetala leaves extract. 2019. 5(1): p. 1690316.
29. Fentie, E.G., et al., Cereal-and fruit-based Ethiopian traditional fermented alcoholic beverages. 2020. 9(12): p. 1781.
30. Makita, K. and D. Grace, JIRCAS Newsletter for International Collaboration. 2014.
31. Bulathgama, A.U., et al., Development of Commercial Tapioca Pearls used in Bubble Tea by Microwave Heat–Moisture Treatment in Cassava Starch Modification. 2020. 5(1): p. 103-106.
32. Hahn, S.K., Traditional processing and utilization of cassava in Africa: IITA research guide, No. 41. 1997.
33. Oladunmoye, O.O., et al., Chemical and functional properties of cassava starch, durum wheat semolina flour, and their blends. 2014. 2(2): p. 132-138.
34. Shittu, T.A., et al., Cassava flour and starch: Processing technology and utilization. 2016: p. 415-450.
35. Boon, E.K.J.R.S.D.R., Africa, Food security in Africa: challenges and prospects. 2007.
36. Framework, A.N.C., The Food Security System. 2012.
37. Qian, J., et al., Filling the trust gap of food safety in food trade between the EU and China: An interconnected conceptual traceability framework based on blockchain. 2020. 9(4): p. e249.
38. Kuyu, C.G., T.Y.J.F.S. Bereka, and Nutrition, Review on contribution of indigenous food preparation and preservation techniques to attainment of food security in Ethiopian. 2020. 8(1): p. 3-15.
39. Lama, P.J.I.G., Japan's food security problem: Increasing self-sufficiency in traditional food. 2017(7): p. 7.
40. Nanda, B.R., Mahatma Gandhi. 1958: Citeseer.
41. Bannerman, C.J.J.o.A.S., Indigenous food and cookery books: Redefining aboriginal cuisine. 2006. 30(87): p. 19-36.
42. Short, F., Kitchen secrets: The meaning of cooking in everyday life. 2006: Berg.
43. Bowser, T.J., Planning the engineering design of a food processing facility. 2000.
44. Hadis,A.Z.J.J.o.A.P. & Technologies, Estimation of thermo-physical properties of selected Ethiopian indigenous foods and industrialization of Tef Injera, traditional bread. 2020. 26: p. 265-270.
45. Ngadi, M., M.J.S.Q. Bazhal, and S.A.i.t.N. Millennium, EMERGING FOOD PROCESSING TECHNOLOGIES: FOOD SAFETY AND. 2004: p. 7.
46. Burnett, S.L. and R. Hagberg, Dry cleaning, wet cleaning, and alternatives to processing plant hygiene and sanitation, in The Microbiological Safety of Low Water Activity Foods and Spices. 2014, Springer. p. 85-96.
47. Scott, S., P. Vandergeest, and M.J.C.p.i.g.a.g. Young, Certification Standards and the Governance of Green Foods in Southeast Asia. 2009. 61.
48. McCartan, J., et al., Traditional Food Energy Intake among Indigenous Populations in Select High-Income Settler-Colonized Countries: A Systematic Literature Review. 2020. 4(11): p. nzaa163.
49. Grimstad, L. and P.J.J.R. From, The Thorvald II agricultural robotic system. 2017. 6(4): p. 24.
50. Ho, S.K., S. Cicmil, and C.K.J.T.f.Q. Fung, The Japanese 5-S practice and TQM training. 1995.
51. Clark, J.P.J.F.E., Food plant design. 2005. 4: p. 683-696.
52. Engelund, E.H., G. Breum, and A.J.J.o.f. Friis, Optimisation of large-scale food production using Lean Manufacturing principles. 2009. 20(1): p. 4-14.
53. Nikoleiski, D.J.J.H.E.D., Principles of hygienic design. 2012. 1(1): p. 15-18.
54. Lelieveld, H.J.I.J.o.D.T., Hygienic design and test methods. 1985. 38(1): p. 14-16.
55. Weinekötter, R. and H. Gericke, Designing Solids Mixing Processes, in Mixing of Solids. 2000, Springer. p. 107-129.
56. Bowser, T., et al., Design and testing of a low-cost, pilot-scale batch gasifier for food processing byproducts. 2005. 21(5): p. 901-906.
57. Fryer, P.J., P.T. Robbins, and I. Asteriadou, Current knowledge in hygienic design: can we minimise fouling and speed cleaning?, in Advances in food process engineering research and applications. 2013, Springer. p. 209-227.
58. Fellows, P.J.V.U.N.I.D.O., Small-scale fruit and vegetable processing and products: Production methods, equipment and quality assurance practices. 2004.
59. Ranganna, S., Handbook of analysis and quality control for fruit and vegetable products. 1986: Tata McGraw-Hill Education.
60. Organization, W.H., Assuring food safety and quality: Guidelines for strengthening national food control systems, in Assuring food safety and quality: guidelines for strengthening national food control systems. 2003. p. 73-73.
61. Marriott, N.G., R.B. Gravani, and M.W. Schilling, Principles of food sanitation. Vol. 22. 2006: Springer.
62. Tacon, A.G. and M.J.A.o.t.N.Y.A.o.S. Metian, Aquaculture feed and food safety: the role of the food and agriculture organization and the codex alimentarius. 2008. 1140(1): p. 50-59.
63. Lin, C.S.K., et al., Food waste as a valuable resource for the production of chemicals, materials and fuels. Current situation and global perspective. 2013. 6(2): p. 426-464.
64. Clark, J. and F.J.I.t.c.f.b. Deswarte, The biorefinery concept: an integrated approach. 2015: p. 1-29.
65. Oyewole, O.B.J.F.c., Lactic fermented foods in Africa and their benefits. 1997. 8(5-6): p. 289-297.
66. Fadahunsi, I.F. and O.O.J.J.A.B.B. Soremekun, Production, nutritional and microbiological evaluation of mahewu a South African traditional fermented porridge. 2017. 14(4): p. 1-10.
67. Nout, M.R., P.K. Sarkar, and L.R. Beuchat, Indigenous fermented foods, in Food Microbiology: Fundamentals and Frontiers, Third Edition. 2007, American Society of Microbiology. p. 817-835.
68. Egbeocha, C., S. Asoegwu, and N.J.F.J.S. Okereke, A review on performance of cassava peeling machines in Nigeria. 2016. 2(1): p. 140-168.
69. Vedove, T.M., B.C. Maniglia, and C.C.J.J.o.F.E. Tadini, Production of sustainable smart packaging based on cassava

starch and anthocyanin by an extrusion process. 2021. 289: p. 110274.
70. Schaefer, D. and W.M.J.P.C. Cheung, Smart packaging: Opportunities and challenges. 2018. 72: p. 1022-1027.
71. Beck, M.E.J.B.F.J., Dinner preparation in the modern United States. 2007.
72. Bowser, T., Selecting and purchasing food processing equipment. 1999, Oklahoma Cooperative Extension Service.
73. Weinekötter, R. and H. Gericke, Equipment for Mixing of Solids, in Mixing of Solids. 2000, Springer. p. 55-65.
74. Rizo, J., et al., Omics in traditional vegetable fermented foods and beverages. 2020. 60 (5): p. 791-809.
75. Adebiyi, J., et al., Fermented and malted millet products in Africa: Expedition from traditional/ethnic foods to industrial value-added products. 2018. 58 (3): p. 463-474.
76. Hott, A. and M.J.T.A.B.T. Loftin, Investigate the Intersection of Agriculture & Biotechnology with Timeline Challenge. 2021. 83 (6): p. 404-406.
77. Godfray, H.C.J., et al., Food security: the challenge of feeding 9 billion people. 2010. 327(5967): p. 812-818.
78. Darley, W.K.J.J.o.A.B., Increasing Sub-Saharan Africa's share of foreign direct investment: Public policy challenges, strategies, and implications. 2012. 13(1): p. 62-69.
79. Desta, B. and G.J.A.J.A.C. Melese, Determination of protein value and alcoholic content in locally prepared different types of Cheka at different stages using CHNS elemental analyzer and specific gravity methods. 2019. 7: p. 168-174.
80. Peters, S.A., et al., The sodium content of processed foods in South Africa during the introduction of mandatory sodium limits. 2017. 9(4): p. 404.
81. Van Soest, P.J., Nutritional ecology of the ruminant. 1994: Cornell university press.
82. Counihan, C. and P.J.N.Y.R. Van Esterik, Food and culture. 1997.
83. Van de Vegte, J., Feedback control systems. 1994: Prentice-Hall, Inc.
84. Weinekötter, R. and H. Gericke, The Statistical Definition of Homogeneity, in Mixing of Solids. 2000, Springer. p.15-34.
85. Weinekötter, R. and H. Gericke, Related Processes to Mixing, in Mixing of Solids. 2000, Springer. p. 99-105.
86. Weinekötter, R. and H. Gericke, Mixing of solids. Vol. 12. 2013: Springer Science & Business Media.
87. Weinekötter, R. and H. Gericke, Mixing and Segregation Processes, in Mixing of solids. 2000, Springer. p. 7-14.
88. Weinekötter, R. and H. Gericke, Measuring Mix Quality Using Off and On Line Procedures, in Mixing of Solids. 2000, Springer. p. 43-54.
89. Weinekötter, R. and H. Gericke, Implementing mixing processes, in Mixing of Solids. 2000, Springer. p. 131-145.
90. Weinekötter, R. and H. Gericke, Example: Mix Quality of a Sand and Cement Mixture, in Mixing of Solids. 2000, Springer. p. 35-41.
91. Weinekötter, R. and H. Gericke, Batch Mixing, in Mixing of Solids. 2000, Springer. p. 67-79.
92. Kutz, M., Handbook of farm, dairy, and food machinery. 2007: William Andrew.
93. Kutz, M., Handbook of farm, dairy and food machinery engineering. 2019: Academic Press.
94. Reardon, T., et al., Rapid transformation of food systems in developing regions: Highlighting the role of agricultural research & innovations. 2019. 172: p. 47-59.
95. Ma, S., et al., Sourdough improves the quality of whole-wheat flour products: Mechanisms and challenges-A review. 2021. 360: p. 130038.
96. Caldwell, W. and K.J.C.A.o.P. Lang, Perspectives on planning for agriculture and food security in the commonwealth. 2014.
97. Caldwell, M.L. and E.P.J.T.b.c.t.g. Lozada Jr, The fate of the local. 2007: p. 498.
98. Caldwell, M.L.J.J.o.C.C., Domesticating the French fry: McDonald's and consumerism in Moscow. 2004. 4(1): p. 5-26.
99. Caldwell, C., Agroecology and Hunger, in Introduction to Agroecology. 2020, Springer. p. 87-102.
100. Muhamedbegović, B., et al., MODERN PACKAGING AND TRENDS IN FOOD PACKAGING.
101. Brody, A.L., B.J.C.R.i.F.S. Miyares, and Nutrition, Impact of external influences on food packaging. 1977. 9(3): p. 227-264.
102. Paine, F.A. and H.Y. Paine, A handbook of food packaging. 2012: Springer Science & Business Media.
103. Coles, R., D. McDowell, and M.J. Kirwan, Food packaging technology. Vol. 5. 2003: CRC press.
104. Yildirim, S., et al., Active packaging applications for food. 2018. 17(1): p. 165-199.
105. Brody, A.L.J.N.F.P.D., 14 Food Packaging Trends. 2009: p. 263.
106. Evans, S., P.J. Partidário, and J.J.I.J.o.P.R. Lambert, Industrialization as a key element of sustainable product-service solutions. 2007. 45(18-19): p. 4225-4246.
107. Olukunle, O., B.J.J.o.E.T.i.E. Akinnuli, and A. Sciences, Performance evaluation of a single action cassava peeling machine. 2012. 3(5): p. 806-811.
108. Jimoh, M. and O.J.N.F.J. Olukunle, An automated cassava peeling system for the enhancement of food security in Nigeria. 2012. 30(2): p. 73-79.
109. Barati, Z., et al., Enzymatic hydrolysis of cassava peels as potential pre-treatment for peeling of cassava tubers. 2019. 20: p. 101247.
110. Negu, A., et al., Development and quality evaluation of wheat based cookies enriched with fenugreek and oat flours. 2020. 57(10): p. 3573-3580.
111. Celma, A., et al., Improving target and suspect screening high-resolution mass spectrometry workflows in environmental analysis by ion mobility separation. 2020. 54(23): p. 15120-15131.
112. Cullen, A.J.P.o.t.I.-P.B.E. and C. Engineering, Theory of the travelling-wave parametric amplifier. 1960. 107(32): p. 101-107.
113. Cullen, P., C. O'donnell, and M.J.J.o.t.s. Houška, Rotational rheometry using complex geometries—a review. 2003. 34(1): p. 1-20.
114. Cullen, A.C., H.C. Frey, and C.H. Frey, Probabilistic techniques in exposure assessment: a handbook for dealing with

variability and uncertainty in models and inputs. 1999: Springer Science & Business Media.
115. Cullen, M., et al., Deep sequencing of HPV16 genomes: A new high-throughput tool for exploring the carcinogenicity and natural history of HPV16 infection. 2015. 1: p. 3-11.
116. van der Avoird, A., P.E. Wormer, and R.J.C.R. Moszynski, From intermolecular potentials to the spectra of van der Waals molecules, and vice versa. 1994. 94(7): p. 1931-1974.
117. Ngapo, T.M., et al., Historical indigenous food preparation using produce of the three sisters intercropping system. 2021. 10(3): p. 524.
118. Leistner, L.J.E.o.M.S.V.o.O.E., Hurdle technology. 2004: p. 640-647.
119. Ahmed, A., N. Ahmed, and A.J.B.F.J. Salman, Critical issues in packaged food business. 2005.
120. Boehlje, M.J.C., Industrialization of agriculture: what are the implications? 1996. 11(316-2016-6650).

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