Processing Handbook for ProKal Products

Infant & Young Child Nutrition Project

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IYCN USAID's Infant & Young Child Nutrition Project

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Table of contents

Acronyms

CCP	critical control point
COA	Certificate of Acceptance
CRS	Catholic Relief Services
CSB	corn-soya blend
DRC	Democratic Republic of the Congo
EFA	essential fatty acid
EPS	expanded polystyrene
FCF	fortified supplementary and complementary foods
FDA	Food and Drug Administration
GAIN	Global Alliance for Improved Nutrition
GM	General Manager
GMPs	good manufacturing practices
HACCP	Hazard Analysis and Critical Control Points
HDPE	high-density polyethylene
IYCN	Infant & Young Child Nutrition Project
LDPE	low-density polyethylene
OVC	orphans and vulnerable children
PEPFAR	President's Emergency Plan for AIDS Relief
PET	polyethylene terephthalate
PMTCT	prevention-of-mother-to-child transmission
PP	polypropylene
PS	polystyrene
PVC	polyvinyl chloride
QA	quality assurance
RTE	ready to eat
RUSFs	ready-to-use supplementary foods
RUTFs	ready-to-use therapeutic foods
SOPs	standard operating procedures
USAID	United States Agency for International Development
WHO	World Health Organization

Executive summary

The Infant & Young Child Nutrition (IYCN) Project (2006–2011) is USAID's flagship project for feeding and improving the nutrition of infants and young children. In 2008 and 2009, IYCN contracted consultants to assist in the development of Ready-to-Use Supplementary Foods (RUSFs), and these consultants developed formulations on behalf of IYCN that they named "ProKal." Zambia was identified as a country where USAID already funds nutrition-based programs and projects such as those undertaken by IYCN; by another USAID collaborating agency, FANTA; and by the President's Emergency Plan for AIDS Relief (PEPFAR).

Zambia was identified as a country where a pilot program could be developed in collaboration with other donors such as Global Alliance for Improved Nutrition (GAIN), in order to establish a manufacturing facility to make RUSFs. The RUSFs produced in Zambia could then be distributed to neighboring countries in the region, such as the Democratic Republic of the Congo (DRC), Malawi, and Zimbabwe.

This handbook focuses on describing and presenting guidelines for the manufacture and handling of three supplementary food products developed by consultants within the context of the IYCN project for Zambia. The three supplementary food products—ProKal $6_2$9, ProKal $10_2$24, and ProKal P_2L—have been developed as supplementary foods for, respectively, (1) HIV-positive pregnant and lactating women using prevention-of-mother-to-child transmission (PMTCT) services in Zambia, (2) their children 6 to 24 months of age, and (3) other orphans and vulnerable children (OVC) 6 to 24 months of age in Zambia.

The following criteria were developed by IYCN as part of a strategy to assist Zambia in developing local capacity to manufacture RUSFs, including the three ProKal products for the three target beneficiary groups: (1) include a high percentage of raw materials available in Zambia and thus minimize imports; (2) prepare formulations that are nutritionally balanced for the target beneficiaries; (3) identify processing facilities within Zambia; and (4) assess the ability of those facilities to prepare these supplementary foods at the desired quality level and in the desired quantities.

The product also had to meet the specific nutrients requirements of the three target beneficiary groups, and it had to be palatable, appealing, and (unless in ready-to-eat form) easy to prepare at minimal cost in the home.

Following are the ingredients used in the three ProKal products—in different proportions in the case of some of the ingredients, depending on whether the consumer would be a child or a pregnant or lactating woman: peanut butter (for flavor, protein, and fat content), soya oil (for high energy density and essential fatty acids [EFAs]), extruded maize and lecithin (for both structural and nutritional purposes, including choline in the lecithin), milk powder (for protein), icing sugar (for sweetness), soy flour (for the essential amino acid lysine), vitamins and minerals, and in some cases, antioxidants.

Since all the ProKal products are supplementary foods, they are used by the target beneficiaries along with other foods. ProKal $6_2$9 and ProKal $10_2$24 (for infants and children) are fed in the ratio of two heaped Zambian tablespoons of maize meal (approx. 10 g/spoonful) to one level Zambian tablespoon of ProKal supplement (12 g/spoonful).The quantities to be fed will depend on the child's age and his or her ability to swallow. The maize meal is prepared as a thin or thick porridge (with thinner porridges being prepared for younger children), and the ProKal supplement is added approximately two minutes before the porridge is completely cooked. For ProKal P_2L (used by pregnant and lactating women), the supplement can be included within the daily porridge or mixed with relish.

This handbook focuses largely on the following items:

- Descriptions of the raw materials and ingredients used in the three ProKal products.
- Building requirements for food-processing plants manufacturing the products.
- Process flow and procedures and process-line layout.
- Handling and storage of raw materials and ingredients.
- Principles of hygiene to be followed by plant personnel and others in the plant, including Good Manufacturing Practices (GMPs)
- QA using the Hazard Analysis and Critical Control Points (HACCP) system and ProKal's Standard Operating Procedures (SOPs).
- Management tools, such as record-keeping and preparation of reports.
- Packaging specifications for ProKal products.

Ingredients and the raw materials they come from (e.g., peanut butter from peanuts and soy flour from soybeans) are described in detail, along with the manufacturing processes used to prepare the raw materials for inclusion in the three ProKal products. Food safety hazards (e.g., *Salmonella,* aflatoxins, and coliforms) are also presented—along with quality-control methods used to avoid these hazards after raw materials are harvested, while raw materials and ingredients are being handled and transported to the food-processing plant, while they are being stored before processing, when they are being processed, and when they are packaged and put in storage.

Building requirements for food-processing plants that will manufacture the ProKal products are also included, in the form of detailed floor plans.

The manufacturing process flow is also described, and ProKal process flow diagrams for both base raw materials and pre-manufactured raw materials are provided.

Layouts of processing plants for the manufacture of ProKal products from both base raw materials and pre-manufactured raw materials are included as well.

Hygienic practices for handling and storing raw materials, ingredients, and the three ProKal products are described in detail, including Good Manufacturing Practices (GMPs) (good housekeeping practices concerning food safety and quality). These practices are followed by a description of hygiene procedures to be followed by personnel and visitors in the food-processing plant in order to prevent contamination.

Detailed instructions are also given for cleaning trucks that haul items to and from the food-processing plant, for cleaning crates and pallets, for cleaning cold rooms, and for ensuring that primary and secondary packaging is sanitary.

QA—a necessity for food processing in both small- and large-scale manufacturing operations—is then described, according to the HACCP system, with reference, as well, to ProKal's SOPs. The seven principles of the HACCP system are described as follows: (1) perform a hazard analysis, (2) identify critical control points (CCPs), (3) establish critical limits for each critical control point, (4) establish critical control point monitoring requirements, (5) establish corrective actions, (6) establish a record-keeping procedure, and (7) establish procedures to verify/validate that the HACCP system is applied effectively. Extensive flow charts have been included, illustrating HACCP procedures and control points for processing with both raw materials and pre-manufactured ingredients.

ProKal's nine SOPs are then presented.

The information on QA is followed by descriptions of other management tools, including record keeping and preparation of reports.

The handbook ends with a section on packaging specifications, including an illustration of recommended packaging for ProKal products.

Section 1: Background

The IYCN Project (2006–2011) is USAID's flagship project for feeding and improving the nutrition of infants and young children. In this handbook, we will be focusing on three supplementary food products—ProKal $6_2$9, ProKal $10_2$24, and ProKal P_2L—developed by IYCN-contracted consultants as RUSFs. These RUSFs are to be used to improve the nutritional status of three target beneficiary groups in Zambia: (1) pregnant and lactating women, including those who are HIV positive and who are using internationally funded prevention-of-mother-to-child transmission (PMTCT) services in Zambia; (2) their children 6 to 24 months of age; and (3) other OVC 6 to 24 months of age in Zambia.

IYCN is an international activity that promotes the importance of nutrition for the full development of children, to help them reach their full human potential as adults. IYCN programs have been implemented in many countries at the global level.

In this instance, Zambia was identified as a country where USAID already funds nutrition-based programs and projects such as those undertaken by IYCN; by another USAID collaborating agency, FANTA; and by PEPFAR. Furthermore, a program could be developed in Zambia in collaboration with other donors such as GAIN, in order to establish a manufacturing facility to make RUSFs. The RUSFs produced in Zambia could then be distributed to neighboring countries in the region, such as the DRC, Malawi, and Zimbabwe. The development of a locally produced RUSF such as the ProKal products in Zambia is designed to meet the needs of the target beneficiaries in IYCN programs in Zambia.

The objective of the IYCN program in Zambia is to deliver measurable results at a scale that will improve the growth and nutritional status and increase the HIV-free survival of infants and young children (6–24 months) and to improve maternal nutritional status. So the development, manufacture, and distribution of the three ProKal products fit within their mandate. IYCN programs adhere to current World Health Organization (WHO) recommendations and guidelines on infant and young child feeding programs in the context of addressing the needs of both national and HIV-based target groups.

IYCN, specifically, is providing technical assistance in Zambia to improve nutrition support for pregnant and lactating women and those living with HIV/AIDS who are using PMTCT services. The IYCN program also supports the infants and young children of these women who are under two years, as well as other OVC of the same age using child health services provided by the Ministry of Health, Zambia. As part of this support, IYCN is providing technical assistance for the identification and development of supplementary foods for HIV-positive mothers, their children 6 to 24 months of age, and other OVC 6 to 24 months of age, based on definitions of malnutrition found in WHO guidelines for IYCN.

The IYCN activity will launch PEPFAR, funded by the United States Agency for International Development (USAID) in Zambia. Another USAID collaborating agency, FANTA, has been asked to provide technical assistance in the design and use of supplementary and therapeutic foods for moderately and severely malnourished affected individuals in Zambia. IYCN and FANTA will be coordinating their efforts to avoid duplication and to ensure consistency.

Catholic Relief Services (CRS) will carry out the actual pilot of the use of supplementary and therapeutic foods (RUSFs and RUTFs) at ten PMTCT sites in Zambia. Two of these sites are being supported by IYCN.

IYCN Consultant in Food Technology, John Wood, conducted two trips to Zambia in 2008 and identified and production-tested supplementary foods for use in the PMTCT context. Olivier Van Buynder, Food Technologist and IYCN Consultant, furthered this work by initiating shelf-life trials on the prototype foods (ProKal $6_2$9, $10_2$24, and P_2L).

IYCN also collaborates with GAIN, which supports private-sector companies so that they can produce low-cost, fortified supplementary and complementary foods (FCF) for the commercial market. GAIN, the funding donor to many food and nutrition programs around the world and specifically in Africa, has worked in Zambia in the past and is interested in working there in the future. IYCN will be coordinating with GAIN to promote GAIN's investment in Zambia. In collaborating with IYCN, GAIN may be able to support a private-sector company that would develop low-cost, commercial fortified FCF.

Section 2: USAID's Infant & Young Child Nutrition Project targets specific consumers and product types

Target beneficiaries

Supplementary foods are designed to be consumed by infants and children 6–60 months of age and pregnant and lactating women who are nutritionally deficient. Within this group, there are HIV-positive women and mothers who can benefit from the nutritionally enhanced foods. These women will also have children who are in the 6–60-month age group who may or may not have HIV/AIDS. Additional groups of children who are HIV/AIDS orphans will receive this type of food as well.

Within the IYCN program, the requirement is to provide supplementary foods for the individuals described above, broken down into the following three specific categories:

1. Breastfed infants aged 6–9 months.
2. Breastfed infants and children aged 10–24 months.
3. Pregnant and lactating women.

Recommended protein and energy requirements for formulation purposes

As nutritionists differ on recommended protein and energy requirements for formulation purposes, the author has selected the FANTA recommendations (see Table 1). The categories highlighted in this table will be used as the basis for product formulations.

Table 1: FANTA's recommended energy and protein requirements for women and children

Category	Energy components (kcal/day)	Energy total (kcal/day)	Protein (g/day)
WOMAN			
Female		2,140	49
Female pregnant	2,140 + 285	2,425	49 + 7 = 56
Pregnant HIV+ asymp	2,140 + 214 + 285	2,639	56
Pregnant HIV + symp	2,140 + 428 + 285	2,853	56
Female lactating	2,140 + 500	2,640	49 + 20 = 69
Lactating HIV+ asymp	2,140 + 214 + 500	3,140	69
Lactating HIV+ symp	140 + 428 + 500	3,354	69
CHILD			
6–9 months		615	14.5
6–9 months HIV asymp	615 + 62	677	14.5
9–12 months		686	14
9–12 months HIV asymp	686 + 69	755	14
12–24 months		849	14
12–24 months HIV asymp	849 + 85	934	14

SOURCE: *HIV/AIDS: A Guide to Nutritional Care and Support* (Washington, DC: FANTA, 2004).

Product formulation criteria

In presenting provisional formulations of supplementary foods for the three target groups, the following criteria, based on WHO Guidelines for Infants and Young Children (see http://www.who.int/nutrition/publications/infantfeeding/en/index.html), were considered:

- Include a high percentage of raw materials available in Zambia and thus minimize imports.
- Prepare formulations that are nutritionally balanced for the target beneficiaries.
- Identify processing facilities within Zambia and carry out an assessment of their ability to prepare supplementary foods of the desired quality and quantity.

Types of supplementary feeding products

Conventionally, fortified cereal and soy-based products such as corn-soya blend (CSB) have been used for supplementary feeding. However, more recently, much interest has been shown in Ready to Eat (RTE) Therapeutic Foods and RUTF. RTE/RUTF foods, such as Plumpy Nut and similar products promoted by Valid International, have been developed as recovery foods for individuals suffering from severe malnutrition and are designed as peanut-butter-based pastes to be consumed directly from the packet.

CSB-type products were never formulated as foods for recovery from malnutrition, but within the general aid/emergency program, they have played an important role as sources of micronutrients. As a pre-cooked (extruded) product, CSB needs to be cooked in boiling water for only a few minutes, primarily to ensure that the water used in preparation is safe from microbiological contamination. For refugees and other displaced people, it is a valuable source of energy and protein, but the nutrient profile is quite inadequate for adults or children recovering from malnutrition—hence the development of paste products with high energy density.

However, products like this that are already on the global market have to be imported and are expensive. In many African countries, the raw materials are available, but there isn't any capacity yet to produce them in the country. This manual is designed to help them set up manufacturing operations at either the country or the regional level in Africa.

Furthermore, within the overall development context in Africa (as opposed to emergency-response situations), options other than importation were available. This allowed aid agencies and their suppliers to build on some of the aspects of both CSBs and RTE/RUTFs—especially where the feeding of infants and children was concerned.

Supplementary foods or food supplements?

Both CSB- and RUSF-/RUTF-type products can be classified as *supplementary foods* (i.e., they are stand-alone products). CSB is cooked with water and consumed as porridge, and RUSF/RUTF products are ready to eat from the packet and can be eaten at any time of the day.

In contrast, *food supplements* are blends of ingredients in the form of a product that is *added to* a normal home-prepared food in order to enhance its nutritional value. Typically, these are blends of essential micronutrients.

Food supplements are not a new concept, since livestock farmers at the global level, including Africa, commonly have the opportunity to purchase a complete feed or an energy-protein-micronutrient concentrate to be blended with farm-grown maize or barley. The concentrate is the food supplement. It is fed to livestock along with maize.

Food supplements in the form of micronutrients blended as powders and packaged in small sachets or small packages are being used by international aid agencies and NGOs. These products are then added to household meals and blended by hand into the food prior to consumption by women and children.

Traditional weaning practices for infants and children within Zambia and much of Africa are commonly based on maize porridge, into which the mother may add ingredients such as pulverized groundnuts, chickpeas, vegetables, vegetable oil, or the like. Those who are poor, however, cannot always afford to add these non-maize components. The low energy density of maize, linked with its low-grade protein, minimal fat, and unavailable niacin ensures that maize is an inadequate weaning food for infants and children. However, for most families, maize is the family staple—grown at the homestead in rural areas and available from the market in urban communities. The situation of the very poor is even worse, since they may not have access even to maize.

In this handbook, however, the emphasis will be almost exclusively on supplementary foods, rather than food supplements, since supplementary foods are used to help the malnourished infants, children, and women who are the focus of IYCN's work in Zambia.

Raw materials available in African countries

The main raw materials available in Africa, in commercial quantities, for the manufacture of all supplementary foods are maize, soya beans, peanuts and other groundnuts, and beans. Others, such as sesame, sorghum, millet, cassava, and bambara nuts, have been discounted due to inconsistency in commercial supply, quality issues, and processing limitations. All products require imported blends of vitamins and minerals, and formulations for infants require the inclusion of imported dried skimmed milk or whole milk powder.

Product formulations

There is a close relationship between a product formulation and the processing machinery required—or, more often, in Zambia and other African countries, *available*—for product processing. This factor has been taken into consideration in the preparation of this handbook. The product must not only meet the nutrient requirements; it must also be palatable, appealing, and (unless it is ready to eat) easy to prepare at minimal cost in the home.

Producers of supplementary foods differ as to whether or not maize should be included in their products. While most commercially manufactured infant foods are based on cereals, they are usually complemented with milk products or soya proteins. But in African countries like Zambia,

where porridge (*nshima*) made of maize is the daily norm, there is little logic in transporting maize from the developing nation to a developed country, processing it there, and then returning it to a needy household at high cost. This makes even less sense, given the fact that the processed maize would still require supplementation with protein, oil, and micronutrients once it arrived back in the country where it was to be consumed.

Therefore, in formulating products for infants and children, producers assume that their dietary requirements will be met by these three components:

- Breastmilk.
- Maize porridge from the household.
- A food supplement produced by a processor and supplied through IYCN.

The daily diet of adult pregnant and lactating women in Zambia and other sub-Saharan African countries is breakfast porridge *(nshima)* and a main meal of the same porridge or relish made from vegetables. As a result, supplementary foods for this diet are formulated with minimal amounts of maize or other cereals. In nutritional terms, the breastmilk will provide high-quality protein, EFAs, and digestible carbohydrate as lactose, while the household maize porridge will provide the complex carbohydrate (starch). The supplementary food will provide the balance of high-density energy in the form of fat, good-quality plant protein, and essential micronutrients.

Accessibility to ingredients for product formulations for supplementary foods

The ability of African producers to develop formulations for supplementary foods depends on access to local ingredients to be included in the product and the local manufacturing capability to process ingredients and blend them into a finished product. Products requiring several ingredients can pose a particular problem, since only a few of the ingredients are manufactured in Zambia and surrounding countries. For instance, most of the following ingredients will need to be imported from overseas countries: peanut butter; heat-treated, full-fat soy flour; icing sugar; extruded maize grits for snack foods; dry cereal blends for infants; and baking powder. Some of these products require the inclusion of milk powders, vegetable oils, and lecithin (or another emulsifier or stabilizer), all of which are desirable components for a high-protein and high-energy food supplement.

The actual concepts of formulation will not be described here, since this would entail a complex description of a series of steps in product development, including details about the nutritional, physical, chemical, and organoleptic characteristics of the individual ingredients and their interaction as a blend. Suffice it to say that three oil-based liquid/paste supplementary foods have been formulated for the three target groups mentioned earlier:

1. Breastfed infants aged 6–9 months.
2. Breastfed infants and children aged 10–24 months.
3. Pregnant and lactating women.

The three ProKal product formulations

The formulations of the three products and their calculated nutritional compositions are shown in Table 2. For identification purposes, the products were designated as "ProKal formulations (an abbreviation derived from "protein" and "kcal") $6_2$9, $10_2$24, and P_2L (6 to 9 months, 10 to 24

months, and Pregnancy to Lactation, respectively). However, the products can be given any other name that IYCN may wish to give them.
Here is an overview of the formulations:

- ProKal $6_2$9 was formulated with a relatively high inclusion of milk powder, ProKal $10_2$24 had a reduced level, and ProKal P_2L had no milk powder. Peanut butter was included for flavor, protein, and fat content.
- Soya was restricted in ProKal $6_2$9 and $10_2$24 because it was suspected that soya beans could cause problems due to the phyto-estrogens they contain. However, the soya that was included was a good source of the essential amino acid lysine.
- Soya oil provided high energy density and was a good source of EFAs.
- Icing sugar added sweetness.
- Extruded maize meal and lecithin were important structural (as well as nutritional) components that helped reduce the tendency of oil-based pastes to separate into oil and solid phases. Lecithin was also a valuable source of choline (see notes at the base of the table) and a natural emulsifier.
- Vitamins and minerals have not been defined and require discussion with other nutritionists.
- Antioxidants such as ascorbyl palmitate and mixed tocopherols may be required to reduce the rate of fat oxidative rancidity.

Table 2: ProKal product formulations and nutritional composition

Characteristic	**ProKal $6_2$9**	**ProKal $10_2$24**	**ProKal P_2L**
FORMULATION	**%**	**%**	**%**
Peanut butter	36	39	41
Soya oil	23	27	27
Soya lecithin	0.5	0.5	0.5
Dry whole milk powder (or dry skim milk + soya oil)	27.5	14.5	—
Icing sugar	6.0	6.0	6.0
Extruded maize meal	—	6.0	6.0
Full-fat soy flour	5.0	6.0	16.5
Vitamin and mineral pre-mix	2.0	2.0	2.0
NUTRIENT CONTENT			
Moisture content (%)	4.0	4.0	4.0
Energy kcal/100 g	592	592	593
Crude protein (N x 6.25) (%)	18.1	16.9	17.4

Crude fat (%)	49.3	49.7	50.7
Crude fiber (%)	0.6	0.8	1.5
Lysine (%)	1.10	0.87	0.68
Methionine + cystine (%)	0.50	0.38	0.40
Linoleic acid (%)	17.0	16.9	19.9
Linolenic acid (%)	1.5	1.6	1.9
Calcium (%)	0.32	0.19	0.08
Lactose	12.1	7.5	—
Sucrose	6.0	6.0	6.0

Codex standard 72-1981 for infant formula

1. Linoleic acid not less than 300 mg /100 kcal; not more than 1,200 mg/100 kcal.
2. Fat not less than 4.4 g/100 kcal; not more than 6.6 g/100 kcal.
3. Alpha linolenic acid not less than 50 mg/100 kcal.
4. Max. lecithin at 0.5 g/100 mL of ready-to-drink product.
5. Antioxidants: mixed tocopherols/ascorbyl palmitate—1 mg in 100 mL of drink.
6. In the United States, infant formulas approved by the Food and Drug Administration (FDA) are required to contain at least 7 mg of choline
7. per 100 kcal, based on the choline content of breastmilk (1 g lecithin contains 0.1–0.17 g choline, and 0.5 g lecithin contains approximately 65 mg choline per 590 kcal, or 11 mg choline per 100 kcal).

ProKal supplementary foods and total dietary intake

The total dietary intake for children is based on the combination of breastmilk, maize porridge, and a formulated ProKal supplementary food. For pregnant and lactating women, home-prepared foods are supplemented with ProKal P_2L. The details of this combination are summarized in Table 3.

Table 3: Indicative quantities of food components to meet the daily dietary requirements of target beneficiaries

Target consumer: All HIV + asymptotic	**Breastmilk**	**Home food**	**Food supplement to be divided between 2 or 3 meals**
Infants 6–9 months (38 g made into a thin porridge)	550 mL	Maize meal	28 g ProKal 629
Young child 10–12 months normal porridge)	500 mL	Maize meal (54 g made into a	38 g ProKal $10_2$24
Young child 12–24 months	450 mL	Maize meal (93 g made into a normal porridge)	47 g ProKal 10224

Pregnant or lactating woman	Home food	120 g ProKal P2L

In practical terms, both ProKal $6_2$9 and ProKal $10_2$24 are fed in the ratio of two heaped Zambian tablespoons of maize meal (approx. 10 g/spoonful) to one level Zambian tablespoon of ProKal supplement (12 g/spoonful). (Note: one Zambian tablespoon = one U.K. dessert spoon). The quantities to be fed will depend on the child's age and his or her ability to swallow. The maize meal is prepared as a thin or thick porridge (with thinner porridges being prepared for younger children), and the ProKal supplement is added approximately two minutes before the porridge is completely cooked.

For ProKal P_2L, the supplement can be included within the daily porridge or mixed with relish.

Tables 4 through 7 show raw materials and nutritional data for the three ProKal products and Table 8 shows final formulations for the three products.

Table 4: ProKal $6_2$9: For infants (6–9 months) with HIV + asymptomatic—with breastfeeding and complementary home food (maize gruel) (assuming 55% of energy from breastmilk, 25% from the ProKal $6_2$9 supplementary food, and 20% from cereal porridge)

Raw materials	**%**		**Nutritional data**		
Peanut butter	36.0		Energy (kcal)	Protein (g)	Fat (g)
Dried whole milk powder (or dry skim milk 24 + oil 10)	27.5	ProKal $6_2$9 composition per 100 g	592	18.1	49.3
		Daily requirement	677	14.5	
Soya oil (550 mL) (55% of energy)	23.0	From breastmilk	373	6.0	23.1
Lecithin (25% of energy)	0.5	From ProKal $6_2$9	169	5.0	13.8
Icing sugar (38 g maize)	6.0	From cereal gruel (20% energy)	135	3.4	1.5
Full-fat soy flour	5.0	Total provided in diet	677	14.4	38.4
Vitamins and minerals ProKal $6_2$9 per day to meet 25% of energy	2.0	Grams	28		

requirement

Table 5: ProKal $10_2$24: For young children (10–12 months) with HIV + asymptomatic—with breastfeeding and complementary home food (maize porridge) (assuming 45% of energy from breastmilk, 30% from the ProKal $10_2$24 supplementary food, and 25% from cereal gruel)

Raw materials	**%**		**Nutritional data**		
Peanut butter	39.0		Energy (kcal)	Protein (g)	Fat (g)
Soya oil	27.0	ProKal $10_2$24 composition			
Lecithin	0.5	per 100 g	592	16.9	49.7
Daily Requirement (g)			755	14.0	—
Dried whole milk powder (or dry skim milk 10.1 + oil 3.9)	14.5	From breast milk (500 mL) (45% of energy)	340	5.5	21.0
Icing sugar	6.0	From ProKal $10_2$24 (30% of energy)	226	6.0	19.0
Extruded maize grits (54 g maize)	6.0	From cereal gruel (25% energy)	189	4.9	2.2
Full-fat soya flour	5.0	Total provided in diet	755	16.4	42.2
Vitamins and minerals per day to meet 30% of energy requirement	2.0	Grams ProKal $10_2$24	38	—	—

Table 6: ProKal $10_2$24 (13–24 months) with HIV + asymptomatic—with breastfeeding and complementary home food
(assuming 35% of energy from breastmilk, 30% from the ProKal $10_2$24 supplementary food, and 35% from cereal gruel)

Raw materials	**%**		**Nutritional data**		
Peanut butter	39.0		Energy (kcal)	Protein (g)	Fat (g)
Soya oil	27.0	ProKal $10_2$24			
Lecithin	0.5	composition			
		per 100 g	592	16.9	49.7
Daily requirement (g)			934	14.0	—
Dried whole milk powder (or dry skim milk 10.1 + oil 3.9)	14.5	From breast milk (450 mL) (35% of energy)	326	5.5	21.0
Icing sugar ProKal $10_2$24 (30% of energy)	6.0	From	280	7.9	23.3
Extruded maize grits (35% energy) (93 g maize)	6.0	From cereal gruel	326	8.4	3.7
Full-fat soy flour	5.0	Total provided in diet	932	21.8	48.0
Vitamins and minerals per day to meet 30% of energy requirement	2.0	Grams ProKal $10_2$24	47	—	—

Table 7: ProKal P_2L: A supplementary food for Pregnant or Lactating Women (both with HIV + Asymptomatic)
(assuming 75% of nutrients from family food supply and 25% from the ProKal P_2L supplementary food)

Raw materials	**%**		**Nutritional data**		
Peanut butter	41.0		Energy (kcal)	Protein (g)	Fat (g)
Soya oil composition per 100 g	28.0	ProKal P_2L	593	17.4	50.7
Lecithin	0.5	Daily requirement (g)	3,140 (Lact) 2,639 (Preg)	69 (Lact) 56 (Preg)	— —
Soybean flour	16.5	From supplement (25%)	785 (Lact) 660 (Preg)	23.0 (Lact) 19.3 (Preg)	66.9 56.3
Extruded maize grits	6.0	Grams ProKal P_2L per day to meet 25% of daily requirement	132 (Lact) 111 (Preg) Average 121 g		
Icing sugar	6.0				
Vitamins and minerals	2.0				

Table 8: Final formulations

Product:	ProKal P2 L	Customer:			
Customer Order quantity:				100.00 kg	Filling mass: gram 100
Dry batch size:				100 kg	
Calc.Process loss:				6%	
Process quantity (Dry mass):				106.00 kg	Packaging quantity 1.000
Total batches to be produced for this order:				1.06	
Process Grouping	**Ingredients**	**Description**	**Ingredient spec**	**Recipe Wet Mass**	**% Dry**
Base Mix	Peanut Butter			43.4600 kg	41.00%
				0.0000 kg	0.00%
	Sucrose	Icing sugar		6.3600 kg	6.00%
				0.0000 kg	0.00%
	Maize meal	Extruded		6.3600 kg	6.00%
				0.0000 kg	0.00%
	Soya flour	Full fat		16.0802 kg	15.17%
				0.0000 kg	0.00%
Additional Mix	Oil	Soya		27.5600 kg	26.00%
				0.0000 kg	0.00%
	Milk powder			0.0000 kg	0.00%
				0.0000 kg	0.00%
	Emulsifier			0.0000 kg	0.00%
				0.0000 kg	0.00%
	Stabilizer	MG 45		3.1800 kg	3.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
Final Mix	Citric acid			0.0318 kg	0.03%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
	Vitamin/Mineral pre-mix			2.9150 kg	2.75%
				0.0000 kg	0.00%
	Antioxidants			0.0530 kg	0.05%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
Total wet ingredients:				106.0000 kg	100.00%

Product:	ProKat 62 9	Customer:			
Customer Order quantity:				100.00 kg	Filling mass:
Dry batch size:				100 kg	gram
Calc.Process loss:				6%	100
Process quantity (Dry mass):				106.00 kg	Packaging quantity
Total batches to be produced for this order:				1.04	1,000
Process Grouping	**Ingredients**	**Description**	**Ingredient spec**	**Recipe Wet Mass**	**% Dry**
Base Mix	Peanut Butter			38.1600 kg	36.00%
				0.0000 kg	0.00%
	Sucrose	Icing sugar		5.3000 kg	5.00%
				0.0000 kg	0.00%
	Maize meal	Extruded		0.0000 kg	0.00%
				0.0000 kg	0.00%
	Soya flour	Full fat		4.5580 kg	4.30%
				0.0000 kg	0.00%
Additional Mix	Oil	Soya		22.2600 kg	21.00%
				0.0000 kg	0.00%
	Milk powder			27.5600 kg	26.00%
				0.0000 kg	0.00%
	Emulsifier			0.0000 kg	0.00%
				0.0000 kg	0.00%
	Stabilizer	MG 45		3.1800 kg	3.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
Final Mix	Citric acid			0.0318 kg	0.03%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
	Vitamin/Mineral pre-mix			4.9077 kg	4.62%
				0.0000 kg	0.00%
	Antioxidants			0.0530 kg	0.05%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
Total wet ingredients:				106.0000 kg	100.00%

Product:	ProKal 102 24	Customer:			
Customer Order quantity:				100.00 kg	Filling mass: gram 100
Dry batch size:				100 kg	
Calc.Process loss:				6%	
Process quantity (Dry mass):				106.00 kg	Packaging quan- 1,000
Total batches to be produced for this order:				1.06	
Process Group-ing	**Ingredients**	**Description**	**Ingredient spec**	**Recipe Wet Mass**	**% Dry**
Base Mix	Peanut Butter			41.3400 kg	39.00%
				0.0000 kg	0.00%
	Sucrose	Icing sugar		5.6180 kg	5.30%
				0.0000 kg	0.00%
	Maize meal	Extruded		5.3000 kg	5.00%
				0.0000 kg	0.00%
	Soya flour	Full fat		6.3600 kg	6.00%
				0.0000 kg	0.00%
Additional Mix	Oil	Soya		26.5000 kg	25.00%
				0.0000 kg	0.00%
	Milk powder			12.7200 kg	12.00%
				0.0000 kg	0.00%
	Emulsifier			0.0000 kg	0.00%
				0.0000 kg	0.00%
	Stabilizer	MG45		3.1800 kg	3.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
Final Mix	Citric acid			0.0375 kg	0.03%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
	Vitamin/Mineral pre-mix			4.8975 kg	4.62%
				0.0000 kg	0.00%
	Antioxidants			0.0530 kg	0.05%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
				0.0000 kg	0.00%
Total wet ingredients:				106.0000 kg	100.00%

Section 3: Raw materials

This section covers information about the raw materials used to manufacture the three ProKal supplementary foods. It is designed to give the user/reader information regarding the quality parameters and specifications of the raw materials to ensure that the finished products will meet the required finished-product specifications.

All the ProKal supplementary foods are lipid-based products made of peanuts and other groundnuts, soybeans, and other ingredients that can be added to the staple diet to improve the diet of HIV-positive mothers, their infants and young children, and other OVC. Recent research suggests that EFAs improve linear growth in children, and these supplementary foods were developed to reflect those recent findings. EFAs also have anti-oxidant properties that may have health benefits for HIV-affected individuals. EFAs are found in soy flour and other foods and vegetable oils, but not all the important ones are available in soy flour, so EFAs from other sources have to be used. In addition, EFAs (particularly those found in soya) are subject to oxidation, and products made of EFAs require storage testing for six months to ensure their stability for nutritional content, appearance, and/or organoleptic properties.

Peanut Butter

Raw materials: Peanuts are rich in fat, protein, vitamin B, phosphorus, and iron. Peanut butter consists of +/- 95% blanched, dry-roasted peanuts, ground to a fine paste format, and it contains 50–52% fat, 28–29% protein, 2–5% carbohydrate, and +/- 2% moisture.

Harvesting peanuts: The soil must be dry enough to prevent soil residues from adhering to the stems and pods. After the peanuts are harvested, they are partially cured on a sill or screen for two to five days and then manually/mechanically separated from the vine and transported to a peanut de-huller. The moisture content of the peanut kernel at harvest ranges from 30% to 50%. Heated air is used to dry the peanuts further to approximately 10% moisture content.

De-hulling and processing: Peanuts from the farms are delivered to warehouses for cleaning. Blowers remove dust, sand, vines, stems, leaves, and empty shells. Screens, magnets, and size graders remove trash, metal, rocks, and clods. To ensure proper grading, the truckloads transporting peanuts to peanut manufacturers are sampled mechanically. The sampler executes grading by examining ten samples per truckload. If edible peanuts need to be stored for more than 60 days, they are placed in refrigerated storage at 2–6°C, and they may be held there for as long as 25 months. The raw, cleaned peanuts are stored, unshelled, in silos or in bags at warehouses.

The peanuts are shipped in large, bulk containers or sacks to peanut-butter manufacturers, where they are de-hulled. De-hulling consists of removing the shell hull of the peanuts with the least damage to the seed or kernels. The moisture of the unshelled peanuts is adjusted to prevent the shells and kernels from becoming excessively brittle and to reduce the amount of dust in the manufacturing plant. The peanuts are dry-roasted in large ovens, and then they are transferred to cooling machines, where suction fans draw cooling air over the peanuts. The peanuts are then

graded for color, defects, spots, and broken skins. After the peanuts are roasted and cooled, the skins are removed by blanching.

Making peanut butter: First, the de-hulled and de-skinned peanuts are dry-roasted. Dry roasting is done either by the *batch* or by the *continuous method.* The peanuts are heated to 160°C and held at this temperature for 40 to 60 minutes to reach the exact temperature of completion. All the nuts in each batch must be uniformly roasted. Large manufacturers prefer the continuous method, in which peanuts are fed from the hopper, roasted, cooled, ground into peanut butter, and stabilized in one operation. This method is less labor intensive, creates a more uniform roasting, and decreases spillage.

However, some operators believe that the best commercial peanut butter is obtained by using the batch method. Since peanut butter may call for a blending of different varieties of peanuts, the batch method allows for those different varieties to be roasted separately. Furthermore, peanuts frequently come in lots of different moisture content, which may need special attention during roasting, and the batch method can also meet these needs readily. The steps outlined below apply to peanut-butter manufacturing that uses the batch method of roasting.

Cooling and blanching: At the exact time when roasting is completed, the roasted peanuts are removed from the heat as quickly as possible. The hot peanuts then pass from the roaster directly to a perforated metal-cylinder blower-cooler, where a large volume of air is pulled through the mass by suction fans. Once cooled to a temperature of 30°C, the peanuts pass through a gravity separator that removes foreign materials. The skins are then removed with either heat or water. The blanching method has the advantage of removing the hearts of the peanuts, which contain a bitter-tasting component. Depending on the variety and degree of doneness desired, the peanuts are exposed to a temperature of 138°C for 15 to 20 minutes to loosen and crack the skins. After cooling, the peanuts are passed through the blancher in a continuous stream and subjected to a thorough but gentle rubbing between brushes or ribbed rubber belting.

Grinding: Most of the devices used for grinding peanuts into butter are built so they can be adjusted over a wide range, permitting variations in the quantity of peanuts ground per hour, the fineness of the product, and the amount of oil freed from the peanuts. Most grinding mills also have an automatic feed for peanuts and salt and are easy to clean. To prevent overheating, grinding mills are cooled by a water jacket.

Peanut butter is usually made through two grinding operations. The first reduces the nuts to a medium grind and the second, to a fine, smooth texture. For fine grinding, clearance between plates is about 0.08 cm. The second milling uses a very high speed comminutor/cutter/grinder that uses a combination cutting-shearing and attrition action and operates at 9,600 rpm. This milling produces a very fine particle with a maximum size of less than 0.025 cm. Peanuts are kept under constant pressure from the start to the finish of the grinding process to ensure that grinding is uniform and to protect the product from air bubbles. A heavy screw feeds the peanuts into the grinder. This screw may also deliver the de-aerated peanut butter into containers in a continuous stream under even pressure.

From the grinder, the peanut butter goes to a stainless-steel hopper, which serves as an intermediate mixing and storage vessel. The stabilized peanut butter is cooled in this rotating cooling cylinder from +/-77°C to +/- 49°C or less before it is packed.

Packaging: The stabilized peanut butter is automatically packed in jars or buckets and is then capped and labeled.

Quality assurance: QA of peanut butter starts on the farm, goes on through harvesting and curing, and continues through the steps of shelling, storing, and manufacturing the product. All these steps are handled by machines. While complete mechanical harvesting, curing, and shelling may have some disadvantages, the result is a brighter, cleaner, and more uniform peanut crop and a smooth peanut-butter product.

Microorganism contamination in peanuts–Salmonella: *Salmonella* is a genus of bacteria in the Enterobacteria family that can survive in soil for months or years, and possible contamination sources are as follows:

- Field irrigated with water contaminated with animal waste.
- Untreated surface water (ponds, rivers) with runoff from livestock operations.
- Wildlife grazing on or near fields.
- Leaks in roof of storage shed and warehousing on which birds congregate.
- Rodent and insect activity, especially if facility is near livestock operations.
- Forklift and transport equipment exposed to mud, water, or contaminated soil outdoors, which then bring these items into sheds and warehouses without prior cleaning and disinfection.
- Cattle, livestock, or wildlife grazing in orchards—especially near trees—which can result in fecal contamination when the peanuts are harvested.
- Fertilizing soil in orchards with untreated fecal waste.

Roasting of peanuts is the only method that will kill the *Salmonella* bacteria. If contamination occurs after the roasting process, *Salmonella* is going to survive. Studies have shown that *Salmonella* can survive for many months in peanut butter once it's present, since it survives easily in fatty food products. Then, when it gets into the acid of the stomach, it may not be destroyed. And since peanut butter is a highly fatty food, *Salmonella* has even more chances of surviving in it than in some other foods. Other factors affecting the growth of *Salmonella* are as follows:

- Growth is typically prevented by low moisture content (water activity <0.95).
- Growth is also typically prevented by temperatures less than 5°C or greater than 46°C.
- The optimum temperature for growth is 35–37°C.

Aflatoxins: Aflatoxins are naturally occurring mycotoxins that are produced by many species of *Aspergillus*, a fungus—most notably, *Aspergillus flavus* and *Aspergillus parasiticus.* Aflatoxins are toxic and among the most carcinogenic substances known. After entering the body, aflatoxins may be metabolized by the liver to a reactive epoxide intermediate, or they may be hydroxylated and become the less harmful aflatoxin M_1.

Aflatoxin-producing species of the *Aspergillus* genus are commonly found in cereals, including maize, as well as peanuts and other groundnuts. They can colonize and contaminate grain before harvest or during storage. Host crops are particularly susceptible to infection by *Aspergillus* following prolonged exposure to a high-humidity environment or following damage from stressful conditions such as drought (which lowers the barrier to entry). The native habitat of *Aspergillus* is in soil, decaying vegetation, hay, and grains undergoing microbiological deterioration. It also invades all types of organic substrates whenever conditions are favorable for its growth.

Favorable conditions include high moisture content (at least 7%) and high temperature. Crops that are frequently affected include maize, sorghum, pearl millet, rice, wheat, oilseeds (peanut, soybean, sunflower, cotton), spices, and tree nuts. The toxin can also be found in the milk of animals that are fed contaminated feed.

Aflatoxins are potent human carcinogens and act as potent liver carcinogens in rodents. They are probably the best known and most intensively researched mycotoxins in the world. They have been associated with various other diseases besides cancer, as well—such as aflatoxicosis, which attacks livestock, domestic animals, and humans throughout the world. The occurrence of aflatoxins is influenced by the weather (high temperatures and high humidity, producing warm, wet conditions), so the extent of contamination will vary according to geographic location, agricultural and agronomic practices, and the susceptibility of the peanuts to the fungus before they are harvested, during storage, and/or during processing periods.

Aflatoxins often occur in crops in the field prior to harvest. Contamination can also occur after harvest if crop-drying is delayed and during storage if the crop is kept too moist. Insect or rodent infestations also facilitate mold invasion of some stored commodities.

Coliforms: Coliforms are abundant in the feces of warm-blooded animals but can also be found in the aquatic environment, in soil, and on vegetation. Coliforms are the cause of many nosocomial illnesses, since they are easy to culture. Their presence is also used to indicate that other pathogenic organisms of fecal origin may be present.

Coliform bacteria are members of the Enterobacteria family, a group of pathogens that commonly cause gastrointestinal ailments. Coliform infections usually result from ingesting contaminated food or water. Major coliform bacteria include *Shigella,* which causes dysentery, and certain strains of *Escherichia coli* (referred to as *E. coli*), which can cause urinary tract infections and diarrhea.

Following is some specific information about Enterohemorrhagic *E. coli* (*E. coli* O157:H7):

- Can survive in soil and water for months.
- Exceptional tolerance to acidic conditions.
- Can persist in acidic foods for exceptionally long periods of time.
- Has a low infectious dose (<100 cells).
- Causes severe symptoms in children.

Table 9 shows nutritional values for peanut butter, and a typical commercial peanut butter data sheet is illustrated in Table 10.

Table 9: Nutritional values for peanut butter

Nutrient	Units	Value per 100 grams
Water	g	1.81
Energy	kcal	588
Energy	kj	2462
Protein	g	25.09
Total lipid (fat)	g	50.39
Ash	g	3.19
Carbohydrate, by difference	g	19.56
Fiber, total dietary	g	6.0
Sugars, total	g	9.22
Sucrose	g	8.68
Glucose (dextrose)	g	0.54
Starch	g	4.79
Calcium, Ca	mg	43
Iron, Fe	mg	1.87
Magnesium, Mg	mg	154
Phosphorus, P	mg	358
Potassium, K	mg	649
Sodium, Na	mg	17
Zinc, Zn	mg	2.91
Copper, Cu	mg	0.473
Manganese, Mn	mg	1.466
Selenium, Se	mcg	5.6
Thiamin	mg	0.073
Riboflavin	mg	0.105
Niacin	mg	13.403
Pantothenic acid	mg	1.060
Vitamin B-6	mg	0.543
Folate, total	mcg	74
Choline, total	mg	63.0
Betaine	mg	0.8
Vitamin E (alpha-tocopherol)	mg	8.99
Tocopherol, beta	mg	0.24
Tocopherol, gamma	mg	9.30
Tocopherol, delta	mg	0.59
Vitamin K (phylloquinone)	mcg	0.6
Fatty acids, total saturated	g	10.292
Fatty acids, total monounsaturated	g	23.713
Fatty acids, total polyunsaturated	g	13.867
Cholesterol	mg	0
Phytosterols	mg	102
Tryptophan	g	0.227
Threonine	g	0.515
Isoleucine	g	0.605
Leucine	g	1.518
Lysine	g	0.669
Methionine	g	0.261
Cystine	g	0.225
Phenylalanine	g	1.180
Tyrosine	g	0.814
Valine	g	0.768
Arginine	g	2.719
Histidine	g	0.547
Alanine	g	0.899
Aspartic acid	g	2.999
Glutamic acid	g	5.001
Glycine	g	1.411
Proline	g	1.383
Serine	g	1.455

Table 10: Typical commercial peanut butter data sheet

Item No:	Product Name: Creamy Peanut Butter

1. **Ingredients:** Premium peanut, sugar, peanut oil, salt, stabilizer
2. **Sensory Characteristics:**

Appearance	: Uniformly ground Peanut butter
Color	: Uniform Golden Brown
Odor & Flavor	: Typical Fresh Roasted peanut aroma and Flavor

3. **Physical-Chemical Specifications:**

	Min.	Max.
Color	21.5	24.5
Moisture (%)		2.0
Salt (%)	1.06	1.36
Spread ability (mm)	19.5	24.5
Head space oxygen (%)		3.5
Peroxide meg/kg		10.0
Air Content (%)		0.75
Fat (%)	48	
Thermal stability		IBHC
Grind	5	8

4. **Microbiological Specifications:**

	Max/g
TPC	3000
Coli form	10
Escherichia coli	Negative
Yeast/Mould	100
Aflatoxin (ppb)	20
Salmonella	
Lactobacillus	

5. **Shipping Conditions:**
Use food grade transportation at room temperature, protected from any non-food contamination.
6. **Packing and Storage:**

Packing	PET jar/tray
Lot identification:	Product Identity, Net Contents, Production Date, Lot Number
Storage Condition	Temperature: 15-25C
	Store in dry indoor warehouse, avoid any possible non-food contamination

Sucrose

Sugar Processing

Sugar or, more specifically, sucrose, is a carbohydrate that occurs naturally in every fruit and vegetable. It is the major product of photosynthesis, the process by which plants transform the sun's energy into food. Sugar occurs in the greatest quantities in sugar cane and sugar beets, from which it is separated for commercial use.

The following is the method for extracting sugar from sugar cane:

1. In the first stage of processing, the natural sugar stored in the cane stalk is separated from the rest of the plant material by pressing the cane to extract the juice containing the sugar.
2. This juice is then boiled until it begins to thicken and the sugar begins to crystallize, creating sugar crystals.
3. The sugar crystals are then spun in a centrifuge to remove the syrup, thus producing raw sugar (but the raw sugar still contains many impurities).
4. The raw sugar is then shipped to a refinery, where it is washed and filtered to remove any remaining non-sugar ingredients and color.
5. The refined sugar is then crystallized, dried, and packaged.

Beet-sugar processing is done in a similar way, but it is carried out in one continuous process, without the raw-sugar stage:

1. The sugar beets are washed, sliced, and soaked in hot water to separate the sugar-containing juice from the beet fiber.
2. The sugar-laden juice is then purified, filtered, concentrated, and dried in a series of steps similar to those followed for cane-sugar processing.

Powdered sugar, also known as confectioners' sugar or icing sugar, is very fine sugar. It is produced by grinding granulated sugar to a fine particle size using a sugar mill. When intended for home use, it typically contains a small amount of anti-caking agent. In industrial food production, it is used where a quick-dissolving sugar is required.

A typical commercial crystalline white sugar data sheet is shown in Table 11.

Table 11: Typical commercial white sugar (crystalline) data sheet

SECTION 1: IDENTIFICATION OF THE MATERIAL AND SUPPLIER Product name: White Sugar (Crystalline) Other Names: Sucrose, Sugar, Refined Sugar, Caster Sugar Recommended use: As a sweetener or ingredient in food processing and food preparation **SECTION 2: COMPOSITION/INFORMATION ON INGREDIENTS** Chemical Name: Sucrose 100% **SECTION 3: PHYSICAL AND CHEMICAL PROPERTIES** Appearance: White crystalline solid Odor: Sweet odor

Boiling point/range: 170–186°C
Freezing/Melting point (°C): Decomposes with heat
Solubility in water: 2 kg/L
Specific gravity: (H_2O = 1) 1.59
Molecular weight: 342
Flammability limits: Combustible
Auto-ignition temperature: 500°C

SECTION 4: HANDLING AND STORAGE
Handling: Material can ferment if excessive moisture contamination is allowed. Fermentation can yield carbon dioxide with possible traces of ethanol or volatile fatty acids (e.g., acetic, propionic, lactic, or butyric) and if exposed to a spark or flame, an explosion may result. These conditions should be avoided. If maintenance of tank requires entry by personnel, confined space precautions should be complied with. Insufficient oxygen may be present in vessels containing the product due to the generation of carbon monoxide during fermentation.

Storage: This product should be stored in its factory packaging in a dry area.

Chemical stability: Stable.

Incompatible materials: Incompatible with oxidizing agents (e.g., peroxides).

Maize

In the 16th century, maize diffused rapidly across the African continent as a result of the slave trade. By the end of the 19th century, a maize meal called *posho* was among the most popular foods of eastern Africa. Sylvia Johnson (1997) notes that the primary African use of maize as a food is in mush or porridge. Africans grind and boil maize in water in much the same way that Europeans and Americans have done for many years to create oatmeal porridge (pp. 236–237).

Maize porridge is known as *kpekple* in Ghana and *bidia* in Zaire. In Zimbabwe, people consume *sadza*, whereas East Africans eat *posho* or *ugali*. Zulu-speaking people consume *putu* as a primary source of nutrition. One African dish called *coocoo* contains maize mush with okra, an African vegetable that slaves introduced into the Caribbean as a vegetable (Johnson, 1997, pp. 22–23).

In Nigeria, maize is boiled and roasted in different forms. For example, *adalu* consists of maize kernels or cornmeal boiled with beans, while *ogi* and *tuwo* consist of ground and boiled maize flour. *Ogi* is a breakfast dish prepared from maize flour that is boiled until it attains a smooth consistency. *Tuwo* also consists of maize flour that is boiled until it acquires a thick consistency. Nigerians generally consume *tuwo* with soup dishes. Similarly, *kokoro* is a Nigerian snack food composed of ground maize dough rolled together with other ingredients and then fried in vegetable oil. *Aadun* is a cooked or baked snack prepared in Nigeria from ground maize, red pepper, and oil. Invariably, many of those maize foods developed in Africa found their way back to the New World by way of the Caribbean and have lasted in the African-American culinary tradition.

Grits can also be added to this list of African maize culinary concoctions. Grits consist of coarsely ground dried corn (the U.S. term for "maize"), and they are used as an ingredient in any number of other maize-based recipes, ranging from cornbread to corn chowder, fried catfish basted with yellow cornmeal, and a host of cornbread stuffings and hominy-based recipes. Extrusion cooking is considered to be one of the most efficient and versatile techniques for cooking maize—combining short-time heating and shearing processes to produce different functionalities in a large variety of products. Most of the extruded expanded products found in the global marketplace use maize grits as the main ingredient due to its low cost, abundance, and high expansion capacity. Nevertheless, it has a limited nutrient profile with low protein and dietary fiber content (Onwulata et al., 2001).

Extrusion processing: Maize grits are mixed with water in a planetary mixer for five minutes and stored overnight at 5°C in a plastic bag. The final moisture content of the mixture is then adjusted to 16%. The extrusion process is performed in a screw extruder, and care is taken to maintain a constant height of the material inside the hopper during the process. The extruder has two temperature zones, and temperature is maintained during extrusion at 70°C (±2°C) and 100°C (±2 °C), respectively. The final moisture content of the extruded maize is <12%. The extruded maize is then milled to final grade.

Microorganism contamination in maize: See "Microorganism contamination in peanuts" under "Peanut Butter" in this "Raw Materials" section of the handbook.

Table 12 shows nutritional values for maize, but it should be noted that these figures differ from variety to variety and according to the region or country where the maize is grown.

Table 12: Nutritional values for maize

Nutritional value per 100 g (3.5 oz)	
Energy	360 kJ (86 kcal)
Carbohydrates	19.02 g
Sugars	3.22 g
Dietary fiber	2.7 g
Fat	1.18 g
Protein	3.2 g
Tryptophan	0.023 g
Threonine	0.129 g
Isoleucine	0.129 g
Leucine	0.348 g
Lysine	0.137 g
Methionine	0.067 g
Cystine	0.026 g
Phenylalanine	0.150 g
Tyrosine	0.123 g
Valine	0.185 g
Arginine	0.131 g
Histidine	0.089 g
Alanine	0.295 g
Aspartic acid	0.244 g
Glutamic acid	0.636 g
Glycine	0.127 g
Proline	0.292 g
Serine	0.153 g
Water	75.96 g
Vitamin A equiv.	9 µg (1%)
Thiamine (Vit. B1)	0.200 mg (15%)
Niacin (Vit. B3)	1.700 mg (11%)
Folate (Vit. B9)	46 µg (12%)
Vitamin C	6.8 mg (11%)
Iron	0.52 mg (4%)
Magnesium	37 mg (10%)
Potassium	270 mg (6%)

Soy flour

Soy flour is made from roasted soybeans that have been ground into a fine powder. Rich in high-quality protein and other nutrients, soy flour also adds a pleasant texture and flavor to a variety of products. Two kinds of soy flour are available:

1. Natural, or full-fat, soy flour contains the natural oils that are found in the soybean.
2. De-fatted soy flour has had the oils removed during processing.

Both kinds of soy flour will give a protein boost to recipes; however, de-fatted soy flour has even higher concentrations of protein than full-fat soy flour. Like whole-grain flours, both de-fatted and full-fat soy flour should be stored in the refrigerator or freezer. Soy flour is used extensively by the food industry.

Soy flour is extremely rich in high-quality protein and is an excellent source of iron, calcium, and B vitamins.

Basic preparation of soy flour or soy grits—wet heat method:

Ingredients: water, baking soda, mature soybeans (debris removed). (Be sure the beans are clean)

1. Blanch the beans: Bring five cups of water to a boil for each cup of soybeans. Add a pinch of baking soda to the boiling water and then add the soybeans. Cook at a low boil for 20 to 25 minutes. Drain and rinse the soybeans in cool water.
2. Dry the beans: Spread the beans in a single layer and dry at about 95°C, stirring occasionally. This should take +/- one hour.
3. Grind to grits or flour: Use a grain mill, blender, or hand crusher to grind the beans coarsely into grits or, more finely, into flour. If desired, toast the grits or flour lightly in a dry skillet over moderate heat, stirring occasionally, to enhance the nutty flavor.

Basic preparation of soy flour or soy grits—dry heat method:

Ingredients: water, mature soybeans (debris removed). (Be sure the beans are clean)

1. Soak the beans: Cover the soybeans with several times their volume of water and soak for eight hours. Drain the beans.
2. Bake the beans: Spread the beans in a single layer on an oven-proof plate and bake them at 175°C for 15 minutes or longer while stirring the beans.
3. Grind to grits or flour: Use a grain mill, blender, or hand crusher to grind the beans coarsely into grits or, more finely, into flour.

Table 13 shows soy flour nutrients per 3 1/2 ounces.

Table 13: Soy flour—Nutrients per 3 1/2 ounces

Soy Flour	Full-fat, roasted	Defatted
Calories	441	329
Protein (gm)	34.80	47.00
Fat (gm)	21.90	1.20
Carbohydrate (gm)	33.70	38.40
Fiber (gm)	2.20	4.30
Calcium (mg)	188.00	241.00
Iron (mg)	5.80	9.20
Zinc (mg)	3.50	2.40
Thiamine (B1) (mg)	41.00	7.00
Riboflavin (mg)	94.00	25.00
Niacin (mg)	3.29	2.61

SOURCE: United States. (1987). *Composition of foods: Legume and legume products (Agriculture Handbook nos. 8–16)* (United States Department of Agriculture, Human Nutrition Information Service). (See http://openlibrary.org/books/OL13377604M/Composition_of_Foods_Legumes_and_Legume_Products. Accessed January 9, 2012)

Microorganism contamination in soy flour: See "Microorganism contamination in peanuts" under "Peanut Butter" in this "Raw Materials" section of the handbook.

Soybean (Soya) oil

The production of commercial soybean oil is complicated. The mechanical production of soybean oil with hydraulic presses is not used much, because it's expensive and gives lower yields. So soybean oil is normally produced by extraction with solvents (chemical oil extraction).

Chemical oil extraction consists of the following steps:

Cleaning the soybeans
The soybeans are first cleaned, dried, and de-hulled. The hulls need to be removed, because they absorb oil and thus create a lower yield. The de-hulling is done by cracking the soybeans and by separating the hulls and cracked soybeans mechanically. Magnets are used to separate any iron from the soybeans.

Heating the soybeans to about 75°C to coagulate the soy proteins, in order to make the oil extraction easier.

Extracting the soybean oil
In order to extract the soybean oil, first the soybeans are cut into flakes. These flakes are then immersed in a solvent (normally hexane) in a percolation extractor. Counter-flow is used as the extraction system, because it gives the highest yield. Once the oil is extracted, the hexane is

separated from the soybean oil in evaporators. The evaporated hexane is then recovered and returned to the extraction process.

After the hexane is removed, the extracted flakes contain only about 1% soybean oil, and they are used as livestock meal or to produce food products such as soy protein. The hexane-free crude soybean oil is then further purified.

Purifying the soybean oil
The crude soybean oil still contains many oil-insoluble and oil-soluble impurities that need to be removed. The oil-insoluble impurities are removed by filtration, and the soluble ones are removed through different processes (including de-gumming, alkali refining, and bleaching).

According to the ***mechanical*** method of extraction, the oil is pressed from the soybean without using any chemicals. This process leaves intact the beneficial nutrients that are naturally contained in the soybean and eliminates any possibility of solvent residue remaining in the oil.

Basic processing steps

Seed cleaning
Preparation of the raw material often includes removing husks or seed coats from the seeds and separating the seeds from the chaff.

Seed preparation and conditioning
For successful pressing, the seed must be clean. Fine dust in the seed may clog the oil-press hardware. Moist seed may also get moldy, as mold spores are present in all crops. A rule of thumb to follow is this: the moisture content of the seed should be close to 10%, though soybean seed is safe for storage and processing at 12% moisture content. Warm seed will yield the most oil for the least effort. The optimum heat range for oil extraction is from 100°C to 160°C.

Extraction by cold pressing
Oil can be extracted mechanically with a ram press, an expeller, or even a wooden mortar and pestle, a traditional method that originated in India. Presses range from small, hand-driven models that an individual can build to power-driven commercial presses. The *ram press* uses a piston inside a cage to crush the seed and force out the oil. *Expellers* have a rotating screw inside a horizontal cylinder that is capped at one end. The screw forces the seeds or nuts through the cylinder with gradually increasing pressure. The seed is heated by friction and electric heaters or a combination of the two. Once the cap is removed, the oil escapes from the cylinder through small holes or slots, and the press cake, or meal, emerges from the end of the cylinder. Both the pressure and the temperature can be adjusted for different kinds of feedstock.

Oil expellers
These machines operate on a gentle mechanical-press principle that does not involve mixing and tearing the seeds.

Microorganism contamination in soybean oil: See “Microorganism contamination in peanuts” under “Peanut Butter” in this “Raw Materials” section of the handbook.

Table 14 shows nutritional values per 100 g of soybean oil, and a typical commercial soya oil data sheet is illustrated in Table 15.

Table 14: Nutritional values per 100 g soybean oil

Energy		884 kcal
Energy		3,699 kJ
Protein		0.0 g
Fat (total lipid)		100 g
Fatty acids, saturated		14.4 g
Fatty acids, mono-unsaturated		23.3 g
Fatty acids, poly-unsaturated		57.9 g
Linoleic acid		54.2 g
Oleic acid		20.4 g
Linolenic acid	7.7 g	
Palmitic acid	9.6 g	
Stearic acid		3.5 g
Carbohydrates		0.0 g
Fiber		0.0 g
Sodium, Na		0.0 mg
Cholesterol		0.0 mg
Vitamin E		17.0 mg

SOURCE: USDA Nutrient Database for Standard Reference, Food Composition and Nutritional Tables (Souci-Fachamnn-Kraut). (See www.nal.**usda**.gov/fnic/**food**comp/search/. Accessed January 9, 2012)

Table 15: Typical commercial soybean oil data sheet

SECTION 1:
Common/Trade name: 100% crude soybean oil

SECTION 2:
Soybean oil: TWA (ppm) 15 mg/L 100% by weight

SECTION 3: PHYSICAL DATA
Appearance: Pale yellow to brownish-yellow liquid
Melting point: -20°C
Specific gravity: 0.992 (water = 1) at 20°C
Insoluble in cold water
Fatty acid, % max. 0.05
Fatty acid composition: palmitic 9.0%; stearic 5.0%; oleic 25.0%; linoleic 52.5%; linolenic 7.0%
Peroxide value (at time of packaging) max. 10
Smoke point: 400°F min.

SECTION 4: FIRE AND EXPLOSION DATA
Flash point: 282.22°C

SECTION 5: SHELF LIFE AND STORAGE
Shelf life and storage of soybean oil is a maximum six months from the date of manufacture in the original, unopened container under suggested storage conditions
Store in a cool, dry place at 25ºC
Do not freeze
Avoid excessive exposure to heat and light

Milk powder

Powdered milk is a manufactured dairy product made by evaporating milk to dryness. One purpose of drying milk is to preserve it; milk powder has a far longer shelf life than liquid milk and does not need to be refrigerated, due to its low moisture content. Another purpose is to reduce its bulk for economy of transportation. Powdered milk and dairy products include such items as dry whole milk, non-fat dry milk, dry buttermilk, dry whey products, and dry dairy blends.

Table 16 shows typical compositions of non-fat dry milk and whole dry milk.

Table 16: Comparative typical compositions of dry milks

	Non-fat dry milk	Whole dry milk
Lactose (%)	51.00	38.00
Fat (%)	0.70	26.75
Moisture (%)	3.00	2.25
Total minerals (%*)	8.20	6.00
Calcium (%)	1.31	0.97
Phosphorus (%)	1.02	0.75
Vitamin A (I.U./100 g)	36.40	1,091.30
Thiamin/Vitamin B1 (mg/100 g)	0.35	0.26
Riboflavin/Vitamin B2 (mg/100 g)	2.03	1.48
Niacin/Vitamin B3 (mg/100 g)	0.93	0.68
Niacin Equivalents (mg/100 g)	9.30	6.75
Pantothenic Acid (mg/100 g)	3.31	2.87
Pyridoxine/Vitamin B6 (mg/100 g)	0.44	0.33
Biotin (mg/100 g)	0.04	0.04
Ascorbic Acid/Vitamin C (mg/100 g)	2.00	2.20
Choline (mg/100 g)	111.20	88.18
Energy (calories/100 g)	359.40	498.20

Typical full cream milk powder product specifications[1]

Full cream milk powder is a soluble powder made by concentration and spray drying of pasteurized whole milk.

[1] From www.nal.**usda**.gov/fnic/**food**comp/search/.

Typical chemical value specification

Fat 26.1–26.0 % min.; protein (N x 6.38) 26.5–24.0 % min.; lactose 37.5–36.0 % min.; ash 5.8–6.0% max.; moisture 3.5–5.0% max.; titratable acidity 0.1–0.17% max.

Physical

Insolubility 0.5/1.5 mL max.; scorched particles (ADPI) A B max.

Microbiological

Coagulase positive staphylococcus <10 cfu/g; standard plate count <10 000/g max.; *E coli* negative/g; yeast and molds <50 cfu/g max.; *Salmonella* negative/125 g; coliforms<5 cfu/g.

Sensory

Color white to creamy white; taste and odor authentic, sweet; flavor pleasant.

Nutritional information

Energy content 2,050 kJ/100 g.

Shelf life and storage

Relative humidity 65% max.; temperature 25°C max.; shelf life 12 months maximum.

Packaging

Bag: multiply with inner liner (25 kg).

Quality and assurance

The product must be manufactured in accordance with international standards and guidelines. Each package must be marked to enable traceability.

Stabilizer

Table 17 shows KMDG-40 peanut butter stabilizer mono- and diglycerides.

Table 17: KMDG-40 peanut butter stabilizer mono- and diglycerides

Product Description:	KMDG-40 is a mono-diglyceride synthesized from plant oils and fats. Small white, beady particles.
Physical Appearance:	E471
EC no.:	21 CFR 184.1505
US FDA no.:	Stabiliser and emulsifier - holds fat and water
Applicable Function:	in emulsion e.g. margarine Aerating Agent in baked confectionary and dairy applications
Product Specification	45%
Total Monoglyceride:	>1.5%
Free Glycerol:	> 99 g / 100 g
Saturated Fat :	< 1 g / 100 g < 1 g
Mono Unsaturated Fat :	/ 100g 1%max.
Trans Fatty Acids :	
Moisture :	
Recommended Storage: Please store in cool dry conditions (under 25°C)	

Food acids

Citric acid is a weak organic acid. It is a natural preservative and is also used to add an acidic, or sour, taste to foods and soft drinks.

Ascorbic acid is a sugar acid with antioxidant properties. It comes in the form of white to light-yellow crystals or powder, and it is water soluble. One form of ascorbic acid is commonly known as vitamin C.

Vitamin and mineral pre-mix

Table 18 shows nutritional values for the vitamin and mineral pre-mixes used in the ProKal products for pregnant and lactating women, and Table 19 shows the same for pre-mixes used in the ProKal products for children 6 to 9 months and 10 to 24 months.

Table 18: Pregnant and lactating woman—Vitamin and mineral pre-mix

Vitamins	Inclusion /100gr	Minerals	Inclusion /100gr
Vitamin A	13.3mg	Iodium	0.033mg
Vitamin D	13.2mg	Calcium	759mg
Vitamin C	165mg	Manganese	0.165mg
Vitamin B1	9.9mg	Magnesium	1.65mg
Vitamin B2	6.6mg	Zinc	0.28mg
Vitamin B6	3.3mg	Iodine	70µg
Vitamin B12	6.6µg	Potassium	2.8mg
Folic acid	2623.5µg	Copper	1.4mg
Fluoride	0.05mg	Iron	66mg
Niacin	33mg	Molybdenum	0.082mg

Table 19: Children 6 to 9 and 10 to 24 months—Vitamin and mineral pre-mix

Vitamins	Inclusion /100gr	Minerals	Inclusion /100gr	Elements	Inclu-sion /100gr
Vitamin A	0.7mg	Crome	82.5µg	Brocoli extract 5%	62mg
Vitamin D	8.25µg	Calcium	415mg	probiotic blend	1650x10^{6} c fu
Vitamin E	22mg	Phosphor	300mg		
Vitamin C	150mg	Magnesium	206.25mg		
Vitamin B1	1.65mg	Zinc	16.5mg		
Vitamin B2	1.98mg	Iodine	70µg		
Vitamin B3	21.45mg	Potassium	1100mg		
Vitamin B5	6.6mg	Copper	1.4mg		
Vitamin B6	2.31mg	Selenium	50µg		
Vitamin B12	2.31µg	Iron	10mg		
Folic acid	330µg	Boron	1.65mg		
Inositol	8.25mg	Manganese	206.25µg		
Biotin	50µg				
Choline bitar-trate	8.25mg				
Taurine	82.5mg				
L-tyrosine	165mg				

Product specifications

Tables 20, 21, and 22 show product specification tables for all three ProKal supplementary foods: ProKal $6_2$9, ProKal $10_2$24, and ProKal P_2L. Specifications are not given for all categories shown in these tables, but these specifications will be available from ProKal after shelf-life trials are completed.

Table 20: ProKal 6_29

PROKAL

Urgent Enquiries
Technical Support

PRODUCT DATA AND SPECIFICATION

1. PRODUCT DESCRIPTION	
Product Name	PROKAL 6 to 9
Stock Code	

2. INGREDIENTS	
Peanut butter Milk powder Soya oil Sucrose Soya flour Vitamin - Mineral mix Stabilizer Food acid	

3. CHEMICAL	
Carbohydrate	
Food Acids:	
Citric Acid	E 330

4. NUTRITIONAL ANALYSIS (Theoretical)	
Ash	
Dietary Fiber	
Fat	
Protein	
Carbohydrates	
Energy	
Moisture	

The published data are purely informative.

Under no circumstances can PROKAL be held responsible for the application of its products in violation with existing regulation and/or licenses

5. PHYSICAL	
Water Activity at 20 °C	< 0.60
Moisture	< 2%
Colour	Typical for Peanut butter
Sensory Evaluation: Flavour	Typical for Peanut butter
Odour	Typical for Peanut butter
Particle Size	Paste

6. MICROBIOLOGY		
TPC	cfu/g	
Yeast & Moulds	cfu/g	
Coliforms	cfu/g	
Aflatoxin	ppb	
Aflatoxin B1	ppb	
Salmonella spp.		
E.coli		

7. RESIDUES	
Pesticides	Absent

8. PRESERVATIVES	Nil

9. GMO	
Status	We have, together with our suppliers, thoroughly investigated the GMO status of the ingredients used to produce Tropi Cube products and declare that these are free of genetically modified organisms.

10. RECOMMENDED STORAGE	
Standard	Store in a dry, clean area away from direct sunlight, preferably at a temperature ranging between 23°C and 28 °C at 65% RH.

11. SHELF LIFE	
Standard	6 months when stored in original sealed packaging under the recommended storage conditions.

Table 21: ProKal 10_224

PROKAL

Urgent Enquiries
Technical Support

PRODUCT DATA AND SPECIFICATION

1. PRODUCT DESCRIPTION	
Product Name Stock Code	PROKAL 10 to 24

2. INGREDIENTS	
Peanut butter Soya oil Milk powder Soya flour Sucrose Vitamin - Mineral mix Stabilizer Food acid	

3. CHEMICAL	
Carbohydrate Food Acids: Citric Acid	 E 330

4. NUTRITIONAL ANALYSIS (Theoretical)	
Ash Dietary Fiber Fat Protein Carbohydrates Energy Moisture	

The published data are purely informative.

Under no circumstances can PROKAL be held responsible for the application of its products in violation with existing regulation and/or licenses

5. PHYSICAL	
Water Activity at 20 °C	< 0.60
Moisture	< 2%
Colour	Typical for Peanut butter
Sensory Evaluation: Flavour	Typical for Peanut butter
Odour	Typical for Peanut butter
Particle Size	Paste

6. MICROBIOLOGY		
TPC	cfu/g	
Yeast & Moulds	cfu/g	
Coliforms	cfu/g	
Aflatoxin	ppb	
Aflatoxin B1	ppb	
Salmonella spp.		
E.coli		

7. RESIDUES	
Pesticides	Absent

8. PRESERVATIVES	Nil

9. GMO	
Status	We have, together with our suppliers, thoroughly investigated the GMO status of the ingredients used to produce Tropi Cube products and declare that these are free of genetically modified organisms.

10. RECOMMENDED STORAGE	
Standard	Store in a dry, clean area away from direct sunlight, preferably at a temperature ranging between 23°C and 28 °C at 65% RH.

11. SHELF LIFE	
Standard	6 months when stored in original sealed packaging under the recommended storage conditions.

Table 22: ProKal P_2L

PROKAL

Urgent Enquiries
Technical Support

PRODUCT DATA AND SPECIFICATION

1. PRODUCT DESCRIPTION	
Product Name	PROKAL P to L
Stock Code	

2. INGREDIENTS	
Peanut butter Soya oil Soya flour Sucrose Maize grids Stabilizer Food acid Vitamin - Mineral mix	

3. CHEMICAL	
Carbohydrate	
Food Acids:	
Citric Acid	E 330

4. NUTRITIONAL ANALYSIS (Theoretical)	
Ash	
Dietary Fiber	
Fat	
Protein	
Carbohydrates	
Energy	
Moisture	

The published data are purely informative.

Under no circumstances can PROKAL be held responsible for the application of its products in violation with existing regulation and/or licenses.

5. PHYSICAL	
Water Activity at 20 °C	< 0.60
Moisture	< 2%
Colour	Typical for Peanut butter
Sensory Evaluation: Flavour	Typical for Peanut butter
Odour	Typical for Peanut butter
Particle Size	Paste

6. MICROBIOLOGY		
TPC	cfu/g	
Yeast & Moulds	cfu/g	
Coliforms	cfu/g	
Aflatoxin	ppb	
Aflatoxin B1	ppb	
Salmonella spp.		
E.coli		

7. RESIDUES	
Pesticides	Absent

8. PRESERVATIVES	Nil

9. GMO	
Status	We have, together with our suppliers, thoroughly investigated the GMO status of the ingredients used to produce Tropi Cube products and declare that these are free of genetically modified organisms.

10. RECOMMENDED STORAGE	
Standard	Store in a dry, clean area away from direct sunlight, preferably at a temperature ranging between 23°C and 28 °C at 65% RH.

11. SHELF LIFE	
Standard	6 months when stored in original sealed packaging under the recommended storage conditions.

Section 4: Building requirements

Table 23 shows minimum building requirements for ProKal food-processing plants, and Figures 1 and 2 show building floor plans for these plants.

Table 23: Minimum building requirements

Minimum Building Requirements	
Section	**Specifications**
Outside Walls	All walls plastered bricks with paint finishing, free height in dryer, section minimum 5.0m pending the final height of the dryer
Platforms	Concrete with smooth finishing
Waste water drain system	Plastered bricks, water proof finishing covered with steel grid with acid resistant coating. piping & fittings 110mm PVC
Inside walls in processing areas	Tiled up to 1.8m and upper parts plastered with washable paint finishing
Roof	Galvanized sheeting, fitted on painted wooden trusses
Floor	Concrete base tiled wall to wall
Ceiling	All PROKAL product processing area a ceiling with washable coating
Special walls	All PROKAL product processing area a wall tiled up to ceiling with rounds of wall to floor finishing
Open waste water drain	Concrete pre-form waterproofed and tiled
Windows	Standard size steel with paint finishing minimum area per unit 2.4m2 fit with standard size mosquito net
Air vents	Standard size fit with standard mosquito net
Doors	Single, sliding and double standard steel with washable food grade paint finishing and fit with plastic strip curtains

Figure 1: Layout of processing plant for base raw materials

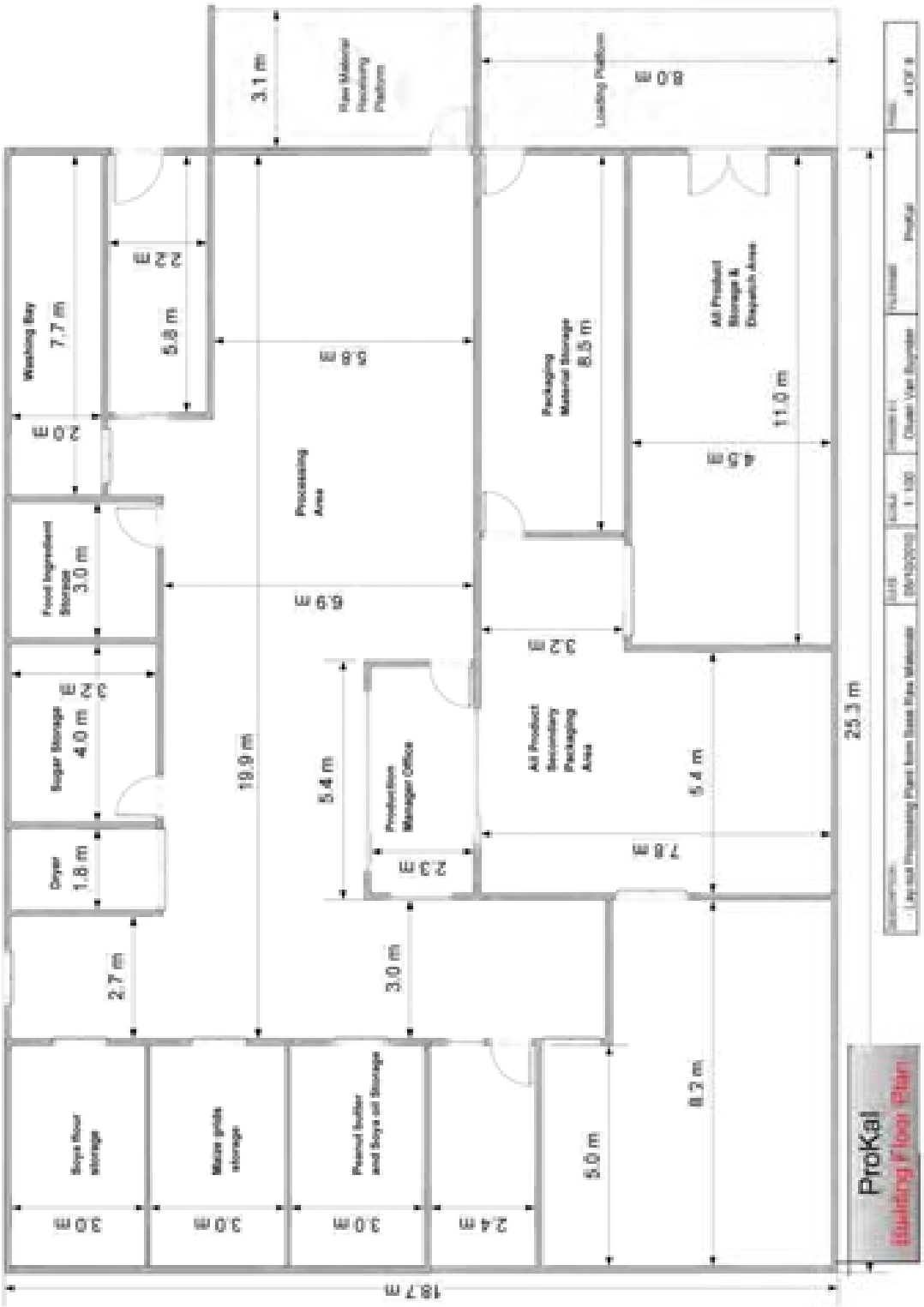
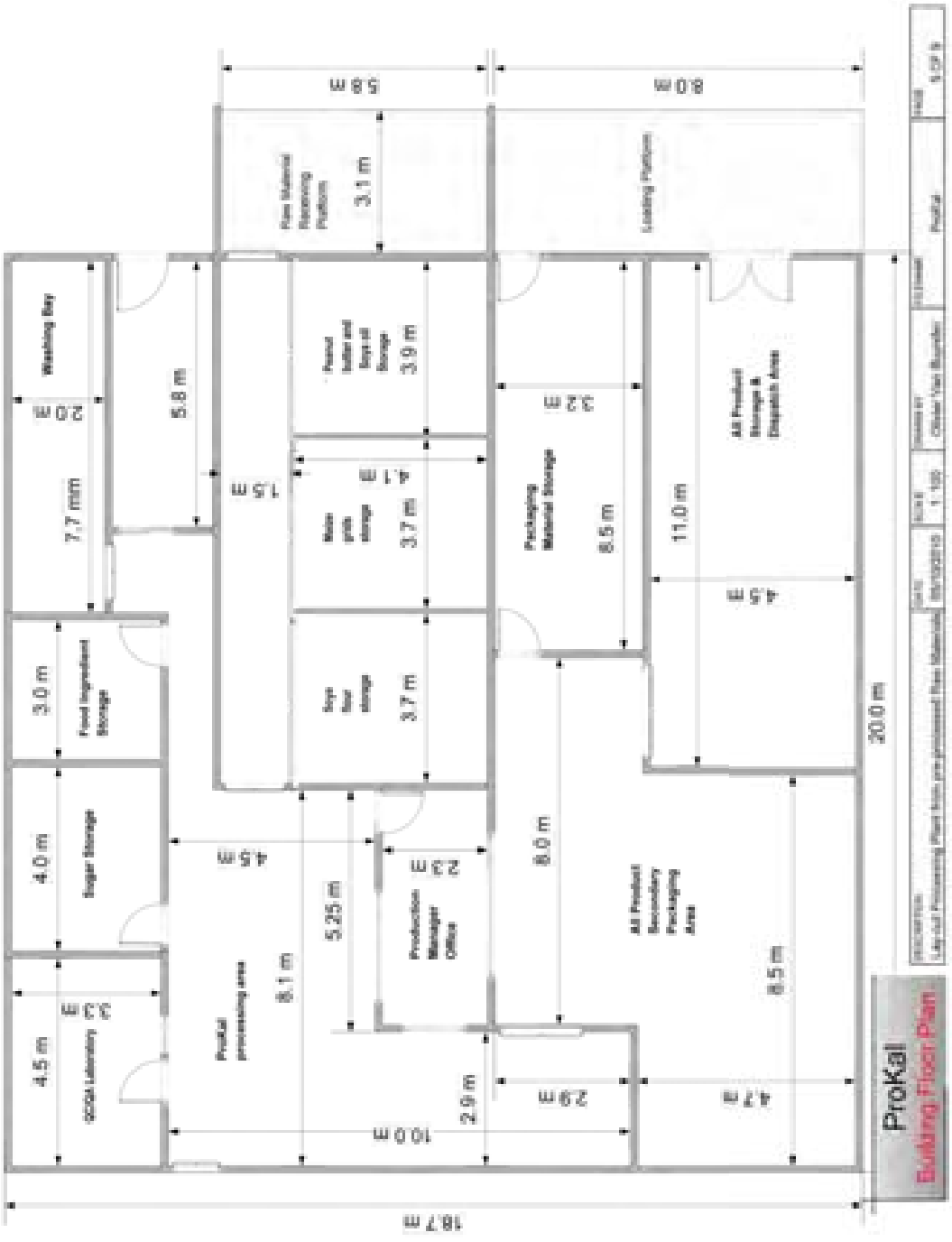


Figure 2: Layout of processing plant for pre-manufactured raw materials



Section 5: Process flow and procedures and process line layout

Process flow

Production of ProKal products can be done (1) with pre-manufactured raw materials or (2) with base raw materials. (See Figures 3 and 4)

Figure 3: ProKal process flow diagram with pre-manufactured raw materials

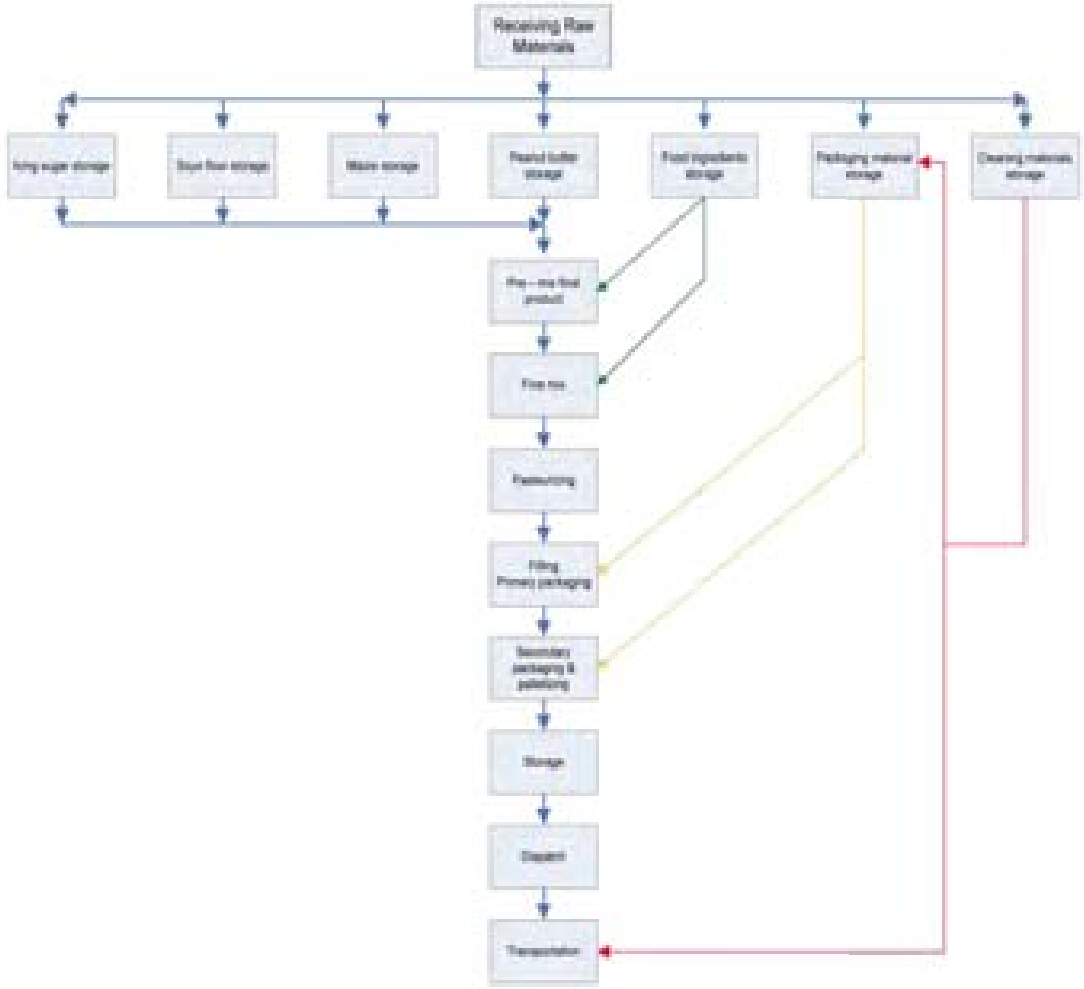
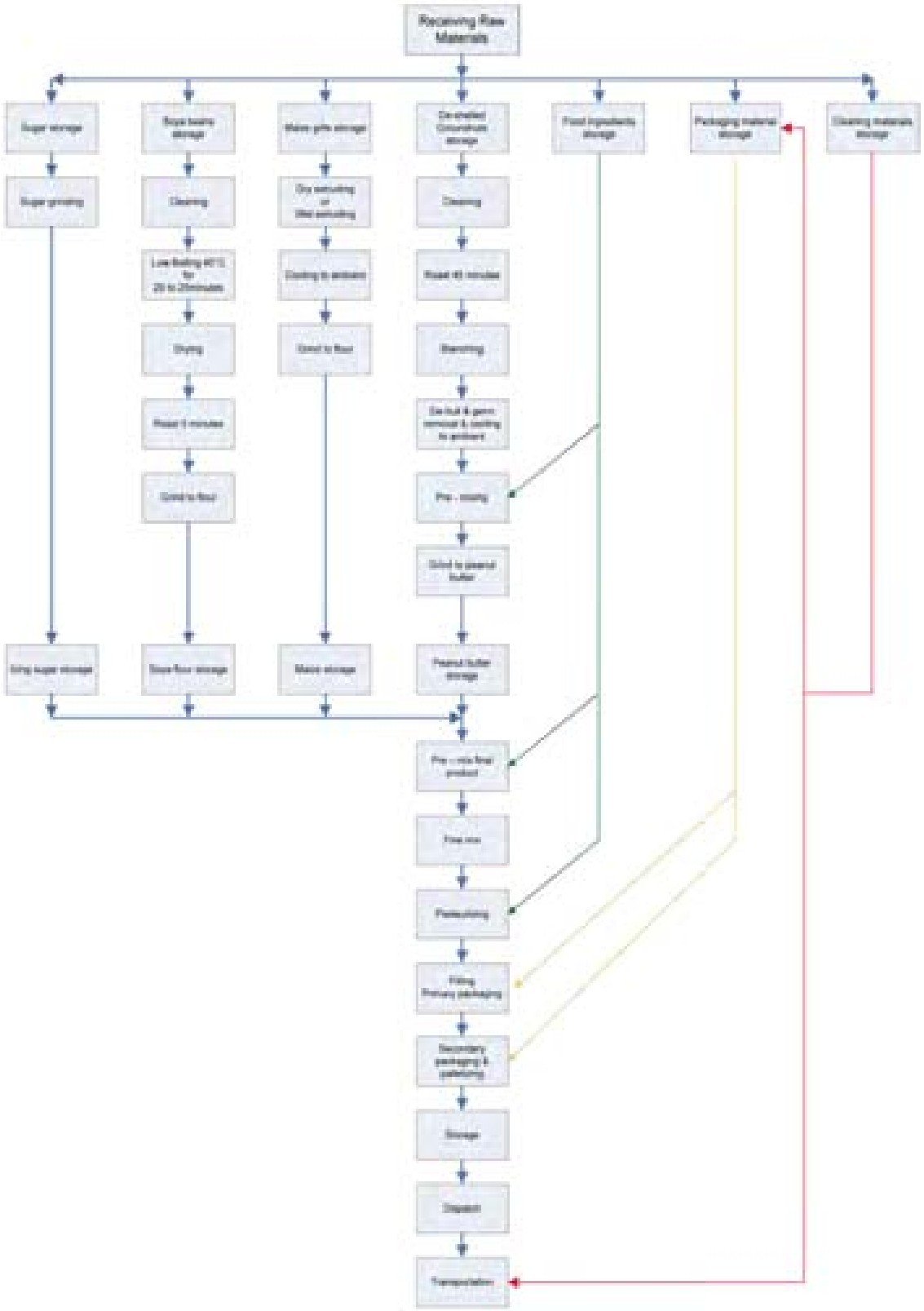


Figure 4: ProKal process flow diagram with base raw materials



Process procedures

The procedure described in the numbered list below is for ready-to-use raw materials; no pre-manufacturing procedures are noted.

Pre-manufacturing is to be done according to the available equipment and procedures.

Pre-manufacturing is defined as the processes used during the growing, harvesting, and postharvest handling of the commodities at the farm gate level. The production capacity of the equipment required will depend, to some extent, on the factory's planned production capacity and operational throughput.

1. Pre-mix: peanut butter, maize grits, sucrose, soya oil, soy flour, milk powder, and stabilizer

(a) Mix the peanut butter with the soya oil until totally dissolved.
(b) Mix the sugar with soy flour, maize grits, and milk powder until totally dissolved.
(c) Mix (b) into (a) until totally dissolved.
(d) Mix the stabilizer in (c) until totally dissolved.

2. Final mix

Blend the vitamin and mineral pre-mix with the food acids into the pre-mix until totally dissolved.

3. Pasteurization

Transfer the final mix to the pasteurizer and heat up to 65°C for 15 minutes.

4. Filling of the product

Keep the finished product at 65°C and put into appropriate primary packaging. Then cool down to ambient temperature.

5. Clean-in-place preparation

Clean-in-place the used equipment and prepare for the next batch.

Process line layout

The process line layout where all raw materials are processed and stored for final processing must include the following:

1. Staff access
2. Washing bay
3. Raw material receiving platform
4. Pre-processing peanuts to peanut butter
5. Pre-processing soybeans to soy flour
6. Pre-processing maize to maize grits
7. Pre-processing of refined sugar to icing sugar
8. Dryer

9. Food ingredients storage
10. Sugar storage
11. Soy flour storage
12. Maize grits storage
13. Peanut butter and soya oil storage
14. QA/QC laboratory
15. ProKal product processing area
16. Production manager office
17. All products' secondary packaging
18. Packaging material storage
19. All finished products' storage and dispatch areas
20. Loading platform

The process line layout where pre-processed materials are processed must include the following:

1. Staff access
2. Washing bay
3. Raw material receiving platform
4. Food ingredients storage
5. Sugar storage
6. Soy flour storage
7. Maize grits storage
8. Peanut butter and soya oil storage
9. QA/QC laboratory
10. ProKal product processing area
11. Production manager office
12. All products' secondary packaging area
13. Packaging material storage
14. All products' storage and dispatch areas
15. Loading platform

Figures 5 and 6 show layouts of ProKal food-processing plants when the products are being manufactured from (1) base raw materials and (2) pre-processed raw materials.

Figure 5: Layout of processing plant for manufacture of ProKal products from base raw materials

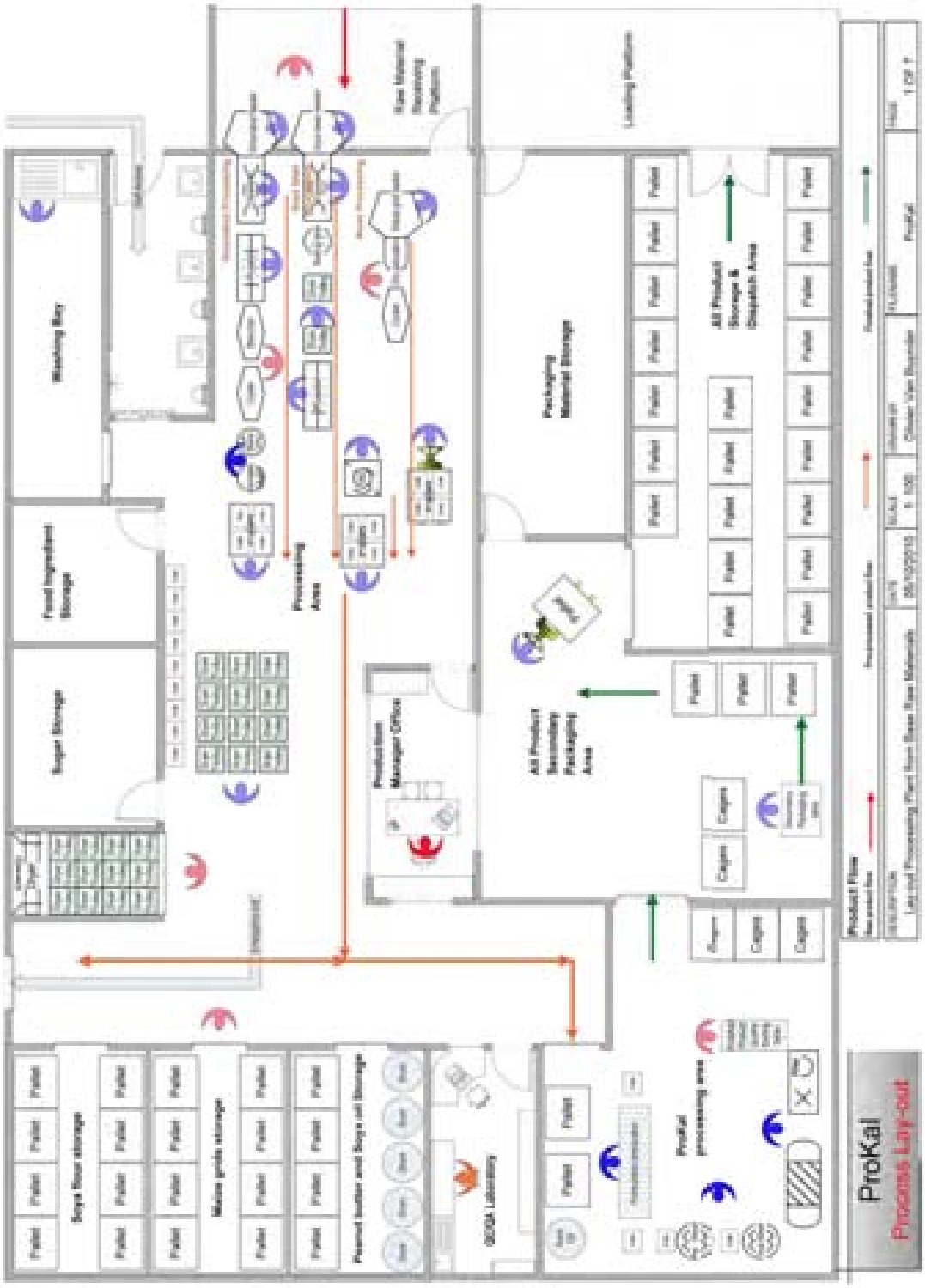


Figure 6: Layout of processing plant for manufacture of ProKal products from pre-processed raw materials

Section 6: Handling and storage

Postharvest handling, receiving, and storage of raw materials

In order to ensure that raw materials are as fresh as possible before they are processed, the food-processing company must follow and enforce rules to check for freshness status when these raw materials arrive at the plant and to ensure that they remain fresh and free of contamination through proper storage at the plant before processing begins.

The major causes of deterioration of raw materials include the following:

1. Growth
2. Microorganism activity
3. Natural food enzyme activity
4. Insects, parasites, and rodents
5. Temperature (both heat and cold)
6. Moisture and dryness
7. Air and, in particular, oxygen
8. Light
9. Time

Quality and quantity checks upon arrival of raw materials at the plant

Checks of raw materials that have just arrived at the processing plant are performed mainly for the following purposes:

1. Checking of sanitary and freshness status.
2. Control of raw material types.
3. Control of wholeness of raw material.
4. Evaluation of degree of maturity.
5. Collection of data about quantities received from source of supply.

Temporary storage before processing

Some basic rules are as follows:

1. Keep products in the shade without any possible direct contact with sunlight.
2. Prevent dust from getting into the raw materials as much as possible.
3. Keep the raw material away from excessive heat.
4. Prevent any possible contamination of the raw material.
5. Store in a place protected from possible attacks by rodents, insects, and other predators.

Storage requirements and dosage and directions

These are finished product storage requirements and Instructions for Use (of ProKal products) in the field by aid agencies and NGOs. The storage requirements for finished food products are usually the same for all foods—that is, keep the products dry, away from sunlight, and in warehouses and storage rooms designed for storing food products. Details about storage requirements and dosage and directions will be finalized after shelf-life trials are completed.

Section 7: Principles of hygiene and good manufacturing practices (GMPs)

The word "hygiene" derives from the French *hygiène,* which, in turn, stems from the Greek *hygieine techne,* meaning "the healthful art," "living well," or "having a vigorous life." Today, hygiene is a science that deals with practices and conditions conducive to the preservation of health, and it is only through hygienic practices that food safety can be ensured.

Food safety standards

Food safety is a scientific discipline governing the handling, preparation, and storage of food in ways that prevent *food-borne illness.* This includes a number of routines that should be followed to avoid potentially severe health hazards.

Disease can be transmitted from person to person through food, and food can also serve as a growth medium for bacteria that can cause food poisoning.

In developed countries, there are intricate standards for food preparation, whereas in less developed countries, one of the main issues is simply the availability of adequate safe water, which is usually a critical item.

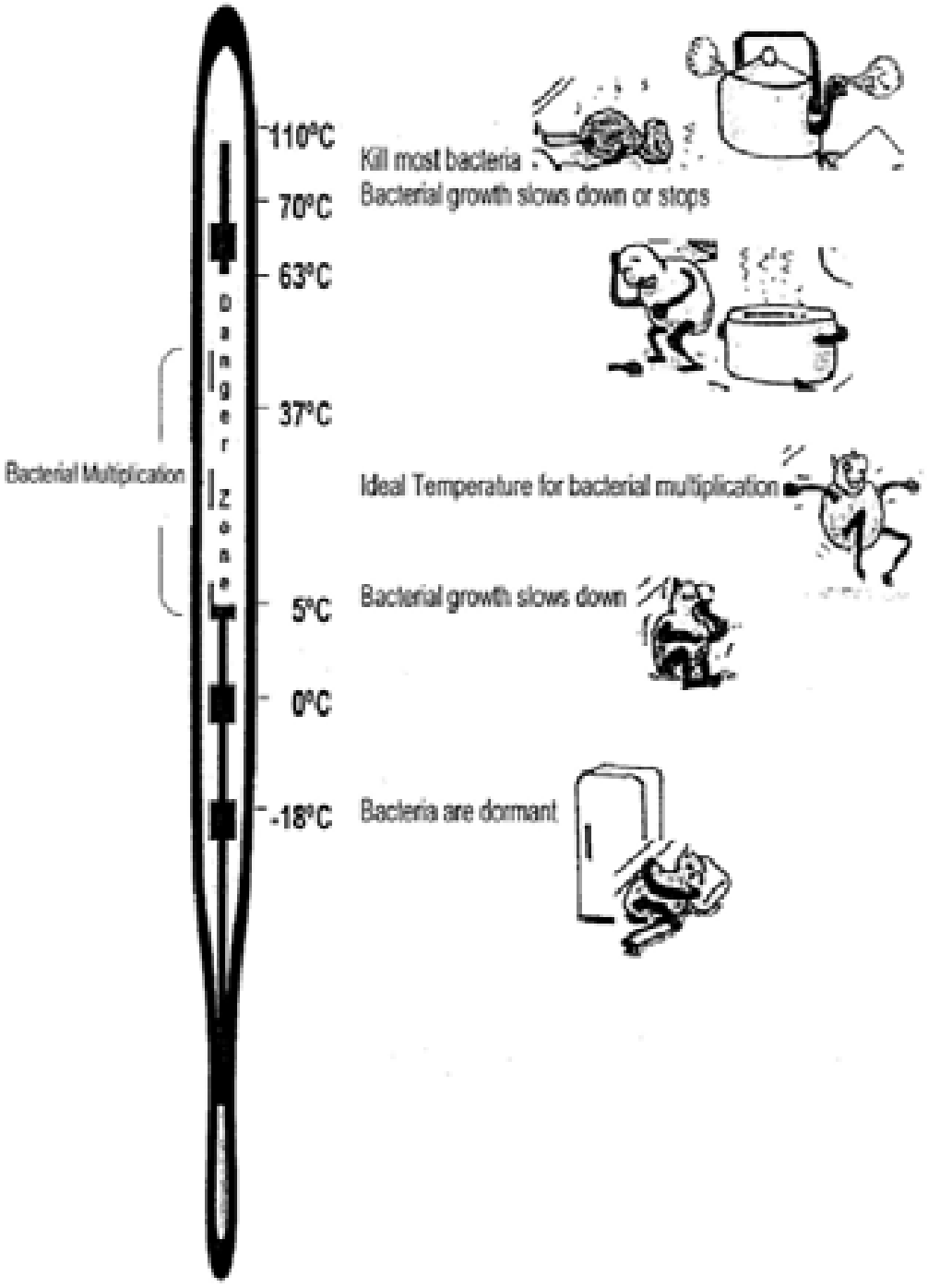
General principles of hygiene for food handling

Current recommendations for handling all food products are to keep them clean and covered, in order to maintain quality and to protect against food poisoning and disease. Generally, contamination occurs when the product comes into contact with dirty hands, clothing, equipment, or facilities. If the product is kept clean, there will be little or no contamination by microorganisms such as bacteria, yeasts, molds, viruses, or protozoa and poisonous chemicals.

Ideal conditions for the multiplication of bacteria

A single bacterium that can cause food poisoning can multiply to 17,000,000 within eight hours if conditions are right. Bacteria have six main requirements: food, moisture, the correct pH, warmth, oxygen, and time. Figure 7 shows ideal and less than ideal conditions for the growth of these bacteria.

Figure 7: The danger zone



Current recommendations for handling all food products

- Keep food products clean and covered in order to maintain quality and protect against food poisoning and disease.
- Generally, contamination occurs when the food product comes into contact with dirty hands, clothing, equipment, or facilities.
- If the product is kept clean, there will be little or no contamination by microorganisms (bacteria, yeasts, molds, viruses, or protozoa and poisonous chemicals).
- GMPs are minimum, commonsense sanitary and processing requirements, which should apply to all food processing establishments.
- Personnel hygiene has a great impact on cleanliness and food safety.

Good manufacturing practices (GMPs)

As mentioned in the list above, GMPs are minimum, common-sense sanitary and processing requirements developed and published by USFDA and many other national food-inspection agency bodies around the world, which should apply to all food-processing establishments. The purpose of GMPs is to establish both broad and specific rules governing personal appearance, hygiene, sanitation, and food-handling practices. GMPs generally relate to good housekeeping practices concerning food safety and quality. Many food processors have made GMPs for food plants the foundation upon which they have developed and published more specific practices for food safety in their particular sector.

1. WORKING AREA

Supervisor oversees the washing of the working area at the end of the shift:

- Wash the lower portion of the walls using scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water). Note: Avoid getting water near the electrical fittings on the wall.
- Remove all loose debris and small items from the working area. Spray sterilizing solution onto floor and let stand for 10 minutes.
- Scrub sterilizing solution onto floor with a rubber broom.
- Use a floor bucket and floor cloth to wipe and remove the sterilizing solution from the floor.

2. EQUIPMENT

Cleaning at the end of the shift and with product changeover. Supervisor oversees the cleaning of equipment at the end of the shift and during product changeover within each shift.

2.1 Pasteurizing pots/vessels

- Rinse empty pots/vessels with water, then spray and scrub with sterilizing solution and allow to stand for 10 minutes. Fill pot/vessel with hot water and let stand for 10 minutes.
- Drain the pot/vessel and discard the water.
- Spray inside surface area of pot/vessel with sterilizing solution.
- Do not remove residual solution. Let it remain inside pot/vessel.

2.2 Processing pots/vessels

- Product is removed from pot/vessel with a clean cloth.
- Rinse with water and drain the water and residual pulp.
- Spray and scrub with sterilizing solution; let stand for 10 minutes.
- Rinse with water.

Note: The clean, empty pot should stand overnight.

2.3 Drying trolleys

- Remove product rests from drying trolleys using a clean cloth.
- Rinse with water and allow the water to drain from the product rests.
- Spray and scrub with sterilizing solution. Let stand for 10 minutes.
- Rinse with water.

2.4 Drying trays

- Product rests are removed from the drying trays with a clean cloth.
- Rinse with water and drain.
- Spray and scrub with sterilizing solution. Let stand for 10 minutes.
- Rinse with water.

2.5 Drying netting

- Product rests are removed from the drying netting with a clean cloth.
- Rinse with water and allow the water to drain.
- Spray and scrub with sterilizing solution. Let stand for 10 minutes.
- Rinse with water.

3. CONTAINERS

Supervisor oversees the cleaning of containers after product is removed:

- Wash the dirty containers in a washbasin in the wash bay or cleaning area.
- Wash the containers in the washbasins in hot water using a clean cloth.
- When all or a suitable number of containers are clean, discard the wash water and fill the washbasins with sterilizing solution in cold to warm water.
- Hold the containers in the sterilizing solution for 10 minutes.
- Place the clean containers directly on a drying rack.

4. CLEANING AREA

Supervisor oversees the cleaning of the cleaning area after container washing has been completed:

- Wash the walls using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
- Spray sterilizing solution onto floor and let stand for 10 minutes.
- Use a floor bucket and floor cloth to wipe and remove the solution from the floor.

5. PROCESS EQUIPMENT

Supervisor oversees the cleaning of the process equipment after every batch:

- Spray sterilizing solution over the mixer and let stand for 10 minutes.
- Wash the sterilizing solution off and wipe dry with a clean cloth.
- At the end of a shift, spray a light mist of antibacterial solution over the equipment and leave (Do not rinse).

6. WORKING SURFACES

Supervisor oversees the cleaning of working surfaces at the end of the shift:

- Clean working surfaces with a wet cloth.
- Spray a light mist of antibacterial solution over the working surfaces and leave (Do not rinse).

7. CLEANING POTS/VESSELS/DRYING TRAYS AT START-UP

Supervisor oversees the cleaning of pots/vessels/drying trays at start-up:

- Supervisor inspects pots/vessels/drying trays for presence of night-flying insects and other foreign bodies.
- Pots/vessels/drying trays are rinsed with cold water, ready for processing.

8. CLEANING SCHEDULE

Supervisor oversees cleaning process based on a weekly/monthly schedule:

- Remove all loose debris and small items from the working area, including walls, floors, and ceiling.
- Wash the walls using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
- Wash the ceiling using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
- Wash the windows using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
- Wash the burglar proofing and mosquito netting using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
- Wash all fixed equipment—dryers, baths, lamps, fans, etc.—using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
- Wash the floor using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
- Wash the outside equipment using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
- Wash the walls of the outside machine rooms—boiler, generator, water treatment, etc.—using scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).

- Spray sterilizing solution onto working area, walls, floors, ceilings, windows, burglar proofing, mosquito netting, and steps.
- Scrub sterilizing solution onto floor with a rubber broom.
- Use a floor bucket and floor cloth to wipe and remove the sterilizing solution from the floor.
- Pay special attention to ablutions, change rooms, canteens, and staff kitchens.
- Clean the outside areas of debris and other items at least 10 m away from the factory walls.
- Rinse outside walls with chlorinated water at 50 ppm.
- Use a bucket and cloth to wipe and remove the sterilizing solution from the floor, walls, ceiling, windows, mosquito netting, etc.
- Let stand to dry for 12 hours.

Internal audits for HACCP and hygiene must be done on a regular basis to monitor conformity to hygiene and HACCP procedures.

Table 24 provides an HACCP internal auditing form for all departments in a ProKal food-processing plant.

Table 24: HACCP auditing

INTERNAL AUDIT BY DEPT – WHOLE PRODUCTION LINE

DEPARTMENT:

AUDIT DATE: SCORE:

1. PREMISES

ITEM	OVERALL SCORE	COMMENTS
Walls	/5	
Floors	/5	
Ceiling	/5	
Windows	/5	
Doors	/5	
Drains	/5	
Other		
TOTAL	/30	

2. RAW MATERIALS/PRODUCTS

ITEM	OVERALL SCORE	COMMENTS
Segregation	/5	
Stock control	/5	
Label identification	/5	
Pallet neatness	/5	
Space between pal-lets	/5	
Packing material	/5	
Other		
TOTAL	/30	

3. OPERATIONS

ITEM	OVERALL SCORE	COMMENTS
Documentation	/5	
Process control	/5	
Rework control	/5	
Cleaning sched-ules And records	/5	
Packaging	/5	
Traceability	/5	
Other		
TOTAL	/30	

4. STORES AND STOCK CONTROL

ITEM	OVERALL SCORE	COMMENTS
Stock identification	/5	
Correct storage of boxes and pallets	/5	
Stock rotation	/5	
Other		
TOTAL	/15	

5. QUALITY

ITEM	OVERALL SCORE	COMMENTS
Operation of testing equipment	/5	
Calibration of testing equipment	/5	
Specification control	/5	
Documentation methods/records	/5	
Available and traceable records	/5	
Non-conformance procedure	/5	
Customer complaints	/5	
Product recall	/5	
Analysis and procedures	/5	
Traceability procedures	/5	
TOTAL	/50	

6. HYGIENE

ITEM	OVERALL SCORE	COMMENTS
Toilet and locker facilities	/5	
Washbasins	/5	
TOTAL	/10	

7. **GENERAL**

ITEM	OVERALL SCORE	COMMENTS
Personnel training	/5	
Good manufacturing Practices	/5	
Safety data sheets	/5	
Internal audits	/5	
External audits	/5	
TOTAL	/25	

Score:

Unacceptable 1

Poor 2

Average 3

Good 4

Excellent 5

Each item has a maximum score of 5 points.

The (total score achieved divided by the maximum score obtainable) x 100 gives the % score for each section.

The total % received as a % of the total maximum achievable is the overall score for the internal audit.

Overall Score:	**0-49%**	**Unacceptable**
	50-79%	**Conditionally acceptable**
	80-100%	**Acceptable**

Comments:

CAR = Corrective action required

N/A = Not applicable to Department being inspected

N/I = Not inspected

BLANK SQUARES = Inspect

INTERNAL AUDIT BY DEPT
ITEM CONTRIBUTION TO MAXIMUM OVERALL SCORE (Sections 1 to 6)

ITEM	% contribution to overall score	Maximum overall score	Receiving	Preparation/Pre-processing	Processing	Packaging	Storage	Dispatch
Premises	18	30	30	30	30	30	20	20
Raw materials/ products	18	30	20	20	15	15	25	15
Operations	18	30	25	25	25	25	25	25
Stores/ stock control	9	15	15	10	10	10	10	10
Quality	30	50	35	40	30	40	30	30
Hygiene	6	10	10	10	10	10	10	10
TOTAL	100	165	135	135	120	130	120	110

Department Head:

Date:

Signature:

Designation:

Personnel hygiene

Probably as important as anything in the production of clean, wholesome, unspoiled products is the attitude of workers toward cleanliness.

- Personnel with clean hands and clothing and good hygienic practices are absolutely essential to the production of high-quality foods.
- All clothing should be clean, in good repair, and made of washable material.
- Street clothing should be covered with coats or gowns while exposed product is being handled.
- White or light-colored clothing is most desirable, and garments that become soiled or contaminated should be changed when necessary.
- All persons working with exposed food products should have their hair under control—either completely covered with a clean cap or hat or confined by a hairnet to prevent hair from falling into products.
- Safety devices such as aprons, wrist guards, and mesh gloves must be made of impervious material, and they must be clean and in good repair.
- At no time should leather aprons, wrist guards, or other devices be worn unless clean, washable coverings are used over them.
- Light-colored rubber or plastic gloves may be worn by product handlers only if clean and in good repair.
- No person working with foods should wear any kind of jewelry, badges, or buttons that may come loose and be accidentally included in the product.
- Shoes and boots should be worn at all times and should be appropriate for the operations being conducted and should also be made of impervious materials.
- Any aprons, knives, and footwear that become contaminated during operations should be routinely cleaned in areas or facilities provided for that purpose.
- No cloth twine, belts, or other, similar materials should be used to cover implement handles or used in other places where they may harbor filth and serve as a ready source of product contamination.
- All unsanitary practices should be avoided by food handlers.
- No one should smoke or otherwise use tobacco in areas where edible products and ingredients are handled, prepared, or stored or where equipment and utensils are cleaned.
- When handling edible products, scratching the head, placing fingers in or around the nose or mouth, and sneezing or coughing on the product should never occur.
- Workers must also guard against contaminating products from localized infections or sores.
- Workers must not contaminate food through handling, coughing, and sneezing, as this may cause rapid spoilage of the food or, more seriously, food poisoning. Coughs and sneezes are a particularly effective way of transmitting bacteria to food.
- Transfer of fecal matter of either animal or human origin to the food is particularly hazardous.
- Hands should be washed frequently to remove all visible soiling. With proper hand washing, bacteria will be removed in the process, as well.
- Stainless-steel sinks without plugs should be conveniently accessible to all workers.

- Water should be supplied at approximately 43°C to a single tap which is foot- or knee-operated.
- Liquid disinfectant soap and paper towels should be available at the sink.
- Particular attention should be paid to cleaning under the fingernails, which should be kept short at all times.
- Hands should also be thoroughly washed after using the toilet, smoking, coughing or sneezing, and after handling money, garbage, or soiled or infected material.
- All precautions should be taken to prevent product contamination by visitors or other persons who are simply passing through the process area.

Company policies are essential to direct and keep discipline concerning QA, hygiene, and food safety. Here are some examples of such company policies.

Sample company hygiene policy no. 1

1. The Food and Drugs Board policies on the "Yearly inspection recommendations in food processing facilities" states that this is a health risk and has to be under control. Our policy is that the premises are "NON-SMOKING AREAS".
SMOKING IS NOT ALLOWED ON THE PREMISES.

2. Private electronic equipment is not allowed in the factory.
THE USE OF MOBILE PHONES, I-PODS AND OTHERS MUSIC DEVICES ARE NOT ALLOWED IN THE FACTORY.

3. Protective clothing needs to be washed on a daily basis, including boots, dresses, gloves, and aprons.
WEARING DIRTY PROTECTIVE CLOTHING IS NOT ALLOWED ON THE PREMISES.

4. Hairnets need to be replaced on a daily basis and/or when dirty.
WEARING OF DIRTY HAIRNETS ON THE PREMISES IS NOT ALLOWED.

5. No staff member can enter the factory if not wearing the recommended protective clothing.
ENTERING THE FACTORY WITHOUT THE RECOMMENDED PROTECTIVE CLOTHING IS NOT ALLOWED.

6. No staff member can take the protective clothing, boots, and the hairnet off of the premises except for cleaning and washing.
GOING OFF OF THE PREMISES WITH YOUR PROTECTIVE CLOTHING, BOOTS, AND HAIRNETS IS NOT ALLOWED EXCEPT FOR CLEANING AND WASHING.

7. Visitors allowed in the factory need to wear protective clothing and a hairnet and have to remove jewelry, watches, and other loose items that can contaminate our products.
VISITORS ARE NOT ALLOWED TO ENTER THE FACTORY WITHOUT PROTECTIVE CLOTHING AND HAIRNETS.

8. No processing equipment, utensils, or equipment parts can be taken off of the premises.

ANY PROCESSING EQUIPMENT, UTENSILS, OR EQUIPMENT ARE NOT ALLOWED TO BE TAKEN OFF OF THE PREMISES WITHOUT PERMISSION.

9. Outside foods cannot be taken or eaten in the processing areas.
OUTSIDE FOODSTUFF IS NOT ALLOWED IN NOR EATEN IN THE PRODUCTION AREAS.

10. No raw or finished material can be taken away or eaten in the production areas.
TAKING AWAY OR EATING OF RAW OR FINISHED PRODUCTS IS NOT ALLOWED.

11. Any foodstuff storage in any of the processing areas, cold rooms, stores, machine rooms, and workshops is not allowed.
STORAGE OF ANY FOODSTUFF AT THE PREMISES IS NOT ALLOWED.

Sample company hygiene policy no. 2: Staff personal hygiene

- Nails must kept short and neat, no nail polish or other ornamentals.
- Hair must be covered totally.
- No jewelry, piercings, rings, or other loose body attachments allowed in the factory.
- If suffering from cold or sinus congestion, mouth masks need to be worn.
- When entering and exiting the factory, hands must be free of any contaminant.
- Factory workers must thoroughly wash their hands at the washing basin, any time when entering or leaving the factory.
- Boots must be sterilized by stepping through the foot bath when entering or exiting process areas that require this..
- As needed or instructed by procedures, hands must be thoroughly washed at the washing basin during processing.

Hygienic behaviour:

- No nose picking.
- No ear picking.
- No spitting.
- No coughing on and toward the processing equipment and product.
- If you did one of these actions above, you need to wash your hands immediately and thoroughly.
- If you are feeling sick or not well, please inform management for action.

These policies will be enforced by management, and ignorance of these will not be tolerated.

Hygiene for transportation vehicles

Dirty trucks, shipping containers, and other transporting vehicles present a high risk for contamination of food products, whether those products are packed loose, in crates, or in secondary packaging. Following is a sample company policy pertaining to transportation.

Sample company hygiene policy no. 3: Procedures for cleaning trucks

Truck driver must clean the truck before loading raw materials from the farm and finished products from the factory at the farm and delivery.

Before loading product, the driver must clean the truck as follows:

1. Remove all loose debris and small items from the ceiling, walls, and floor.
2. Rinse the ceiling, walls, and floor with water, using a hosepipe or bucket.
3. Wash the ceiling, walls, and floor using a scrubbing brush or cloth and a bucket containing a 0.8% solution of liquid or powdered soap (400 g soap per 50 L water).
4. Spray the ceiling, walls, and floor with a 0.4 g/L antimicrobial solution containing chlorine solution.
5. Leave the antimicrobial solution on the ceiling, walls, and floor for 10 minutes.
6. Rinse ceiling, walls, and floor with hosepipe or bucket.
7. Remove excess water from ceiling, walls, and floor using a sponge broom. Squeeze excess water into waste plastic container.
8. Continue procedure until all surfaces are dry. If necessary, complete final drying with a clean, dry cloth.

These policies will be enforced by management, and ignorance of these will not be tolerated.

Crates and pallets

Dirty crates and pallets present a high risk for contamination of food products, whether those products are packed loose, in crates, or in secondary packaging. Following is a sample company policy pertaining to crates and pallets.

Sample company hygiene policy no. 4: Procedures for cleaning crates and pallets

1. Receiving staff must keep crates and pallets clean at all times.
2. Remove all loose debris and small items from all crates and pallets.
3. Rinse with water, using hosepipe or bucket.
4. Wash the crates and pallets using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
5. Spray the crates and pallets with 0.4 g/L antimicrobial solution.
6. Leave the antimicrobial solution on the crates and pallets for 10 minutes.
7. Rinse crates and pallets with hosepipe or bucket.
8. Remove excess water using a sponge.

These policies will be enforced by management, and ignorance of these will not be tolerated.

Cold rooms

Dirty cold rooms present a high risk for contamination of food products, whether those products are packed loose, in crates, or in secondary packaging. Following is a sample company policy pertaining to cold rooms.

Sample company hygiene policy no. 5: Procedures for cleaning cold rooms

1. Receiving staff must keep the cold room clean at all times.
2. Remove all loose debris and small items from the ceiling, walls, and floor.
3. Rinse the ceiling, walls, and floor with water, using a hosepipe or bucket.
4. Wash the ceiling, walls, and floor using a scrubbing brush or cloth and a bucket containing 0.8% solution of liquid soap (400 g soap per 50 L water).
5. Spray the ceiling, walls, and floor with 0.4 g/L antimicrobial solution.
6. Leave the antibacterial solution on the ceiling, walls, and floor for 10 minutes.
7. Rinse ceiling, walls, and floor using a hosepipe or bucket. Remove excess water from ceiling, walls, and floor using a sponge broom. Squeeze excess water into waste plastic container.
8. Continue procedure until all surfaces are dry.
9. If necessary, complete final drying with a clean, dry cloth.

These policies will be enforced by management, and ignorance of these will not be tolerated.

Hygienic treatment of primary packaging material

Primary and secondary containers/packaging

The terms *primary containers/packaging* and *secondary containers/packaging* are generally used. Some foods occur naturally provided with efficient primary containers (e.g., nuts, oranges, bananas). Primary containers/packaging are those that come into direct contact with the food, so hygiene in relation to these is more important than in relation to secondary containers. However, all containers/packaging must, of course, be hygienic.

Hermetic closure

The term *hermetically closed container* refers to a container that is absolutely impermeable to gases and vapors in all areas, including its seam or cap. Such a container, as long as it remains intact, will automatically be impervious to bacteria, yeasts, molds, and contamination from dust and other sources. The most common hermetically sealed containers are glass bottles, although faulty closures can make them non-hermetic. Crimping of covers/caps on glass and plastic bottles and seams on cans can result in the container becoming non-hermetic. However, crimping of covers/caps on glass and plastic bottles causes this problem more often than do seams on cans.

Sterilizing of glass and plastic bottles

- Glass and plastic bottles should be soaked in water with a detergent before cleaning.
- Glass and plastic bottles must be constructed in a way that allows the cleaner to reach the entire inside of the bottle.

- Bottles must be handled carefully in order to avoid damage.
- Rinsing can be carried out by immersion or by spray.
- Drying must be done with sterilized air.
- Once dry, the bottles must be kept in a sterile environment.

Some usual practices in bottle washing are as follows:

- Add to the detergent in the washing water a 1.5% HCl solution or 50 ppm chlorine (one 1.67 g tablet in 20 L water).
- Use warm water (about 50°C) in the pre-wash phase and use high water pressure in the rinsing spray.
- Before use, bottles should be sterilized, and they should be kept hot until filled.
- Sterilize the bottles to be used immediately to prevent them from cooling down before they are filled.

Section 8: Quality assurance (QA) using the Hazard Analysis and Critical Control Points (HACCP) system and standard operating procedures (SOPs)/good manufacturing practices (GMPs)

Quality assurance

QA is a necessity in food processing for both small- and large-scale manufacturing operations. Following proper quality-control methods will help guarantee the following:

- Protect customers from dangers such as contaminated foods and ensure that they obtain the weight and quality of food that they pay for.
- Protect the food processor against trickery by suppliers, middlemen, and customers.
- Prevent damage to equipment (such as damage caused by foreign objects in raw materials).
- Ensure compliance with food laws in the country where the food-processing operation is being carried out.

QA does not need to be time-consuming or expensive, and the results of quality-control tests should help save money in the long run. In general, quality-control procedures should be as simple as possible, supplying only the necessary amount of information and requesting no more quality-control testing than is actually required. Too little information means that quality-control testing will not be effective, but too much information and doing more than the required testing will cause management decisions to be delayed or confused.
Quality-control testing is not done on every product or part of a product. The purpose of the exercise is to predict and control the quality of a vast quantity of processed foods being manufactured at a particular plant. There is no point in producing one batch of food, testing it for quality, and then trying to find a buyer for only that particular batch of food. QA is used to *predict* the quality of processed food and then to *control* the process so that the expected quality is achieved in every batch. This means that quality specifications must be written down and agreed upon with suppliers and/or sellers, and control points in the food-production process must be identified. The quality of foods or ingredients must be measured and described in an understandable and logical way. A specification can then be written down and agreed upon with the supplier and/or seller, which lists the quality attributes that are required in a specific food.

The following guidelines should be followed when doing quality-control testing:

- A representative (random) sample of the food must be tested to make sure the whole batch meets the specification.
- There are ways to calculate the size of samples needed for testing. (Sample sizes can be found in such documents as the MIL sampling plans found on http://www.samplingplans.com/aqlprimer.htm. Accessed January 10, 2012)
- The percentage of substandard items that cause a batch to fail the test can be increased or decreased, depending on the reliability of the supplier or how important the particular attribute is to the seller/manufacturer, for instance. (For more details, see the MIL sampling plans on http://www.samplingplans.com/aqlprimer.htm. Accessed January 10, 2012)

- Some attributes may need to be tested with equipment at the processor's QA laboratory, and some may need to be tested at a third-party laboratory in order to avoid arguments over interpretation of the results.

Hazard Analysis and Critical Control Points (HACCP)

HACCP is an abbreviation for the *H*azard *A*nalysis and *C*ritical *C*ontrol *P*oint system.
It is a fundamental procedure/discipline that all food businesses must have in place to safely produce, process, and/or handle food. HACCP is a living system that never stops. It has no limitations and can develop from basic processes to extremely sophisticated processes.

HACCP is a process control system that identifies and prevents microbial and other hazards in food production. In establishing an HACCP plan/process, steps are created to prevent problems before they occur and to correct deviations as soon as they are detected. Preventive control systems are designed with documentation and verification.

An HACCP plan is based on the following seven principles, which are recognized and endorsed by local and international food-safety authorities.

HACCP principles

Principle 1: Perform a hazard analysis.
Food-processing units determine food safety hazards and identify preventive measures to control those hazards.

Principle 2: Identify critical control points (CCPs).
CCPs are points/steps/procedures in a food-processing operation where controls can be applied that can prevent food safety hazards or eliminate or reduce them to acceptable levels. A food safety hazard consists of any biological, physical, and/or chemical characteristic that may cause food to be unsafe for humans to consume.

Principle 3: Establish critical limits for each CCP.
Critical limits are maximum or minimum values to which physical, biological, and/or chemical hazards must be controlled at a specific CCP, in order to prevent food safety hazards or eliminate or reduce them to acceptable levels.

Principle 4: Establish CCP monitoring requirements.
Monitoring activities are necessary to ensure that the process is under control at each CCP. Monitoring procedures must be listed in the HACCP plan.

Principle 5: Establish corrective actions.
Corrective actions are actions to be taken when a deviation is identified at a critical limit. The HACCP plan must identify required corrective actions to be taken if there is a deviation from a critical limit. These corrective actions ensure that unsafe food products are not distributed into the food chain.

Principle 6: Establish a record-keeping procedure.

HACCP regulations require that all food-processing units keep and maintain the following documents: (1) the hazard analysis and HACCP plan and (2) records documenting the monitoring of CCPs, points of deviation from critical limits, and corrective actions taken when there was deviation from a critical limit.

Principle 7: Establish procedures to verify/validate that the HACCP system is applied effectively.

Validation ensures that the HACCP plans do what they are designed to do, in order to ensure the successful production of a safe product. Processing units are required to validate their HACCP plans on a regular basis. Verification ensures that the HACCP plan is adequate and operating in the way that it was designed to operate.

Verification procedures should include activities such as the following: review of HACCP plans, review of CCP records, review of critical limits, and microbial sampling and analysis. An HACCP team, consisting of personnel at the food-processing plant, must be given the task of verifying the HACCP plan. Microbial sampling and analysis must be performed as part of the verification activities. The sampling can be carried out by trained company personnel or by a contract laboratory certified to carry out sampling and microbiological analysis.

ProKal's HACCP

Figures 8 to 11 show the HACCPs used at ProKal food-processing plants. (Some modifications to wording have been done for purposes of this handbook)

Figure 8: ProKal's HACCP process flow diagram with base raw materials

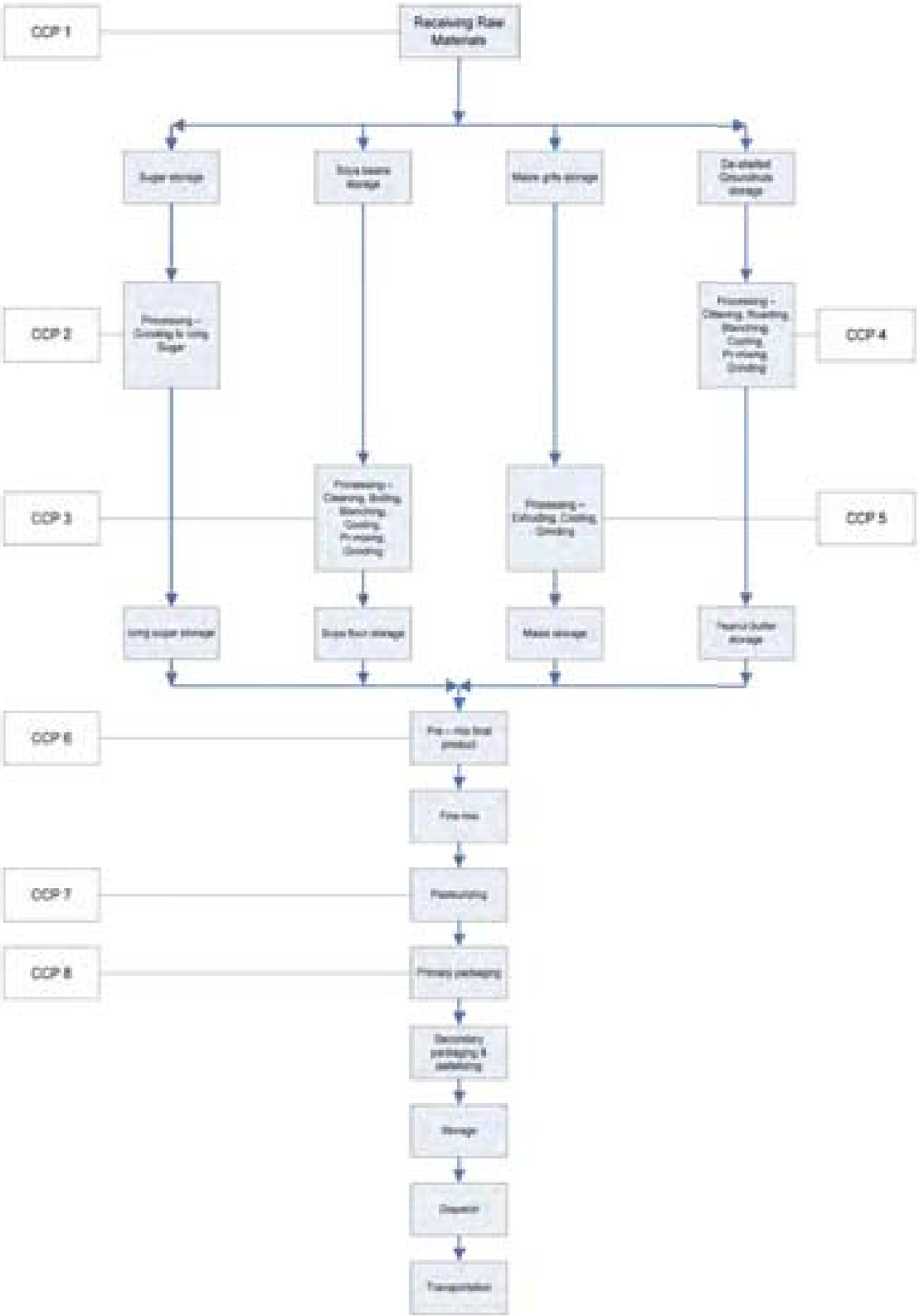


Figure 9: ProKal's HACCP process flow diagram with pre-manufactured raw materials

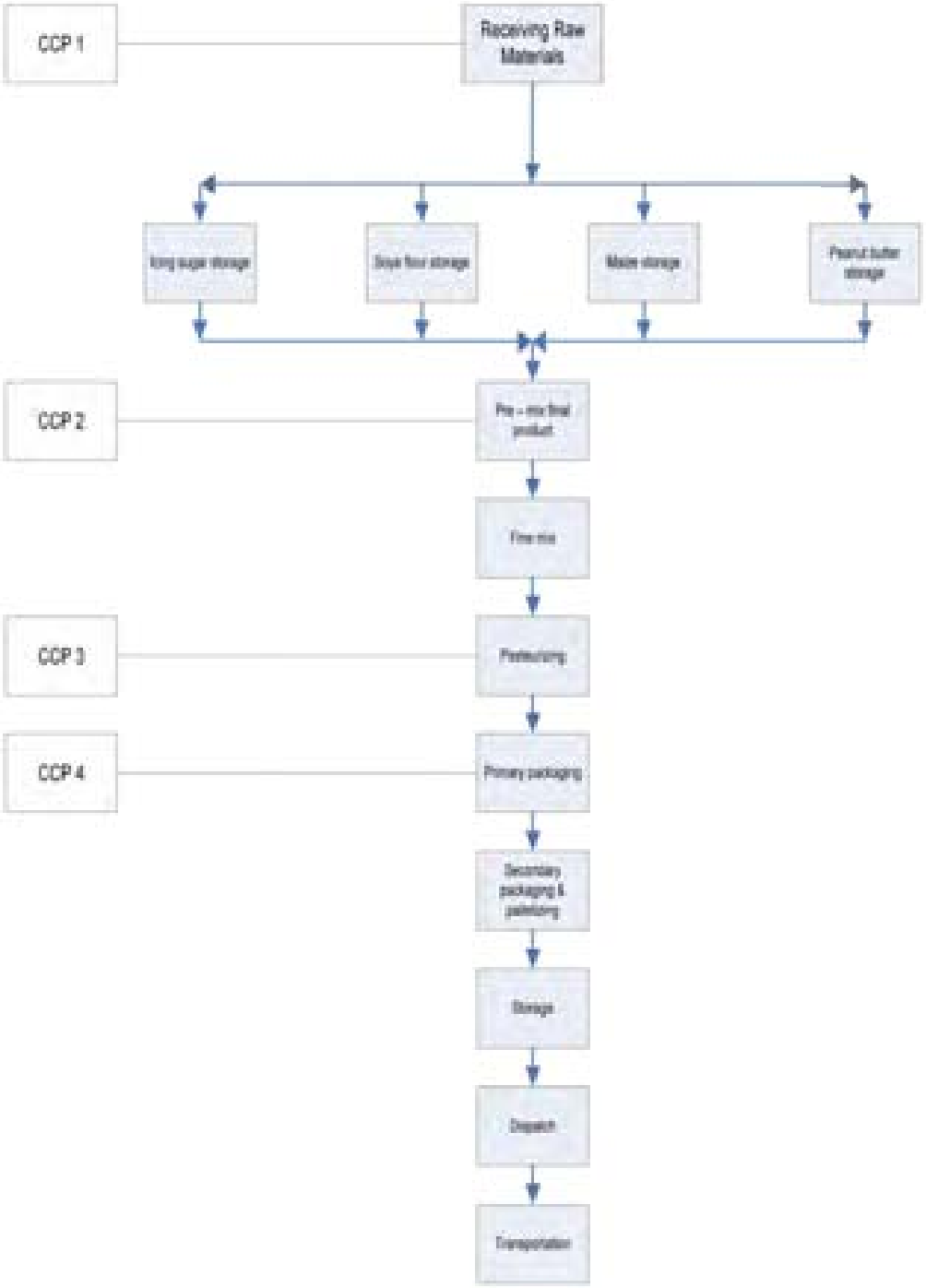
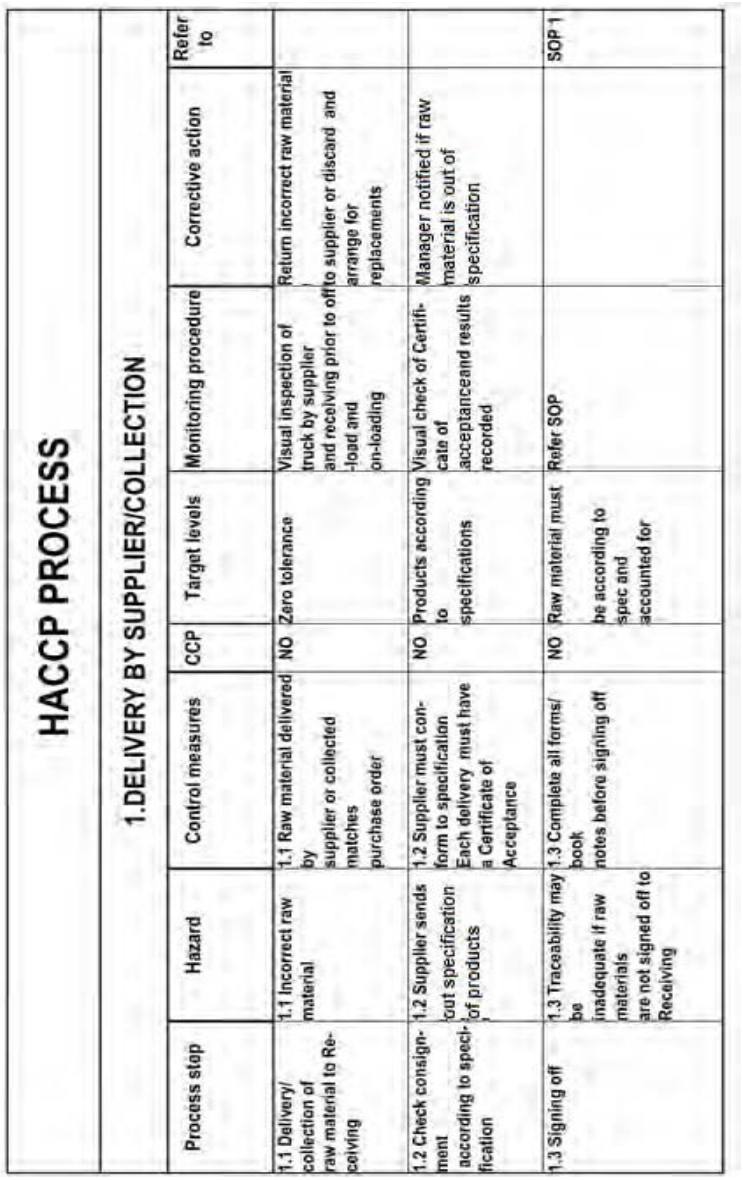


Figure 10: ProKal's HACCP process



HACCP PROCESS

1.DELIVERY BY SUPPLIER/COLLECTION

Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
1.1 Delivery/ collection of raw material to Receiving	1.1 Incorrect raw material	1.1 Raw material delivered by supplier or collected matches purchase order	NO	Zero tolerance	Visual inspection of truck by supplier and receiving prior to off-load and on-loading	Return incorrect raw material to supplier or discard and arrange for replacements	
1.2 Check consignment according to specification	1.2 Supplier sends out specification of products	1.2 Supplier must conform to specification Each delivery must have a Certificate of Acceptance	NO	Products according to specifications	Visual check of Certificate of acceptanceand results recorded	Manager notified if raw material is out of specification	
1.3 Signing off	1.3 Traceability may be inadequate if raw materials are not signed off to Receiving	1.3 Complete all forms/ book notes before signing off	NO	Raw material must be according to spec and accounted for	Refer SOP		SOP 1

2. RECEIVING & STORAGE

Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
2.1 Check raw material	2.1 Incorrect raw material accepted	2.1 Receiving checks all ingredients are correctly identified	YES CCP 1	Zero tolerance	Visual inspection to check raw materiallabels and the number of containers are correct	Receiving to return incorrect raw materiallabels arrange for correct replacement stock	
2.2 Check if product is within specification	2.2 Incorrect properties according to product data sheet and specifications	2.2 All properties must be in specification as per product data sheet	YES CCP 1	Zero tolerance	Moisture content, colour, grid size and condition of packaging size, cleanliness and condition of packaging	If not correct, ask the supplier to check his records and the accuracy of his measuring equipment used or have it checked by independent party, notify manager and return incorrect raw material to supplier or discard and arrange for replacement	
2.3 Check net mass or counts	2.3 Incorrect net mass or counts	2.3 Net mass or count must not be less than the declared mass of the consignment	NO	The declared mass or count must not be the weighed mass or count	If net mass out of spec, check weight to verify the scale accuracy	If our scale is correct, ask supplier to check accuracy of their scale, if our scale is incorrect have it checked by independent party	
2.4 Signing off	2.4 Traceability may be inadequate if raw materials are not signed off to pre- processing	2.4 Complete all forms/ book notes before signing off	NO	Raw material must be in-spec and accounted for	Refer SOP	Refer to QC/QA	SOP 2

3. PRE-PROCESSING SUGAR GRINDING							
Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer
3.1 CIP Grinder	3.1 Equipment not clean	3.1 Equipment to be cleaned before and after use Swabs to be taken regularly	YES CCP 2	Zero tolerance	C I P cleaning GMP	Redo C I P	
3.2 Grinding Icing sugar	3.2 Incorrect particles	3.2 In correct mesh size	NO	As per required mesh size	Standard mesh sieve	Return to grinder	
3.3 Physical properties Icing sugar	3.3 Moisture content	3.3 Standard procedure	YES CCP 3	Moisture content <2%	Moisture meter	Dry off until within target level	
	3.4 Traceability may be inadequate if raw materials are not signed off to filling and storage	3.4 Complete all forms/ book notes before signing off	NO	Refer 3.3	Refer 3.3	Refer to QC/QA	SOP 3

4. PRE-PROCESSING SOYA BEANS							
Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
4.1 C I P Soya bean feeder	4.1 Feeder not clean and sterilized	4.1 Feeder to be cleaned before and after use. Swabs to be taken regularly	YES CCP 3	Zero tolerance	C I P cleaning GMP	Redo C I P	
4.2 C I P Cleaning device	4.2 Cleaning device not clean and sterilized	4.1 Cleaning device to be cleaned before and after use. Swabs to be taken regularly	YES CCP 3	Zero tolerance	C I P cleaning GMP	Redo C I P	
4.3 C I P Boiling device	4.3 Boiling device not clean and sterilized	4.3 Boiling device to be cleaned before and after use. Swabs to be taken regularly	YES CCP 3	Zero tolerance	C I P cleaning GMP	Redo C I P	
4.4 Boiling	4.4 Softness not correct	4.4 Soya beans not soft enough	NO	Zero tolerance	Squeezing, visual, time 20 to 25 minutes Temperature 45 °C	Redo boiling	
4.5 C I P Drier	4.5 Drier and drier equipment not clean and sterilized	4.5 Drier and drier equipment to be cleaned before and after use, swabs to be taken regularly	YES CCP 3	Zero tolerance	C I P cleaning GMP	Redo C I P	
4.6 Drying	4.6 Moisture content and water activity out of spec's	4.6 High moisture content and high water activity	YES CCP 3	Moisture content <2% Water activity <0.6	Moisture meter, water activity meter	Drying time and temperature	

4.7 CIP Roaster	4.7 Roaster equipment not clean and sterilized	4.7 Roaster equipment to be cleaned before and after use	YES CCP 2	Zero tolerance	C I P cleaning GMP	Redo C I P	
4.8 Roasting	4.8 Incorrect roasting	4.8 High moisture content, high water activity and Aflatoxins levels	YES CCP 3	Moisture content <2% Water activity <0.6 Aflatoxins <2 ppb	Moisture meter, water activity meter and Aflatoxins analysis, temperature °C Roasting time 45 minutes	Re - roast	
4.9 CIP Grinder	4.9 Equipment not clean	4.9 Equipment to be cleaned before and after use. Swabs to be taken regularly	YES CCP 2	Zero tolerance	C I P cleaning GMP	Redo C I P	
4.10 Grinding Soya flour	4.10 Incorrect particles	4.10 Incorrect mesh size	No	As per required mesh size	Standard mesh sieve	Return to grinder	
4.11 Physical properties of soya flour	4.11 Moisture content water activity and Aflatoxins out of spec's	4.11 Standard procedure	YES CCP 3	Moisture content <2% Water activity <0.6 Aflatoxins <2 ppb Urease presence	Moisture meter, water activity meter and Aflatoxins analysis Urease analysis	Dry off until within target level	
4.12 Signing off	4.12 Traceability maybe inadequate if products not signed off to Filling and storage	4.12 Complete all forms/ book notes before signing off	NO	Refer 4.6, 4.8 and 4.11	Refer 4.6, 4.8 and 4.11	Refer to QC/QA lab	SOP 4

5. PRE-PROCESSING GROUNDNUTS							
Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer
5.1 C I Groundnut feeder	5.1 Feeder not clean and sterilized	5.1 Feeder to be cleaned before and after use. Swabs to be taken regularly	YES CCP 4	Zero tolerance	C I P cleaning GMP	Redo C I P	
5.2 C I P Cleaning device	5.2 Cleaning device not clean and sterilized	5.1 Cleaning device to be cleaned before and after use. Swabs to be taken regularly	YES CCP 4	Zero tolerance	C I P cleaning GMP	Redo C I P	
5.3 CIP Roaster	5.3 Roaster equipment not clean and sterilized	5.3 Roaster equipment to be cleaned before and after use Swabs to be taken regularly	YES CCP 4	Zero tolerance	C I P cleaning GMP	Redo C I P	
5.4 Roasting	5.4 Incorrect roasting	5.4 High moisture content, high water activity and Aflatoxins levels	YES CCP 4	Moisture content <2% Water activity <0.6 Aflatoxins <2 ppb	Moisture meter, water activity meter and Aflatoxins analysis Roasting temperature 150°C Roasting time 60 minutes	Re - roast	
5.5 CIP Blancher	5.5 Blancher not clean and sterilized	5.5 Blancher to be cleaned before and after use. Swabs to be taken regularly	YES CCP 4	Zero tolerance	C I P cleaning GMP	Redo C I P	
5.6 Blanching	5.6 Hulls not totally removed	5.6 Too many hulls	YES CCP 4	Zero tolerance	Visual Blanching temperature 149°C Blanching time 20 minutes	Redo blanching	

5.7 CIP Cooler	5.7 Cooler equipment not clean and sterilized	5.7 Cooler equipment need to be cleaned before and after use, swabs to be taken regularly	YES CCP 4	Zero tolerance	C I P cleaning GMP	Redo C I P	
5.8 CIP Grinder	5.8 Equipment not clean	5.8 Equipment to be cleaned before and after use Swabs to be taken regularly	YES CCP 4	Zero tolerance	C I P cleaning GMP	Redo C I P	
5.9 Physical properties peanut butter	5.9Moisture content water activity and Aflatoxins out of spec's	5.9 Standard procedure	YES CCP 4	Moisture content <2% Water activity <0.6 Aflatoxins <2 ppb	Moisture meter, water activity meter and Aflatoxins analysis	Refer to QC/QA	
5.10 Signing off	5.10 Traceability maybe inadequate if products not signed off to Filling	5.10 Complete all forms/ book notes before signing off	NO	Refer 5.4, 5.6 and 5.9	Refer 5.4, 5.6 and 5.9	Refer to QC/QA lab	SOP 5

6. PRE-PROCESSING MAIZE GRITS

Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
6.1 C I P Maize grits feeder	6.1 Feeder not clean and sterilized	6.1 Feeder to be cleaned before and after use. Swabs to be taken regularly	YES CCP 4	Zero tolerance	C I P cleaning GMP	Redo C I P	
6.2 C I P Extruder	6.2 Extruder device not clean and sterilized	6.2 Extruder device to be cleaned before and after use. Swabs to be taken regularly	YES CCP 5	Zero tolerance	C I P cleaning GMP	Redo C I P	
6.3 Extruding	6.3 Incorrect extruding	6.3 Extruding not consisted	NO	Zero tolerance	Visual	Redo extruding	
6.4 CIP Cooler	6.4 Cooler equipment not clean and sterilized	6.4 Cooler equipment need to be cleaned before and after use, swabs to be taken regularly	YES CCP 5	Zero tolerance	C I P cleaning GMP	Redo C I P	
6.5 CIP Grinder	6.5 Grinding equipment not clean and sterilized	6.5 Roaster equipment to be cleaned before and after use Swabs to be taken regularly	YES CCP 5	Zero tolerance	C I P cleaning GMP	Redo C I P	
6.6 Physical properties maize flour	6.6 Moisture content water activity and Aflatoxins out of spec's, incorrect particle size	6.6 High moisture consent, high water activity and Aflatoxins levels	YES CCP 5	Moisture content <2% Water activity <0.6 Aflatoxins <2 ppb	Moisture meter, water activity meter and Aflatoxins analysis	Re - grind Refer to QC/QA lab	
6.7 Signing off	6.7 Traceability maybe inadequate if products not signed off to Filling and storage	6.7 Complete all forms/ book notes before signing off	NO	Refer 6.6	Refer 6.6	Refer to QC/QA lab	SOP 6

7. FINAL PROCESS

Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
7.1 CIP Mixer	7.1 Pre - mixer not clean and sterilized	7.1 Pre-mixer to be cleaned before and after use. Swabs to be taken regularly	YES CCP 6	Zero tolerance	C I P cleaning GMP	Redo C I P	
7.2 Pre-mixing	7.2 Ingredients not well mixed Incorrect texture	7.2 Mixing time and formulation	YES CCP 6	Zero tolerance	Recipe	Refer to recipe	
7.3 Physical properties of pre-mix	7.3 Moisture content water activity and Aflatoxins out of spec's	7.3 Standard procedure	YES CCP 6	Moisture content <2% Water activity <0.6 Aflatoxins <2 ppb	Moisture meter, water activity meter and Aflatoxins analysis	Refer to QC/QA	
7.4 Physical properties fine mix	7.4 Moisture content, aW out of spec's	7.4 Standard procedure	YES CCP 6	Moisture content <2% Water activity <0.6	Moisture meter, water activity meter	Refer to QC/QA	
7.5 Final mixing	7.5 Ingredients not well mixed Incorrect texture	7.5 Mixing time and formulation	YES CCP 6	Zero tolerance	Recipe	Refer to recipe	
7.6 Physical properties of final mix	7.6 Moisture content, aW out of spec's	7.6 Standard procedure	YES CCP 6	Moisture content <2% Water activity <0.6	Moisture meter, water activity meter and Aflatoxins analysis	Refer to QC/QA	SOP 7
7.7 CIP Pasteurizer	7.7 Pasteurizer not clean and sterilized	7.7 Pasteurizer to be cleaned before and after use, Swabs to be taken regularly	YES CCP 7	Zero tolerance	C I P cleaning GMP	Redo C I P	
7.8 Pasteurizing	7.8 Poor heat transfer, incorrect pasteurizing temperature Incorrect pasteurizing time	7.8 Pasteurizing temperature and time procedure	YES CCP 7	Continuous mixing Temperature 65°C Time 15 minutes	Mixer, Thermostat - Thermometer Timer, Time reading	Refer to QC/QA	
7.9 Signing off	7.9 Traceability maybe inadequate if products not signed off to Filling	7.9 Complete all forms/ back notes before signing off	NO	Refer 7.3, 7.5 and 7.8	Refer 7.3, 7.5 and 7.8	Refer to QC/QA lab	SOP 8

8. FINAL QC, PACKING, LABELING, STORAGE AND DISPATCH							
Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
8.1 Filler CIP	8.1 Filler not clean and sterilized	8.1 Filler to be cleaned before and after use. Swabs to be taken regularly	YES CCP 8	Zero tolerance	C I P cleaning GMP	Redo C I P	
8.2 Filling	8.2 Product out of spec's browning, blackening	8.2 Visual continuous inspection	YES CCP 8	Zero tolerance	Visually	Discard products	SOP 9
8.3 Weighing, packing and sealing	8.3 Under and over weight bad sealing	8.3 Visual continuous inspection	NO	Zero tolerance	Visually, guideline charts	Redo packing	
8.4 Labeling	8.4 Incorrect labeling	8.4 Visual continuous inspection	NO	Zero tolerance	Visually	Re - label	
8.5 Stock control	8.5 Incorrect stock	8.5 Daily stock control data	NO	Zero tolerance	Monthly verification	Internal audit	
8.6 Signing off	8.6 Traceability may be inadequate if forms not signed off to Dispatch or Customer	8.6 Complete all forms/ book notes before signing off	NO	Zero tolerance	Monthly verification	Internal audit	
8.7 Dispatch	8.7 Incorrect invoicing and stock	8.7 Dispatch order and stock control data	NO	Zero tolerance	Daily verification	Internal audit	

9. TRANSPORTATION							
Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer
9.1 Deliveries Internal order, invoice or delivery note and product data sheets	9.1 Incorrect paper work	9.1 Internal order invoice or delivery note received from Accountant, product data sheets from QC/QA department	NO	Zero tolerance	Order correctly packed and sent to market	Job training	
9.2 Dispatch responsible for loading truck	9.2 Incorrectly loaded or not ready for loading	9.2 If there are 2 or more orders, driver must organize to have orders packed on LIFO (basis last in first out) as per his delivery route	NO	Zero tolerance	Driver must be present at commencement and during loading	Job training	
9.3 Driver checks truck loading and completes checklist	9.3 Loading not checked	9.3 Driver verifies customer name, product name and the number of pallets	NO	Zero tolerance	Driver completes checklist	Job training	
9.4 Driver checks truck offloading	9.4 Offloading not checked	9.4 Driver confirms that offloaded consignment is undamaged and acceptable to the customer	NO	Minimal damage	Visual observation	Job training	
9.5 Driver gets customer to sign invoice	9.5 Invoice not given to or not signed by customer	9.5 Submit invoice to customer and return signed copy to accountant	NO			Job training	

Figure 11: ProKal's HACCP process for processing with pre-manufactured ingredients

HACCP PROCESS FOR PROCESSING WITH PRE-MANUFACTURED INGREDIENTS

1.DELIVERY BY SUPPLIER/COLLECTION

Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
1.1 Delivery/ collection of raw material to Receiving	1.1 Incorrect raw material	1.1 Raw material delivered by supplier or collected matches purchase order	NO	Zero tolerance	Visual inspection of truck by supplier and receiving prior to off-load and on-loading	Return incorrect raw material to supplier or discard and arrange for replacements	
1.2 Check consignment according to specification	1.2 Supplier sends out of specification products	1.2 Supplier must conform to specification Each delivery must have a Certificate of Acceptance	NO	Products according to specifications	Visual check of Certificate of Acceptance and results recorded	Manager notified if supplier raw material is out of specification	
1.3 Signing off	1.3 Traceability may be inadequate if raw materials are not signed off to Receiving	1.3 Complete all forms/ book notes before signing off	NO	Raw material must be according to spec and accounted for	Refer SOP		SOP 1

2. RECEIVING & STORAGE

Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
2.1 Check raw material	2.1 Incorrect raw material accepted	2.1 Receiving checks all ingredients are correctly identified	YES CCP 1	Zero tolerance	Visual inspection to check raw materialllabels and the number of containers are correct	Receiving to return incorrect raw materialllabels arrange for correct replacement stock	
2.2 Check if product is within specification	2.2 Incorrect properties according to product data sheet and specifications	2.2 All properties must be in specification as per product data sheet	YES CCP 1	Zero tolerance	Moisture content; colour, grid size and condition of packaging size, cleanliness and condition of packaging	If not correct, ask the supplier to check his exceeds and the accuracy of his measuring equipment used or have it checked by independent party, notify manager and return incorrect raw material to supplier or discard and arrange for replacement.	
2.3 Check net mass or counts	2.3 Incorrect net mass or counts	2.3 Net mass or count must not be less than the declared mass of the consignment	NO	The declared mass or count must not be the weighed mass or count	If net mass out of spec, check weight to verify the scale accuracy	If our scale is correct, ask supplier to check accuracy of their scale, if our scale is incorrect have it checked by independent party	
2.4 Signing off	2.4 Traceability may be inadequate if raw materials are not signed off to pre- processing	2.4 Complete all forms/ book notes before signing off	NO	Raw material must be in-spec and accounted for	Refer SOP	Refer to QC/QA	SOP 2

3. FINAL PROCESS							
Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer
3.1 CIP Mixer	3.1 Pre - mixer not clean and sterilized	3.1 Pre-mixer to be cleaned before and after use. Swabs to be taken regularly	YES CCP 2	Zero tolerance	C I P cleaning GMP	Redo C I P	
3.2 Pre-mixing	3.2 Ingredients not well mixed Incorrect texture	3.2 Mixing time and formulation	YES CCP 2	Zero tolerance	Recipe	Refer to recipe	
3.3 Physical properties of pre-mix	3.3 Moisture content water activity and Aflatoxins out of spec's	3.3 Standard procedure	YES CCP 2	Moisture content <2% Water activity <0.6 Aflatoxins <2 ppb	Moisture meter, water activity meter and Aflatoxins analysis	Refer to QC/QA	
3.4 Physical properties fine mix	3.4 Moisture content, aW out of spec's	3.4 Standard procedure	YES CCP 2	Moisture content <2% Water activity <0.6	Moisture meter, water activity meter	Refer to QC/QA	
3.5 Final mixing	3.5 Ingredients not well mixed Incorrect texture	3.5 Mixing time and formulation	YES CCP 2	Zero tolerance	Recipe	Refer to recipe	
3.6 Physical properties of final mix	3.6 Moisture content, aW out of spec's	3.6 Standard procedure	YES CCP 2	Moisture content <2% Water activity <0.6	Moisture meter, water activity meter and Aflatoxins analysis	Refer to QC/QA	SOP7
3.7 CIP Pasteurizer	3.7 Pasteurizer not clean and sterilized	3.7 Pasteurizer to be cleaned before and after use, Swabs to be taken regularly	YES CCP 3	Zero tolerance	C I P cleaning GMP	Redo C I P	
3.8 Pasteurizing	3.9 Poor heat transfer, incorrect pasteurizing temperature Incorrect pasteurizing time	3.9 Pasteurizing temperature and time procedure	YES CCP 3	Continuous mixing Temperature 65°C Time 15 minutes	Mixer, Thermostat - Thermometer Timer, Time reading	Refer to QC/QA	
3.9 Signing off	3.9 Traceability maybe inadequate if products not signed off to Filling	3.9 Complete all forms/ book notes before signing off	NO	Refer 3.3, 3.5 and 3.8	Refer 3.3, 3.5 and 3.8	Refer to QC/QA lab	SOP 8

4. FINAL QC, PACKING, LABELING, STORAGE AND DISPATCH

Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
4.1 Filler CIP	4.1 Filler not clean and sterilized	4.1 Filler to be cleaned before and after use. Swabs to be taken regularly	YES CCP 4	Zero tolerance	C I P cleaning GMP	Redo C I P	
4.2 Filling	4.2 Product out of spec's browning, blackening	4.2 Visual continuous inspection	YES CCP 4	Zero tolerance	Visually	Leave more time	
4.3 Weighing, packing and sealing	4.3 Under and over weight bad sealing	4.3 Visual continuous inspection	NO	Zero tolerance	Visually, guideline charts	Redo packing	
4.4 Labeling	4.4 Incorrect labeling	4.4 Visual continuous inspection	NO	Zero tolerance	Visually	Re - label	
4.5 Stock control	4.5 Incorrect stock	4.5 Daily stock control data	NO	Zero tolerance	Monthly verification	Internal audit	
4.6 Signing off	4.6 Traceability may be Inadequate if forms not signed off to Dispatch or Customer	4.6 Complete all forms/ book notes before signing off	NO	Zero tolerance	Monthly verification	Internal audit	
4.7 Dispatch	4.7 Incorrect invoicing and stock	4.7 Dispatch order and stock control data	NO	Zero tolerance	Daily verification	Internal audit	SOP 9

5. TRANSPORTATION							
Process step	Hazard	Control measures	CCP	Target levels	Monitoring procedure	Corrective action	Refer to
5.1 Deliveries Internal order, invoice or delivery note and product data sheets	5.1 Incorrect paper work	5.1 Internal order invoice or delivery note received from Accountant, product data sheets from QC/QA department	NO	Zero tolerance	Order correctly packed and placed in market	Job training	
5.2 Dispatch responsible for loading truck	5.2 Incorrectly loaded or not ready for loading	5.2 If there are 2 or more orders, driver must organize to have orders packed on LIFO (basis last in first out) as per his delivery route	NO	Zero tolerance	Driver must be present at commencement and during loading	Job training	
5.3 Driver checks truck loading and complete checklist	5.3 Loading not checked	5.3 Driver verifies customer name, product name and the number of pallets	NO	Zero tolerance	Driver completes checklist	Job training	
5.4 Driver checks truck offloading	5.4 Offloading not checked	5.4 Driver confirms that off-loaded consignment is undamaged and acceptable to the customer	NO	Minimal damage	Visual observation	Job training	
5.5 Driver gets customer to sign invoice	5.5 Invoice not given to or not signed by customer	5.5 Submit invoice to customer and return signed copy to accountant	NO			Job training	

ProKal's SOPs and GMPs

ProKal SOP 1
SOP FOR RECEIVING
(DELIVERY BY SUPPLIER/COLLECTION)

REFERENCE: HACCP process for processing ProKal products

SOP 1: Inspection of truck and inspection verifying correct product is being offloaded or loaded.

1. Receiving Supervisor verifies that the Bill of Lading agrees with the "Purchase Order to Supplier" submitted by Accounts.
2. Supervisor visually inspects that the correct product is on the truck before offloading or loading starts.
3. Supervisor records on delivery/collection form that the "Goods Receiving Note" matches the "Purchase Order to Supplier."
4. Receiving fills in the checklists for delivered order.
5. Receiving fills in the checklist for collected orders.
6. The General Manager (GM) or QA Supervisor notifies the Supplier if any of the ingredients or products are not acceptable.
7. Supervisor, if required, arranges to return the incorrect ingredients and arranges for correct replacements.
8. The Supervisor stamps and/or signs the Bill of Lading and "Purchase Order to Supplier" if all are correct.
9. Supervisor submits all completed forms to QA.

ProKal SOP 2 CCP 1
SOP FOR RECEIVING
(DELIVERY BY SUPPLIER/COLLECTION)

REFERENCE: HACCP process for processing ProKal products

SOP 2:

- **Receiving Supervisor checks that the Supplier's "Certificate of Acceptance" (COA) is in-specification and our QA analysis is recorded on Supplier's COA. Supervisor checks test analysis when results are available.**
- **Correct identification of ingredients and correct quantities of delivered product during offloading by Receiving.**

1. Supervisor checks that the container label matches the product name and checks that the ingredients are correctly identified.
2. Supervisor checks that the correct number of containers is offloaded.
3. Supervisor ensures COA is received from Supplier.
4. If there is a problem with the labels, stock is to be returned to Supplier and arrangements made for the correct replacement.
5. If a COA is not submitted, report to the QA Supervisor and the GM.

6. Supervisor collects analysis as soon as possible from QA and a copy of the results is recorded on Supplier's COA. Note: Records are filled in by QA and stamped.
7. If Supplier's COA is not available, Supervisor makes a note that our analysis results are in the analysis record book.
8. GM or QA to notify Supplier that the ingredients are out-of-specification.
9. Supervisor signs off approved ingredients.

ProKal SOP 3 CCP 2
SOP FOR GRINDING SUGAR TO ICING SUGAR

REFERENCE: HACCP process for processing ProKal products

SOP 3: Grinding crystallized sugar to icing sugar

1. Samples are taken to do a moisture analysis. If moisture is greater than 2%, the sugar is dried further.
2. The grinder/mill is checked visually for assembly and standard mesh sieve.
3. Test-run the grinder/mill without sugar.
4. The sugar is fed into the grinder/mill and the icing sugar is checked for particle size.
5. If the particle size remains out-of-specifications, report to QA and Production Supervisor.
6. When approved, the Laboratory records the result per batch and submits the form to QA.
7. The icing sugar is poured into bags and marked with a batch number.
8. The product is signed off by the Supervisor and sent to the ingredient storage area.

ProKal SOP 4 CCP 3
SOP FOR PROCESSING SOY FLOUR

REFERENCE: HACCP process for processing ProKal products

SOP 4: Processing soybeans into soy flour

1. Data about each batch of soybeans is recorded (weight, cultivar, origin, harvest time), and each batch is given a sequential number.
2. A random sample is taken and sent to the Laboratory for analysis of moisture content, aW, and Aflatoxin.
3. If out-of-specifications, the processing of this batch is put on hold and the batch is sent back to storage and placed in the non-conformance product area.
4. The batches of soybeans that the Lab has approved are loaded into the feeder for cleaning.
5. The soybeans are then boiled at 45ºC for 20 to 25 minutes.
6. The soybeans are taken to the dryer and dried at 95ºC for 60 minutes. When the product is considered to be at the correct moisture and aW in the dryer, the Laboratory checks a random final sample for moisture and aW, and the Laboratory records the result per batch. If the moisture content is still greater than 2% and the aW is still greater than 0.6, the drying continues until the correct levels are achieved. When approved, the Laboratory submits the form to QA.
7. The dry beans are taken to the roaster and roasted at 175ºC for 15 minutes.
8. The grinder/mill is checked visually for assembly and standard mesh sieve.

9. Test-run the grinder/mill without soybeans.
10. The roasted beans are fed into the grinder/mill and ground to required mesh size.
11. A random sample is taken to the Lab for aW, moisture content, Aflatoxin, and Urease analysis. If the product does not conform to specifications, it is taken to storage and placed in the non-conformance product area. When approved, the Laboratory records the result per batch and submits the form to QA.
12. The soy flour is poured into bags and marked with a batch number.
13. The product is signed off by the Supervisor and sent to storage.

ProKal SOP 5 CCP 4
SOP FOR PROCESSING GROUNDNUTS

REFERENCE: HACCP process for processing ProKal products

SOP 5: Processing groundnuts into peanut butter

1. Data about each batch of raw groundnuts is recorded (weight, cultivar, origin, harvest time), and each batch is given a sequential number.
2. A random sample is taken and sent to the Lab for analysis of moisture content, aW, and Aflatoxin.
3. If out-of-specifications, the processing of this batch is put on hold and the batch is sent back to storage and placed in the non-conformance product area.
4. The groundnuts are loaded into the feeder for roasting. When the product is considered to be correctly roasted, the Laboratory checks a random final sample for moisture content, aW, and Aflatoxins and records the result per batch. If the moisture content is still greater than 2% and the aW is still greater than 0.6, the roasting continues until the correct levels are achieved.
5. If out-of-specifications, the processing of this batch is put on hold, and the batch is sent back to storage and placed in the non-conformance product area.
6. The batches of groundnuts that the Lab has approved are then roasted at 160ºC for 60 minutes.
7. The roasted groundnuts are taken to the blancher and blanched at 140ºC for 20 minutes. The Laboratory checks a random final sample for presence of hulls and records the result per batch. When a batch is approved, the Laboratory submits the form to QA.
8. The blanched groundnuts are cooled to near-ambient temperature.
9. The cooled groundnuts are fed into the grinder/mill and ground to required mesh size.
10. A random sample is taken to the Lab for analysis of aW, moisture content, and Aflatoxin. If the product does not conform to specifications, it is taken to storage and placed in the non-conformance product area. When a batch is approved, the Laboratory records the result per batch and submits the form to QA.
11. The peanut butter is poured into buckets and marked with a batch number. The product is signed off by the Supervisor and sent to storage.

ProKal SOP 6 CCP 5
SOP FOR MAIZE GRITS

REFERENCE: HACCP process for processing ProKal products

SOP 6: Processing extruded maize grits

1. Data about each batch of raw maize is recorded (weight, cultivar, origin, harvest time), and each batch is given a sequential number.
2. The maize is loaded into the feeder for extruding. When the product is considered to be correct, QA checks random sample.
3. The extruded maize is then cooled to near-ambient temperatures.
4. The cooled, extruded maize is fed into the grinder/mill and ground to required mesh size.
5. A random sample is taken to the Lab for analysis of aW, moisture content, and Aflatoxin. If the product does not conform to specifications, it is taken to storage and placed in the non-conformance product area. When approved, the Laboratory records the result per batch and submits the form to QA.
6. The extruded maize is poured into bags and marked with a batch number. The product is signed off by the Supervisor and sent to storage.

ProKal SOP 7 CCP 6 and 2
SOP FOR PROCESSING ALL ProKal PRODUCTS

REFERENCE: HACCP process for processing ProKal products

SOP 7: Final processing

1. The ingredients are requested from storage by internal order.
2. Storage supplies the ingredients as required for processing.
3. The ingredients are placed in the red zone demarcated block for products not in use.
4. The Storage Supervisor opens each package and checks for quality.
5. A sample of each container is taken by the Laboratory and analyzed.
6. If sample is out-of-specification, the Laboratory reports to QA for a decision. Information will be conveyed to the GM if required.
7. If sample is in-specification, Laboratory stamps Analysis Form and submits to QA for counter-signing.
8. If product analysis is passed, the production team weighs the ingredients in suitable containers for transfer to the processing department.
9. All weighed containers must be closed before being transferred to the processing area.
10. QA gives one signed copy to Receiving/Storage Supervisor for attachment to Supplier's COA.
11. Processing Supervisor arranges with Receiving/Storage to re-close all containers that still have ingredients in them at the end of shift and to return them to storage.
12. The amount of product in partly filled containers must be recorded in the form before containers are returned to storage. These containers will be stored and re-issued when required.
13. In the processing area, loose lids should be kept on containers when ingredients are not being weighed. Containers returned to storage must have the lids secured.
14. Production Department operator(s) transfer the base ingredients to the pre-mixer according to the recipe.
15. The pre-mixing is done until all ingredients are evenly distributed.

16. The fine ingredients are added and blended with the pre-mix until those ingredients are totally distributed.
17. The final mix is then transferred to the pasteurizer.

ProKal SOP 8 CCP 7 and 3
SOP FOR PROCESSING ALL ProKal PRODUCTS

REFERENCE: HACCP process for processing ProKal products

SOP 8: Pasteurizing

1. The equipment is checked for malfunction: heat source, thermometer settings, and timer.
2. If there is any malfunction in the equipment during processing, the GM and QA must be notified, and they record the type of malfunction by product, date, time, and batch number and then sign the recording form.
3. Pasteurizing can begin once the equipment has been serviced by maintenance technicians and has been certified that it is operating correctly.
4. When the equipment is operating correctly, the final mix is transferred to the pasteurizing equipment.
5. Pasteurizing begins according to the settings and time provided by the equipment manufacturer.
6. Each batch of product that goes through the pasteurizer must have the following information documented in the production register: batch number, date, time, and temperature-setting readings.
7. A random sample is taken to the Lab for aW, moisture content, and Aflatoxin analysis. If the product does not conform to specifications, it is taken to storage and placed in the non-conformance product area. When approved, the Laboratory records the result per batch and submits the form to QA.

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Technological principles of pasteurization

Physical and chemical factors that influence pasteurization are as follows:

1. Temperature and time
2. Acidity of the product
3. Air remaining in containers

Pasteurizing processes

Low pasteurization:

63°C to 65°C for 15 to 30 minutes
75°C for 8 to 10 minutes

Rapid pasteurization:

88°C for 1 minute
100°C for 12 seconds
121°C for 2 seconds

Pasteurization temperature and time will vary according to:

1. Nature of product
2. Initial degree of contamination
3. Pasteurized product storage conditions and shelf life required

In the first category of pasteurizing processes (low pasteurization), it is possible to define three phases:

1. Heating to fixed temperature
2. Maintaining this temperature throughout the established time period—pasteurizing time
3. Cooling the pasteurized products—natural (slow) or forced cooling

The second category of pasteurization processes (rapid, high, or flash pasteurization) is characterized by a pasteurization time in the order of one minute or less and temperatures of about 88°C to 90°C or more, depending on holding time. While bacterial destruction is very nearly equivalent in low and in high pasteurization processes, the 121°C for 2 seconds of treatment results in the best-quality products with respect to flavor and vitamin retention. Such short holding times, however, require special equipment, which is more difficult to design and is generally more expensive than the pasteurizing equipment used for 63°C–65°C for 15 to 30 minutes of pasteurization processes.

Thermo-penetration:

1. During pasteurization, a sufficient heat quantity must be transferred through the receptacle walls—in order that the product temperature rises sufficiently to be lethal to microorganisms throughout the product mass.
2. The most suitable and practical method for speeding up thermo-penetration is by moving the product during the pasteurization process. Rapid rotation of the product around the receptacle axis is an efficient means of accelerating heat transfer, because this has the effect, among others, of rapidly mixing the contents.
3. The critical speed for this movement is generally about 70 rpm (rotations per minute). This enables a more uniform heating of products, and it reduces heating time and organoleptic degradation.

ProKal SOP 9 CCP 8 and 4
SOP FOR PROCESSING ALL ProKal PRODUCTS

REFERENCE: HACCP process for processing ProKal products

SOP 9: Filling

1. The applicable primary packaging is sterilized and kept in a sterilized cabinet to prevent contamination.
2. The pasteurized product is hot-filled at a target temperature of 65ºC (the actual temperature must be <63ºC) in the applicable primary packaging. The packaging is then sealed, labeled, and marked with a batch number.
3. The primary-packed and sealed products are packed in the secondary packaging, then sealed, labeled, and marked with a batch number.
4. A random sample is taken to the Lab for sensory evaluation. If the product does not conform to specifications, it is taken to storage and placed in the non-conformance product area. When approved, the Laboratory records the result per batch and submits the form to QA.
5. The product is signed off by the Production Supervisor and sent to storage, ready for dispatch.

GMPs need to be carried out in relation to the equipment actually used (GMPs are discussed in Section 7).

Section 9: More management tools

1. RECORD KEEPING

Record keeping is essential for efficient business and HACCP management. (More specific reasons are given immediately below)

WHY KEEP RECORDS?

Record keeping tells you:

- The history of your business
- Which direction are you going?
- How fast/slow are you going?
- Track record/comparisons
- Growth or stagnation
- PROFIT or LOSS
- Is there something you should keep on doing?
- Something you should stop?
- Can you have substitutes?

WHEN TO KEEP RECORDS: ALWAYS

- From start of business until the end
- Record keeping must be a company culture
- All key staff should know importance of record keeping

HOW TO KEEP RECORDS

Raw materials:

- Name of raw material
- Date of purchase
- Type of raw material (variety)
- Source(s): name of vendor, location
- Quantity (kg, pieces, bags, etc.)
- Maturity index
- Condition
- Cost
- Transportation/fuel cost

Production:

- Date
- Product being processed (e.g., ProKal products)
- Batch number
- Type of raw material (variety)
- Fresh weight, waste weight, etc.
- Processing start and end time (total processing hours)

- Percentages: yield, waste/fresh, etc.
- Processing start and end time
- Final product weight
- Quality aspects
- Process flow
- Forms
- Check points and controls
- Signatures
- Frequency
- If you export:
  - International standards, HACCP
  - SOPs
  - Internal audit
  - External audit

AREAS OF RECORD KEEPING

- Raw materials
- Processing
- Finish product records
- QA/QC
- Inventory: raw materials, finished products, logistics
- Sales (local/export)
- Customers (local/export)
- Suppliers
- Energy costs
- Utilities: water, electricity, telephone, waste
- Cleaning schedules
- Transportation
- Packaging: weight, quantity
- Packaging materials: types, sizes, manufacturers
- Banking
- Cash flows (in/out)
- Daily non-processing expenses
- Food and entertainment, stationery, etc.
- Invoices (sales, purchases)
- Salaries/wages (casuals/permanent staff)
- Registration/certification/HACCP
- Quality records
- Traceability
- Operations
- Inventory control
- Sales and marketing control
- Finance
- Operational costing

- Sales accounting
- Sales and marketing

WHO KEEPS THE RECORDS?

- CEO/General Manager
- Production Manager
- Purchasing Officer
- QA manager
- Product Development Manager
- Agronomist
- Factory Engineer
- Export Officer
- Supervisors
- Bookkeeper/Accountant
- Human Resource Manager

BENEFITS OF RECORD KEEPING

- Determine profit/Loss
- Prevent wastage
- Prevent and/or minimize theft/pilfering
- Reduce costs
- Product development/enhancement
- Expansion

2. REPORTS

Reports are essential for efficient business and HACCP management. (More specific reasons for producing reports are given immediately below)

WHY PRODUCE REPORTS?

- Budgets
- Costing
- Budget vs. actual
- MRP—Material resource planning
- Statistical inventory control
- Financing planning
- Company progress
- Production performance
- Management performance
- Crucial decision-making by board of directors

WHEN TO PRODUCE REPORTS

- From start of business until th eend

- Every month as part of the management meeting agenda
- Reporting must be a company culture
- All senior managers should know and understand the importance of reporting

HOW TO PRESENT REPORTS

- Conveniently arranged, easy to scan/survey
- Provide executive summary or other summary

WHAT TO REPORT

- Production figures
- Management programs
- Results
- Incident reports
- Other items as needed and/or specified by top management
- Next steps and schedules

WHO SHOULD DO THE REPORTING?

- CEO/General Manager
- Production Manager
- Purchasing Officer
- QA manager
- Product Development Manager
- Agronomist
- Factory Engineer
- Export Officer
- Supervisors
- Bookkeeper/Accountant
- Human Resource Manager

BENEFITS OF REPORTS

- Information sharing
- Open discussions about management and production
- Debate facilitation
- Ensure certainty and precision
- Assist with forward planning
- Integrated part of annual company report

3. SOPs

SOPs are essential for efficient business and HACCP management (More specific reasons for establishing and following SOPs are given immediately below).

WHY SOPs?

- Outline operational structures
- Provide detailed instructions for activities to be carried out to manufacture the products
- Set operational parameters
- Determine performance areas
- Define goals
- Establish performance standards
- Function as a performance-measuring instrument

WHEN TO APPLY

- From start of business until the end
- All the time
- All senior managers should know and understand the importance of the SOPs

WHO DESIGNS AND SETS THE SOPs?

- CEO/General Manager
- Senior Managers
- Supervisors

BENEFITS OF SOPs

- Improve effectiveness
- Help ensure quality

Section 10: Packaging specifications

Moisture-proof, durable, and appealing packaging is the key to enhance the shelf life, brand image, and marketability of food products. Freshness and taste of the packed food completely depend upon the packaging. Quality food product packaging material is hygienically manufactured from food-grade plastic to maintain the color, flavor, and nutrition values of content inside for a long period of time.

A food-grade container is one that will not transfer noxious or toxic substances into the food it is holding.

Types of plastic packaging

These categories of plastic are used in nearly all plastic containers and product packaging:

PET or PETE (polyethylene terephthalate) is a clear, tough polymer with exceptional gas- and moisture-barrier properties. PET's ability to contain carbon dioxide (carbonation) makes it ideal for use in soft drink bottles. *Examples:* Soft drink bottles, detergent bottles.

HDPE (high-density polyethylene) is used in milk, juice, and water containers in order to take advantage of its excellent protective barrier properties. Its chemical resistance properties also make it well-suited for items such as containers for household chemicals and detergents. Most five-gallon food buckets are made from HDPE. *Examples:* Milk bottles, shopping bags.

Vinyl (polyvinyl chloride, or PVC) provides excellent clarity, puncture resistance, and cling. As a film, vinyl can breathe just the right amount, making it ideal for packaging fresh meats that require oxygen to ensure a bright red surface while maintaining an acceptable shelf life. *Examples:* Plastic food wrap, shrink wrap, garden hose, shoe soles.

LDPE (low-density polyethylene) offers clarity and flexibility. It is used to make bottles that require flexibility. To take advantage of its strength and toughness in film form, it is used to produce grocery bags and garbage bags, to shrink and stretch film, and to coat milk cartons. *Examples:* Squeeze bottles, dry-cleaning bags.

PP (polypropylene) has high tensile strength, making it ideal for use in caps and lids that have to hold tightly onto threaded openings. Because of its high melting point, polypropylene can be hot-filled with products designed to cool in bottles, including ketchup and syrup. It is also used for products that need to be incubated, such as yogurt. Many Tupperware and Rubbermaid food storage containers are made from PP. *Examples:* Bottle caps, take-out food containers, drinking straws.

PS (polystyrene), in its crystalline form, is a colorless plastic that can be clear and hard. It can also be foamed to provide exceptional insulation properties. Foamed or expanded polystyrene (EPS) is used for products such as meat trays, egg cartons, and coffee cups. It is also used for packaging and protecting appliances, electronics, and other sensitive products. *Examples:* Plastic foam, packing peanuts, coat hangers.

Laminates: PET/MET, PET/POLY, and others. This packaging is durable and is highly resistant to stains, heat, and moisture. It is used for storing consumable goods, as it keeps them dry, odorless, and safe from humidity.

Recommended packaging for ProKal products: PP containers or laminate pouches, sizes to be determine by application.

Figure 12 shows various types of plastic packaging.

Figure 12: Types of plastic packaging

References

Johnson, Sylvia A. (1997). *Tomatoes, potatoes, corn, and beans: How the foods of the Americas changed eating around the world.* New York: Atheneum.

Onwulata, et al. (2001). (See http://wyndmoor.arserrc.gov/Page/2000/6853.pdf. Last Accessed January 9, 2012)

USDA Nutrient Database for Standard Reference, Food Composition and Nutritional Tables (Souci-Fachamnn-Kraut). (See www.nal.**usda**.gov/fnic/**food**comp/search/. Accessed January 9, 2012)