Soybean Utilization in Nigeria

by

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S O Y B E A N U T I L I Z A T I O N
I N N I G E R I A

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Preface

Soybean, though relatively new in Nigeria, is gaining acceptance and is making an encouraging incursion into the eating habit of Nigerians.

Soybean has tremenduos potential for alleviating malnutrition in Nigeria. It is an economical source of high quality protein (about 40 percent) with a good balance of amino acids. Its protein content is greater than any of the common vegetable or animal food sources in Nigeria.

These positive attributes of soybean have led to increased interest in soybean production and utilization. Hence there is need for more sources of information on the crop.

This publication is primarily intended to serve as a teaching manual for the soybean untilization course at IITA.

It is subdivided into four main sections: Introduction, Nutritive Value, Industrial Utilization and Village Level Utilization. Much emphasis has been placed on the village level utilization because it is considered the pivot for overall adoption and also because the rural population is the target of the extension workers for whom the IITA course is primarily designed.

It is hoped that this manual will serve the need of the trainees and will also be found useful to housewives and other persons interested in the processing and use of soybean.

H.O. Ogundipe,

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SOYBEAN UTILIZATION

INTRODUCTION

Soybean, (*Glycine max*. L. Merrill), belongs to the family of plants called legumes. Other commonly found legumes in Nigeria are cowpea and groundnut. Groundnut and soybeans are 'oil legumes', whereas cowpea is a typical example of the 'starchy legumes'. In this paper, we are concerned mainly with soybean and more specifically - its utilization.

The history of the soybean is quite fascinating. It is the story of a little round bean which has been with mankind for ages but whose value is only now being appreciated!

The soybean, for long a very important food in many oriental cultures, has only recently received serious and widespread attention as a source of food in the United States, despite the fact that it has been one of the leading agricultural crops in that country for many years!

In Nigeria, and especially at IITA, commendable progress has been made in the development of soybean varieties that are adapted to our ecological conditions, but despite this achievement the potential of this small seed, which not only

furnishes edible oil but also produces a protein which is known to be high in lysine (high quality protein), have not been adequately exploited. Nigeria is a country which like most developing countries of the world is facing a food crisis.

As has been mentioned earlier, Nigeria is facing a serious food crisis which is highly manifested in the grossly inadequate protein-intake.

Serious and concerted effort must be made to alleviate this problem. In Nigeria, as in other similarly food deficit countries, the pressure on land is so much that increased availability of animal protein cannot be achieved and so cannot be a solution to our present predicament.

It is apparent that we urgently need adequate dietary sources of cheap protein to correct both the amount and the quality of this nutrient in the diets of our people; and since animal products, particularly milk, are not usually available and have other limitations for their wider use, it is necessary to consider the possibility of using other available and less expensive sources of protein of vegetable origin such as soybeans. It is known that from an acre of land the protein yield from soybean is more than that of beef!

NURITIVE VALUE OF SOYBEAN

The soybean is composed of three major components: the hull (8%); the cotyledon (90%) and the hypocotyl (2%).

Table 1. Proximate composition of moisture-free soybeans.

Protein (N x 6.25)	42%
Oil	20%
Total carbohydrates	30%
Ash	5%
Crude fiber	5%

Constituents of major interest for food applications are protein and oil which are 42% and 20%, respectively. As can be seen from Table 1, about one-third of the soybean is carbohydrate which include various polysaccharides:- stachyose, raffinose and sucrose. The remaining materials which include many minerals are described as ash.

Protein in Soybeans

Protein as a subject is very wide and complex and we shall not make any attempt to go into the realms of protein chemistry. This notwithstanding, there is no way we can discuss soybean without discussing its protein.

Proteins are complex molecules which the body requires for the build-up of new cells and replacement of worn-out ones, the protein molecule is made up of smaller components called the amino-acids, each protein molecule is made up of several amino acids which have been described as the body's building blocks.

The type, quantity and the pattern of arrangement of these amino acids are of utmost importance in determining the properties and quality of the proteins in which they are present.

In assessing the nutritive quality of any food, the quality of the protein as distinct from the quantity is very important, so also is the market cost of the protein. Soybean has not only high quality protein but also a lot of it.

Soybean protein is desirable not only from the point of view of yield but also from a commodity cost consideration as illustrated in the following tables 2 and 3.

Table 2. Comparative cost of commodity and protein in selected food sources in Nigeria (1987).

Source	Commodity cost N/Kg	% Protein Commodity	Protein Cost N/Kg
Beef	9	15.2	59.2
Pork	6	12.0	50.0
Poutry	8	20.0	40.0
Milk (powder)	8	36.0	22.0
Soybean	2	35.0	5.7

Table 3. Energy and selected nutrients of soybeans compared with some other foods commonly consumed in Nigeria.+

	Dry Matter	Total Digestible Nutrients	Crude Protein xxx	Oil	Carbohy-drate xx	Energy*	Total Ash	Crude Fiber (g/100 grams)
Soybean	93.23	91.99	44.10	19.10	26.05	452.42	5.06	5.71
Cowpeas	91.30	79.52	24.67	2.46	67.28	389.94	3.78	1.81
Groundnut seed	92.88	101.65	21.66	39.09	15.39	605.00	2.72	21.14
Wheat	87.00	80.00	9.30	2.00	75.00	334.00	1.70	2.00
Rice	89.00	82.97	12.51	0.14	90.18	398.00	0.38	0.20
Maize	86.50	84.97	10.65	4.09	83.88	409.65	3.13	2.50
Millet	95.70	81.22	9.02	4.99	83.86	413.79	1.09	2.00
Sweet Cassava (peeled)	28.50	22.88	1.66	0.65	90.86	375.93	5.23	1.66
Yam peeled Rotundata	24.10	20.83	4.42	0.34	90.11	381.18	2.75	1.45
Okra(raw)	11.32	-	15.78	0.98	62.49	321.90	10.97	9.78
African Locust Bean	92.90	80.89	12.71	6.75	49.33	382.72	6.21	18.03

+Source: Nigeria's foods and feeding stuffs (1968).

*Calories (g/100g)

xxCarbohydrate calculated by difference

xxx Factors used to convert Nitrogen to protein are as follows:

Rice = 5.95; Groundnut = 5.46; Soybean = 5.71; others = 6.25.

Table 4. Essential Amino acid composition of selected legumes, cereals and tubers (g/16gN).*

	Isoleu-cine	Leuc-ine	Lysine	Methio-nine	Cyst-ine	Phenyl-alanine	Tyro-sine	Threo-nine	Trypt-ophos	Val-ine
FAO score	4.0	7.0	5.5	(3.5)		(6.9)		4.0	1.0	5.0
Soybean	4.5	7.8	6.4	1.3	1.3	4.9	3.1	3.9	1.3	4.8
Cowpeas	3.8	7.0	6.8	1.2	1.1	5.2	2.6	3.6	1.1	4.5
Maize	6.4	15.0	2.3	3.1	1.5	5.0	6.0	3.7	0.6	5.3
Whole Wheat	3.8	6.7	2.7	1.7	2.2	4.6	3.1	2.9	1.2	1.7
Rice (brown)	5.2	8.2	3.9	3.0	1.3	4.6	5.8	3.2	1.1	6.4
Millet	4.4	9.6	3.9	2.4	1.8	4.1	3.5	4.0	2.0	5.7
Yam (Alata)	3.6	6.3	4.3	1.8	1.1	6.7	3.1	3.5	1.0	4.4
Cocoyam (Tania)	3.3	6.8	3.8	1.2	2.8	5.2	3.0	3.6	-	6.6
Sweet potato	3.6	4.8	4.3	1.7	-	4.3	-	3.8	1.8	5.6
Cassava (Sweet)	1.8	2.9	3.9	1.0	-	2.1	1.6	2.8	-	2.5

*Adopted from different sources (see references).

Soybean protein is of much high quality than the protein of most food crops that we consume locally; it is high in most essential amino acids except in methionine and cystine which are present at lower levels than the FAO recommendations. It is therefore better to use soybean to supplement foods that are high in these two amino acids e.g. maize. Apart from this, defficient amino acids can be added directly to soy based foods. Note that amino acids are conventionally classified into essential and non-essential on the basis of whether they must be supplied in the diet or whether they can be synthesized by the body.

Soybeans are processed into three main high protein products namely: the meal, the concentrate and the isolate.

The meal is obtained by grinding the full fat dry soybean into flour and is not less than 50% protein. The flour is used to produce a wide variety of products with varying particle size, protein solubility and fat content.

The soy protein concentrate which is not less than 70% protein is obtained by removing the oil and water soluble non-protein constituents.

The soy protein isolate which is not less than 90% protein is manufactured by removing a preponderance of the non-protein components, this is achieved by precipitating and

concentrating the protein by acid hydrolysis followed by centrifugation. Each of these products can be textured and used to manufacture several food products.

Quality of Soy protein products depends on several factors: (a) amino acid composition; (b) presence of antinutritional factors; (c) digestibility; (d) overall composition of the diet and (e) nutrient requirements of organism involved. Items a, b, and c are of primary importance in considering the various soy proteins as protein sources.

In the preparation of isolates, for example, there is a change in amino acid composition as well as the removal of the antinutritional factors. Items d and e are of greater importance when a specific food is being considered, i.e an infant food or a snack food. Nutritional requirements for an infant differ greatly from those of an adult who may be trying to lose weight.

In concluding this section, it should be emphasized that the quality of vegetable protein is generally inferior to that of animal and so the consumption of soybean protein alone is not sufficient, therefore soybeans should not be the sole supplier of protein especially to growing children.

Legume proteins in general are poor sources of the sulfur-containing amino acids methionine and cystine and many are deficient in trytophan but they generally have a high lysine content which is the limiting amino acid in cereals. Hence best value is got when a combination of cereals (maize) and soybean is used as food. Soybean are also being used to upgrade the protein and consequently the nutritive value of starchy crops like rice, yam, cassava and others.

The Carbohydrates

The carbohydrate content of soybean varies between 27-30% while its total soluble sugar component may be up to 10%.

The importance of carbohydrate in the diet is well documented. A certain amount in the diet is necessary since it has a protein-sparing function, i.e., if a diet is very low in carbohydrate, then a higher percentage of protein than is usual will be used to provide energy thereby upsetting the major function of protein which is to provide material for growth and repair of tissues. A moderate carbohydrate intake therefore ensures an efficient use of the dietary protein.

Apart from its role in the 'protein-energy balance' soybean carbohydrate is also important for its role in the

functional properties of food. Such functions include adhesion, binding, stabilising, thickening, gelling, anti-staling, shaping, etc.

However, carbohydrates assume another importance in legumes because of the presence of oligosaccharides like raffinose, stachyose and verbascose which when consumed in large quantities cause the production of intenstinal gas which subsequently leads to flatulence. The production of the undesirable gas is due to the fact that human beings have no capability to digest the polysaccharides which are consequently fermented by micro-organisms.

It should be noted that the flatulence problem is much more pronounced in cowpeas than in soybeans because of the near absence of verbascose and starch in soybeans (Table 5). T' is reduction in the incidence of flatulence makes soybean much more useful and acceptable in infant feeding than other legumes. Apart from this, less sugar in soybean may also have special nutritive value in the control of diabetes. In China, soybean as grain is prefered by diabetic patients because of its relatively low sugar content.

Table 5. Percentage of sugar and starch content in whole legume flour.

	Total sugar	Sucrose	Raffi-nose	Stach-yose	Verba-scose	Starch
Groundnut	7.2	5.9	0.3	0.9	0.1	0.0
Soybeans	8.3	4.2	1.3	2.7	0.0	0.0
Cowpeas	8.0	2.0	0.9	2.2	2.8	54.1

Source:- Adopted from 'Legumes in Human Nutrition, FAO 1982.

Minerals and Vitamins

Soybean contains appreciable amount of minerals and vitamins.

Mineral elements are inorganic compounds which appear as 'ash' when all the carbon, hydrogen, oxygen and nitrogen in foods are burnt. They may exist as a simple inorganic salt (e.g. sodium chloride-salt) or as part of a complex organic molecule as in some sulfur-containing proteins.

Minerals elements enter the body fluids and cells, and are needed in definite amounts at specific sites. Functionally, the mineral elements are so interrelated that their specific functions may be difficult to define.

Generally speaking soy products are not a major source of minerals; however in mixed diet the minerals contained in soybean especially calcium, phosphorous and iron can make appreciable contribution to the overall requirement especially for children and pregnant women. It should be noted however that phytic acid which is present in whole soybeans can chelate divalent cations such as calcium, iron, phosphorous and zinc and lower their availability.

Soybean is better than most of the other food items in mineral and vitamin composition (Table 6). Vitamins on the other hand, are a group of complex organic compounds which are generally required in the diet in rather small amounts for normal growth and maintenance of health. Vitamins are not used for structural or energy requirements or as raw materials for synthesising other compounds; this notwithstanding absence of vitamins leads to deficiency diseases, with sometimes fatal consequences.

Table 6. Mineral and vitamin content of some tropical foods and feeding stuff (Mg/100g).

	Calcium	Phosph-orus	Iron	Ascobic Acid	Thiamine	Ribof-lavin	Niacin
Cocoyam (Taro)	24.0	53.0	0.72	14.0	0.08	0.03	0.83
Cocoyam (Tania)	6.0	36.0	0.70	10.0	0.05	0.08	-
Yam	10.4	41.2	0.62	2.0	0.09	0.03	0.47
Sweet potato	16.0	31.0	0.83	26.2	0.13	0.02	0.55
Cassava (Sweet)	10.0	35.0	0.50	35.0	0.04	0.02	0.60
Rice (Brown)	12.0	290.0	2.00	-	0.31	0.04	1.80
Maize (Dry)	6.0	300.0	2.50	11.4	0.50	0.08	2.00
Wheat (Flour)	36.0	392.0	45.91	-	0.24	-	1.60
Groundnut (Seeds)	75.0	38.0	2.00	9.80	0.90	0.14	17.40
Cowpea	90.0	451.0	4.00	-	0.89	0.14	1.30
Soybean	220.0	586.0	7.00	47.00	1.12	0.32	2.10
Orange (Sweet)	33.0	23.0	0.40	49.0	0.08	0.03	0.20
Guava (Edible portion)	16.0	33.0	0.90	300.0	0.06	0.04	1.00
Pineapple	16.0	11.0	0.30	24.0	0.81	0.02	0.20
Water mellon fruit	7.0	12.0	0.20	6.0	0.05	0.05	0.20
Pawpaw (Ripe)	58.6	26.3	0.31	22.0	0.11	0.02	0.22
African Locust Bean (fermented)	278.0	60.0	33.00	-	0.04	trace	2.10
Red pepper (Raw)	58.0	-	2.90	121	0.25	0.20	2.40
Bitter leaf (Raw)	145.0	-	5.00	-	-	-	-
Tomatoes	11.0	-	0.60	23.0	0.06	0.04	0.50
Mango	14.0	9.0	0.50	25.0	0.02	0.03	0.20
Milk	125.0	96.0	trace	1.5	0.04	0.17	0.08

Source: Adapted from Integrated Food Science and Technology for the Tropics (1985).

Effect of Processing

Vitamins are unstable and they are very sensitive to processing conditions. Generally, home cooking leads to a much greater loss of vitamins and minerals than those encountered in industrial processing. Operations such as dehulling, grinding, blanching, freezing, cooking and storage make significant contribution to mineral and vitamin losses. Fortunately, soybean and soybean products can easily be supplemented with minerals and vitamins to the desired level.

Anti-nutrional Factors

Soybean like most legumes contain some biologically active substances in their raw state. These substances are generally referred to as 'biologically active substances' or 'anti-nutritional factors'.

Some of these substances are toxic while others inhibit the availability of desired elements and substances that are otherwise useful to the body.

Examples of such substance are (a) Trypsin inhibitors

(b) Phytic acids

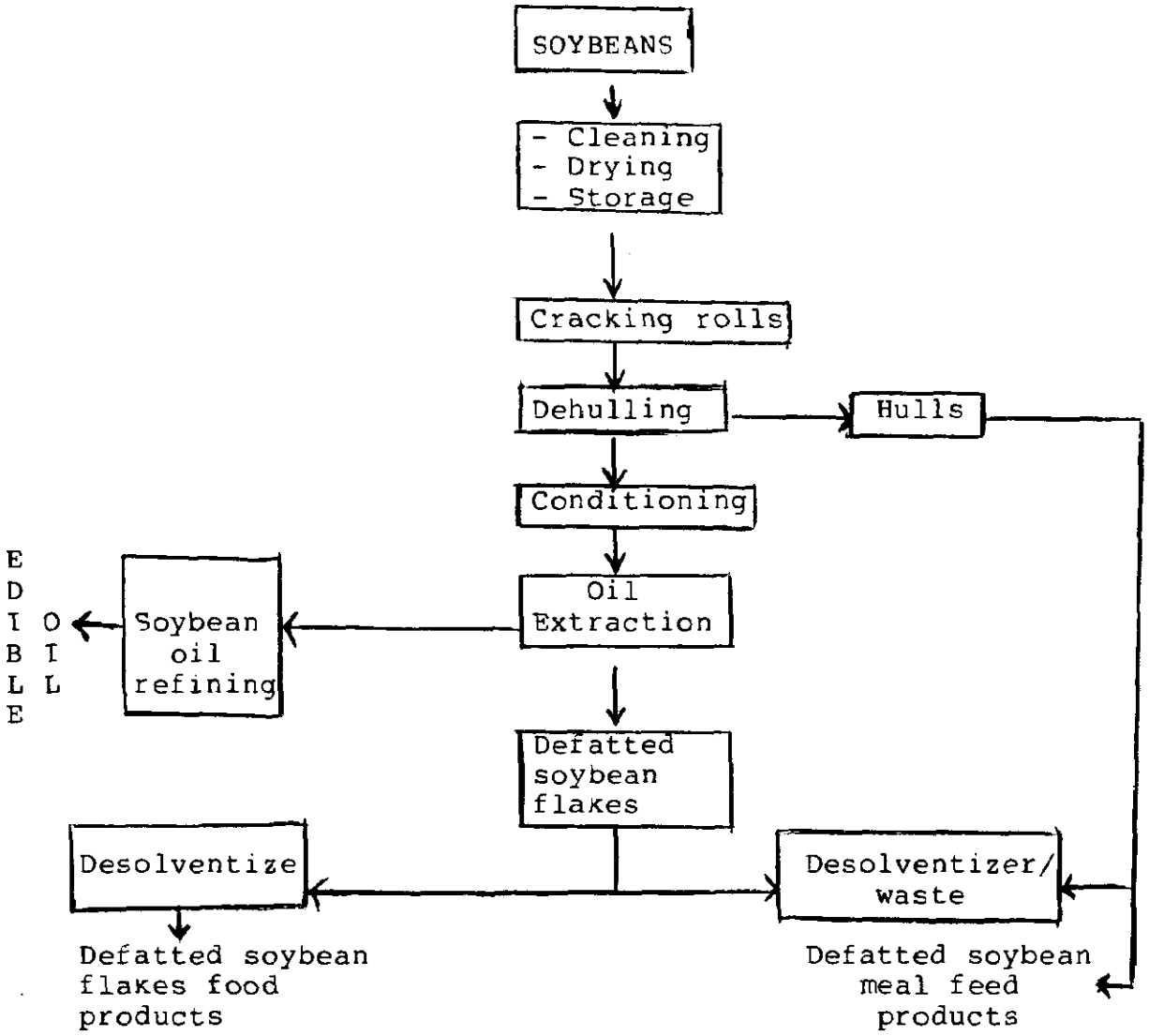
(c) Tannins

(d) Hemagglutinins.

Fortunately, man has learned to avoid circumstances under which these substances would cause hazard by (i) utilizing varieties and strains low in the active substances; (ii) through what has been described as "Safety in Numbers" which in essence means that "the wider the variety of food intakes, the greater is the number of different chemical substance consumed and less is the chance that any one chemical will reach a hazardous level in the diet" and (iii) through what is called 'Safety through technology" which implies that our usual processing methods like soaking, blanching, drying, heating and roasting eliminate or reduce the activities of these substances to non-toxic level. In effect, safety is assured once processing instructions are followed. Therefore raw soybean cannot be consumed by humans, cattle, ruminants, poultry etc; they have to be processed or cooked to get rid of anti-nutritional factors. For home consumption boiling is essential.

II INDUSTRIAL UTILIZATION

Fig. 1. Schematic diagram for processing soybeans into edible soybeans into edible soy oil, defatted food and feed products.



Source: Soy Protein and Human Nutrition.

Soybeans are a relatively recent agricultral crop in the United States. Early interest in the soybean was for the oil which was pressed from the beans. Much of the oil was used in paint and other industrial applications, and the meal was considered a by-product which was then used primarily as cattle feed or fertilizer.

However, in the early 20th century, a continuous oil extraction process using an organic solvent to remove oil was developed, N-hexane being the most commonly used organic solvent. Coincidentally, food uses for the oil also started to develop at about the same time while processing of soybeans into food products such as flour, concentrate and isolate developed in the 1950's. These soyfood products are marketed in a wide variety of forms.

Today, nearly all the oil produced from soybean goes into food use.

OIL

Soybean oil has a composition similar to other vegetable oils such as groundnut and sunflower. Its oil is highly digestible and has a high degree of unsaturation containing about 85% unsaturated and 15% saturated fatty acid. This high degree of unsaturation makes soybean oil specially

favorable with those who have high level of blood cholesterol and hence, high susceptibility to cardio-vascular disease.

It is believed that the use of poly-unsaturated fats in the diet reduces the level of cholesterol in the blood. Cholesterol ($C_{27}H_{45}OH$), a fat like substance is found in all animal tissue. It is also believed that when too much cholesterol has accumulated in the blood, it is deposited along the walls of the arteries thereby making the arteries to be narrower. This may increase the chances of a blood clot forming and a possible occurrence of heart attack.

It is obviously nutritionally wise to prevent cholesterol accumulation in the blood and consumption of soybean oil is one way of achieving this.

Soybean oil also has a high percentage (60%) of the essential fatty acids (EFA) but the presence of large amounts of linoleic acid in soybean has been implicated in the development of the undesirable 'beany' flavours in the stored oil and in food products containing the oil. However, hydrogenation lowers the linoleic acid content.

Soybean oil is primarily used as a starting material for a wide variety of food products such as:

Frying fats,	Margarine,
Mayonnaise,	Salad dressing,
Salad oil,	Cooking oil.

Defatted Soybeans

As discussed earlier, three general categories of food products are produced from defatted soybeans based on the protein content, i.e. the flour, the concentrate and the isolate.

Table 1. Typical composition of soybeans and soybean products.

	% Protein	% Oil	% Total carbohydrate	% Ash	% Crude fiber
Whole soybeans	42	20.0	35.0	5.0	5.5
Defatted soyflour	54	1.0	38.0	6.0	3.5
Soy protein	70	1.0	24.0	5.0	3.5
Isolated soy protein	92	0.5	2.5	4.5	0.5

Industrial Food Uses of Soy Protein

Major applications of soy protein products are in processed meat and fish products, bakery products, dairy-type products, infant formulas, protein supplement, hospital feeding, meat analog products and a variety of fabricated food products.

Use in Meat Products

One of the major uses of isolated soy protein is in extending communited or emulsified meat products, such as frankfurters and other ground meat products. These soy protein are being used as complementary protein to the meat proteins not only because of their moisture binding, fat emulsifying and emulsion stabilizing properties but also for their nutritional and flavor characteristics. The use of soy protein products allows meat emulsions to be prepared in a wider range of emulsion temperatures than is possible when using meat proteins only.

Use in Baked Products

For many years, soy proteins have found favor in the baking industry. Low levels of full-fat soy flour added to wheat flour at levels of 0.5-1% of the wheat flour allows the production of bread with increased crumb softness and improved keeping quality. Soy flour is also used at varying levels in doughnut and cake mixes. The soy flour helps to regulate the amount of oil absorbed during the frying stage in doughnut production.

Soy flour is now commonly used in some varieties of crackers to the level of 2-5% of the total ingredient weight.

Infant Formulas and Food

The use of soy flour to develop milk-free diets started early in the 1950s. Since then, special formulas utilizing isolated soy proteins have been developed for older infants, hospital and post-operative feeding. Soyflour, protein concentrate and isolates have been successfully used to increase the protein content of cereal products such as rice and wheat when the infant begins to utilize solid foods.

Food Analogs

Several meat-like products (or analogs) are being produced using soy flour, soy concentrates and isolated protein. These analogs usually contain other sources of protein such as wheat gluten, egg albumin and yeast.

Dairy Type Foods

In addition to the use of soy protein products as replacements of non-fat dry milk in baked goods and the use of isolated soy protein infant formulas, soy proteins are also being used in products such as non-dairy coffee

whiteners. It is also being used in evaporated-type milk products.

Finally a considerable amount of new product development activity is underway in the utilization of isolated soy protein in yoghurt, cheese and ice-cream.

Miscellaneuos Uses

Products manufactured from the whole bean, without defatting, are now being produced and are called soy nuts. These products are eaten directly as snacks and are also used in the baking industry as a replacement of the more expensive nuts.

Soy flour or isolated soy proteins have been approved for use in margarine. Finally, some of the fortified formulated food products used for distribution in foreign food programs are corn-soy (CSB) and corn-soy-milk (CSM) extruded products.

Village Utilization of Soybean

Food has been variously defined as substance which when continuously consumed can sustain life and its activities, or as substances that can adequately furnish the required nutrients of fat, carbohydrates, proteins, minerals and fiber.

However, let us look at food from a wider perpective. Food is more than a source of sustenance and nutrition. Food is intrinsively intertwined with the cultures and traditions of peoples everywhere. Certain foods are traditional, some have symbolic meanings; others are associated with social status; some are regarded as staples while others are reserved for special guests and occasions. Some foods are preferred by people of one culture, only to be disliked or even tabooed by others; and certain foods are associated with special days, celebrations and religious rites.

In effect, it could be seen that food is more than fat, carbohydrates, proteins, vitamins, minerals and fibers. Food is palatability, taste, forms, appearance and goodness. Food is also a political and economic reality in almost every country in the world and food policies can determine the success or downfall of governments!

Since food is all of these things, because it is so much a part of peoples daily lives, eating habbits and food systems are difficult to change, but that is precisely what we are expected to do if we are to improve the health of our people.

As it is well known, majority of our rural people are grossly malnourished. Soybean as a crop can be used to significantly improve their nutritional status.

At the village level, there are so many food products that can be easily made from soybeans. These products are balanced and nutritious and their stepwise methods of production are clearly set out in the attached appendices.

Storge and Handlings

This is a very important operation that should be constantly emphasized. It is a well known axiom in food processing, that the quality of processed food is as good as the quality of its raw materials.

Soy protein products for human consumption must be produced from high quality soybeans as the materials base.

Proper receiving, handling and cleaning of soybeans are very important steps in the production of high quality products.

Cleaning at the village level may be satisfactorily accomplished by air classification. It is important to remove as much foreign matter as possible in order to maintain a pure product and for processing efficiency.

Clean soybean will retain their quality in bulk storage providing the moisture content does not exceed 12%.

Soybean Utilization

Soybeans can be used for livestock feeds and for preparing various dishes. To prepare soybean for human consumption, two methods are adopted:

(1) the wet method which produces paste and

(2) the dry method which produces flour.

The figure below illustrates the process:

	Wet base	Dry base
(a)	Whole soybeans	Whole soybeans
(b)	Pick stones and damaged broken beans	Pick stones and damaged broken beans
(c)	Put soybeans into boiling water and continue to boil for 20-25 minutes	Put soybeans into boiling water and continue to boil for 20-25 minutes
(d)	Dehusk i.e remove seed coat or testa (this is optional)	Dehusk i.e remove seed coat or testa (this is optional)
(e)	Separate beans from husk	Separate beans from husk
(f)	Grind	Dry
(g)	Paste	Flour

Preparation of Soymilk

1. Clean the whole dry soybeans. Drop them directly into five times their weight of boiling water containing 0.05 percent sodium bicarbonate, and boil for five minutes, (sodium bicarbonate is baking soda and it will help make the soybeans soft. If you do not have baking soda, then boil for 10 minutes).

2. Discard water and drop the partly cooked beans into ten times the raw bean weight of boiling water containing 0.05 percent sodium bicarbonate*.

3. Boil the beans for an additional five minutes and grind (take to local grinding machine), with the second blanch water. If there is no grinding machine you can grind the beans by hand using stone. Then add the paste back to the water.

4. Stir the slurry (paste) well and filter with six-fold finely woven, moist cheesecloth**. Squeeze out as much extract as possible.

5. Cook the liquid at the simmering point (very low boil) for twenty minutes.

*'Kanun' a local tenderizer may be used in the absence of sodium bicarbonate.

**The normal 'Ogi' sieve can be used as substitute for cheesecloth.

6. Stir well to dissolve all the ingredients, pour hot into bottle and cool. If there is no refigerator the milk should be used the same day it is prepared.

7. The thick paste that is remaining can be used the same as soybean paste.

Soy Ogi

Ogi is the Yoruba name for a breakfast food made from maize or Guinea corn.

Soak maize seeds for a miniumum of 3 days. Wash and grind to a paste at the local mill. Add thrice amount of water to paste and sieve with a fine wire mesh 2 or 3 times to removed the shaft. Allow to settle for 6-13 hours and remove excess water. The sediment (the material left after excess water is removed) is the paste Ogi.

1. Prepare soybean paste using steps 1-3 in preparation of soymilk.

2. Put soybean paste into a pot. Add water and boil.

3. Add Ogi to the pot and stir. Your soy ogi is ready.
   To preserve soybean ogi:
   (a) pour the paste into a white cotton material
   (b) fold the cloth and squeeze out excess water
   (c) dry on a flat surface and keep in an air-tight container.

Soy Eko ("Agidi" or "Kamo" in local language).

1. Bring water to boil

2. Add enough water to soy paste to make a slurry

3. Add the slurry to the boiling water and stir continously until the mixture thickens

4. Allow to cook on a low heat for 10-15 minutes

5. Wrap with leaves into small portions

6. Serve with soy akara, soy vegetable soup, soy "moinmoin" or soy "ekuru".

Preparation of **Soy "Moin Moin"**

The ratio of soybean to cowpea is around 1:2 in this recipe (i.e. one cup of soybean to two cups of cowpea).

1. Remove the dirt, stones and any broken soybeans.

2. Put water into a pot and place it over the heat to boil.

3. Drop the soybeans into the boiling water and let them blanch in the water for 10 minutes.

4. Drain off the water and discard (water). Rinse the soybeans in clean water.

5. Cover the soybeans with fresh water and allow them to soak over night.

6. In the morning let the cowpeas soak for a short while (30 mins) before removing the seed coat.

7. Grind the soybeans and the cowpeas together either on a grinding stone or at the local grinding machine.

8. The paste should be beaten well untill it has a light consistency adding a little warm water during this process.

9. Chopped onion and pepper are generally added to the mixture. Other ingredients may inculde ground dried shrimp, chopped liver, chopped cooked or smoked fish, cooked meat, sliced hard-boiled egg. Alternatively fresh egg may be stirred into the mixture. Salt is also added to taste.

10. The mixture is put into small tins or is wrapped in leaves or foil.

11. The tins or wrapped paste are covered and steamed for about 45 minutes.

12. Moin Moin is traditionally served with ogi, eko, garri or rice.

Preparation of **Soy Akara**

The ratio of soybean to cowpea in this recipe is most successful at the ration of 1:2 (i.e. there should be a measure of a small can of soybeans to two of cowpeas). Too much soybean would make the mixture too crumbly.

1. Remove the dirt, stones and any damaged soybeans.

2. Bring a pot of water to boil.

3. Drop the soybeans into the boiling water and let them blanch in the water for 10 minutes.

4. Strain the water off the soybeans, decant and rinse the soybeans well in fresh water.

5. Cover the soybeans with fresh water and let them soak overnight.

6. In the morning soak the cowpeas (local beans) in water for 30 minutes.

7. After soaking, remove the seed coats of the cowpeas (otherwise the coats will give the mixture a blackish color).

8. On a grinding board, grind the soybeans and cowpeas together to a smooth paste or take to the local grinding machine to be finely ground.

9. Grind or chop onion and pepper and add a little salt into the ground soybean and cowpea mixture.

10. The mixture must be beaten hard to incorporate air while adding a small amount of warm water.

11. Akara is cooked by deep frying spoonsful of mixed paste into very hot oil. Normally palm oil would be used.

12. Akara should be crisp on the outside and cooked in the centre. It is eaten with ogi or eko, and is a favorite food for breakfast or snack.

Soy Amala

4 peak milk tinsful (320 g) yam or cassava flour

3 peak milk tinsful (150 g) soy flour

6-11 peak milk tinsful (1000-1443 ml) of water

1. Bring water to boil

2. Sprinkle soybean flour into the boiling water and stir vigorously

3. Add yam or cassava flour to the mixture little at a time and stir vigorously to avoid formation of lumps.

4. Stir until smooth and compact in texture.

5. Serve hot with soybean vegetable soup.

Note: 1 peak milk tinsful yam/cassava flour = 80 g
1 peak milk tinsful soy flour = 50 g

Pounded Yam with Soybean Paste

1. Peel the yam and cut into pieces

2. Put it into water and allow to boil

3. Tie the soybean paste into a plastic bag (nylon) and put it on the top of the pot of yam to boil

4. When the yam is soft and ready, start to pound it

5. When the yam is pounded and BEFORE adding water to it, add the cooked soybean paste and pound it well together with the yam

6. Add a little water to the yam and soybean and pound well until ready to be served

Soybean **Gbegiri** Soup

1 milk tin of soybeans
6 large peppers (rodo)
1 medium sized onion
2 medium sized fresh tomatoes
1 teaspoon ground dried shrimps
Add salt to taste
1 maggi cube or teaspoon of locust bean (or Soy "Tru")
1 soup-spoon palm oil

1. Soak soybeans in cold water for 8-10 hours and remove testas properly

2. Boil, adding half of the onions until soft

3. Blend or use the back of the spoon to press into paste and pass through a sieve. (You don't need to pass it through the sieve if a blender has been used)

4. Put a saucepan (pot) with some oil on stove or cooker and add ground pepper, onion and tomato. Cook until the ingredients are half cooked

5. Pour the blended soybean, and allow to cook for 60 mins

6. Add ground shrimps (or dried fish), maggi and salt to taste

7. Serve with amala, eba or drink

Soybean Vegetable Soup

1kg soybean
1 liter oil (palm oil, groundnut oil, or soybean oil)
1 kg fruit tomatoes
500 g pepper
2 kg picked vegetables (any type)
Salt to taste (8 teaspoons)
1 liter water
Cooking time (50 minutes)

1. Wash and blanch soybean for 30 minutes

2. Remove skins (as for beans) and grind with water into a paste

3. Grind the ingredients, i.e tomatoes, pepper

4. Add ingredients to warm oil and cook for 10 minutes

5. Add water and cook for 5-8 minutes

6. Add soy paste a little at a time and cook for 30 minutes

7. Prepare vegetable according to type: chop boil and add to the soup

8. Allow to simmer for 2 minutes

9. Serve warm with amala, eba, rice or fufu

Note: Other ingredients such as onions, condidments, amd meat may be added as desired.

Fermented soybean - Soy "Iru" (similar to fermented locust bean)

2 peak milk tins of soybean, 1 liter of water, leaves, basket or calabash.

1. Clean soybean

2. Bring water to boil

3. Pour soybeans into twice their volume of boiling water and leave to boil for at least 1 hour

4. Remove pot from cooker or stove, allow to cool and remove testas and wash thoroughly

5. Put the soybean back into pot and cover with twice the volume of water. Bring to boil and cook slowly for about 2 hours or until the beans taste like boiled groundnuts

6. Drain off excess water

7. Line a clean calabash or basket with leaves (plantain or preferably pawpaw leaves)

8. Empty the cooked, hot soybean in the basket or calabash, spread uniformly and cover with leaves. Cover the basket or calabash with a tray or another calabash and wrap with cloth or jute bag

9. Keep the container in a warm place, preferably near a heat for 2-3 days to ferment

10. Remove the fermented soybean and add salt

11. Use as seasoning for vegetable, okra or any type of soup or stew

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