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A review on standardization of a process-based cassava and milk

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Abstract:

Cassava (Manihot esculenta Cralztz) is considered one of the most important root crops, mainly consumed by developing countries and cultivated in the tropics and subtropics where more than half of the population suffers from malnutrition. Cassava leaves are a source of richness in vitamins, proteins and minerals. As for its roots and leaves, they are deficient in amino acids namely methionine and cysteine, so there is a poor distribution of certain nutrients is the cassava plant. Cassava is also packed with many antinutrients which can be beneficial or toxic to our body depending on how much we consume. Cassava (Manihot esculenta Crantz) is one of the most valuable food crops capable of ensuring food security. These roots can be converted by processing to get enough food. The application of the machines for the processing of cassava roots has greatly contributed to add value to it, which has made it possible to make profit and provide food. The objectives of our study are to standardize a cassava and milk-based product in order to improve certain nutrient contents of cassava. All of this was aimed at reducing malnutrition caused by cassava consumption and reducing hunger.

Keywords: Cassava, antinutrients, amino acid, milk, hunger.

1.INTRODUCTION

Cassava (Manihot esculanta Crantz) after rice and corn, is today one of the main sources of energy for millions of people living in the tropics. From the euphorbiaceae family and native to Brazil, cassava then spread to parts of the world, namely Africa, India and Asia. (Somendrika et al., 2016). Cassava is a food crop that has established itself forever in Africa (Blench. 2014). The use of cassava as food in American businesses dates back to the 18th century BC (Blench. 2014). Several processes, including fermentation, are used during post-harvest storage of cassava. Fermentation, however, remains the process of excellence for the evaluation of cassava by-products. It is a good way to improve the storage of foods, their nutritional values, their hygienic and sanitary qualities, their energy densities and their organoleptic characteristics (Filbert et al., 2016). Cassava roots can be made into enough food for everyone, which can help end hunger and lift millions of people out of poverty. The use of machines in the cassava processing process has helped improve the value of cassava and enabled farmers to have better profitability. in addition, it has helped reduce unemployment and change the cost of living for farmers. The processing of cassava roots usually follows the following process: first the cassava is peeled and then finely chopped or grated and dried in the sun. Processing takes place in stages from harvest to arrival on the market, including the different treatments that the product receives (Igbeka. 2013). Cassava tuber is also used as a basic raw material in some industries, namely textile, bakery, food and pharmaceutical industries. Cassava cultivation is a very resistant crop which, even under the most marginal conditions, can be cultivated (Lyer et al., 2010). Despite its low content of protein and cytogenic glycosides, cassava is mainly processed for human consumption or used as animal feed. it is a culture which always succeeds and its finished products are of better quality because of its transformation (Falade et al., 2010). Annual world cassava production exceeds 260,000 million tonnes, of which Africa accounts for 54% of this production, followed by Asia and South America (FAO, 2013). In developing countries, cassava root s a real source of food and energy. Normal post-food processing and preservation techniques help to avoid food insecurity (Uchechukwa-Agua et al., 2015). In developing countries, cassava root is a real source of food and energy. Normal post-food processing and preservation techniques help avoid food insecurity (Uchechukwa-Agua et al., 2015). Most of the articles have been written on cassava showing certain aspects of its products. This review aims to show the nutritional and anti-nutritional value of cassava, the processing techniques applicable to it, cassava products and other cassava-based uses and the future opportunities that cassava may bring us.

2. CONSUMPTION OF CASSAVA

Cassava roots are the fourth largest source of carbohydrates after rice, corn and sugarcane (Blagbrough et al. 2010). Cassava crops are higher n calories per hectare than rice and sorghum. n addition, products made from cassava are less expensive compared to those made from rice, corn, sorghum and millet, which means that cassava occupies a very important place even in the weakest social classes. (Zhu et al. 2015). Another important characteristic of cassava to consider s the presence of hydrocyanic acid (HCN), which represents a toxic potential n the roots. Because of this cyanogenic glycoside toxin naturally occurring n cassava roots, t s therefore necessary to cook before storage or consumption. According to the OECD (2016), depending on its glycoside content, cassava s classified as sweet, Manihot esculenta, this content is less than 100mg or classified as bitter, Manihot utilissima Pohl, when this content is greater than 100mg per kilogram of fresh weight. Authors long before that classified cassava into three groups based on the same glycoside content. According to them, sweet manihot varieties have a content of less than 5mg/kg-1, intermediate varieties have a fixed content which s 5mg/kg-1 and bitter varieties have a content above 100mg/kg-1 (Nambisan. 2011; Guédé 2013). The glycoside content of the bitter variety is much higher than that of the sweet variety but these two types of cassava are currently eaten. However, HCN can be removed by certain techniques such as cooking or fermentation n water for a period of time before proceeding to treatment (Avoaja et al. 2013). Cooking sweet cassava reduces or eliminates the cyanide content. However, cassava that s bitter due to its concentrated toxin content needs to be properly prepared and cooked before being eaten. To do this, you have to soak the grated cassava roots in water for an extended period of time, which helps reduce toxins. Cooking has a great advantage because t further eliminates toxins present in the roots before consumption.

2.1 CASSAVA NUTRITIONAL AND ANTINUTRITIVE VALUE

2.1.1 Nutritive value of cassava

Cassava roots contain high energy and high levels of certain vitamins, minerals and dietary fiber, and do not contain any trypsin inhibitor, but create a problem due to the presence of cyanide which is removed by post-harvest treatments. and cooking. The edible green leaves of cassava are a good source of protein, vitamins and minerals and are often used to supplement the rural diet. The nutritional value of roots is important because they are the main part of the plant consumed in developing countries. Cassava roots and leaves, which constitute 50% and 6% of the mature plant, respectively, are the nutritive parts of the plant. Edible starchy flesh comprises about 80% to 90% of the total root weight, with water being the main component. The moisture content of cassava ranges from 60.3% to 87.1%, the moisture content of cassava flour ranges from 9.2% to 12.3% and from 11% to 16.5% (Zvinavashe. , 2011). Water is an important parameter in the storage of cassava flour; very high levels above 12% allow microbial growth and therefore low levels are favorable and give a relatively longer shelf life. Cassava contains around 1-2% protein, making it a predominantly starchy food. The protein content is low from 1% to 3% on the dry matter and between 0.4 and 1.5 g / 100 g fresh weight. In contrast, maize and sorghum contain around 10g protein / 100g fresh weight (Adugna., 2019). As a human food, it has been criticized for its low protein content and poor quality, but the plant produces more carbohydrate weight per unit area than other staple food crops under comparable agro-climatic conditions for its calorific value of 250 × 103 cal / ha. / day against 176 × 103 for rice, 110 × 103 for wheat, 200 × 103 for maize and 114 × 103 for sorghum. The root is a high carbohydrate physiological energy store, which ranges from 32% to 35% on an FW basis, and 80% to 90% on a dry matter basis. Raw cassava root contains more carbohydrates than potatoes and less carbohydrates than wheat, rice, yellow corn and sorghum on a basis of 100g. The lipid content of cassava roots varies from 0.1% to 0.3% by fresh weight, it varies from 0.1% to 0.4% and 0.65% by dry weight. This content is relatively low compared to maize and sorghum, but higher than that of potato and comparable to rice. Lipids are non-polar (45%) or contain different types of glycolipids (52%). Glycolipids are primarily galactose diglyceride. The predominant fatty acids are palmitate and oleate (Padonou et al., 2010). The nutritional composition of cassava depends on specific tissues and on several factors such as geographic location, variety, age of the plant and environmental conditions. The roots nutritional value is important because, they are the main part of the plant consumed in developing countries.

2.1.2 Cassava peel meal nutritive value

Cassava peel meal s one of the major by-product of cassava during cassava processing. This cassava peel meal constitutes 10-13% of the weight of the tuber (Oladunjoye et al., 2010) s easy to find n all countries where cassava s grown and processed and used for human consumption. n areas where cassava s popular and where cassava is the major source of energy, the abundance of cassava peel poses serious problems because it is difficult to evacuate. The composition of the cassava peel meal depends on many parameters, namely: the type of variety, the stage of maturity and the proportions of peels and tubers n the mixed. Cassava peel meal is composed of 3.1 to 5% crude protein (Babatunde, 2013) and 9 to 12% (Babatunde, 2013; Oladunjoye et al., 2010) of crude fiber. These fiber, energy and protein contents are significantly higher than those of corn. Fresh cassava peels are easily degradable due to their high humidity and need to be processed on site. However, large amounts of sweet cassava, which are low n HCN, are being planted all over the world for human consumption.

2.1.3 Cassava Pulp: Nutritive value

Cassava pulp s considered to be a solid by-product allowing the production of starch via the cassava root. During starch production, the pulp s responsible for the production of 10 to 15% of the root (Khempaka et al., 2014). This pulp s easily found n countries which produce starch. Cassava pulp contains a high amount of starch ranging from 54 to 70% (Khempaka et al., 2014). Apart from starch, the pulp contains 1.7 to 2.8% ash, 1.6 to 2.0% crude protein, 13.6 to 27 crude fiber and 8 to 0.1% extract ether (Khempaka et al., 2014). The Cassava pulp s essentially insoluble n nature.

2.1.4 Nutritional Value of Cassava Leave

Although nutritionally promising, cassava leaves contain endogenous anti-nutritional factors, which may limit their nutritional value. The presence of tannins in cassava leaves is believed to be a contributing factor to the low net protein utilization. Tannins have the ability to form insoluble complexes with proteins, thus interfering with the digestion process by inactivating enzymes contain high levels of cyanogenic glycosides than the amount present in the roots which is a potent inhibitor of reactions catalyzed by enzymes and traditional processing methods such as hammering and grinding provide cyanide reduction.

2.2 Macronutrients

Cassava root is an energy-rich food and produces around 250,000 calories / hectare / d, which puts it ahead of maize, rice, sorghum and wheat. The roots contain small amounts of sucrose, glucose, fructose and maltose. It has two varieties, bitter and sweet. The sweet variety contains up to 17% sucrose and small amounts of dextrose and fructose. The variety and age of cassava determines its fiber content in the root. Usually, its content does not exceed 1.5% in fresh root and 4% in root flour. Essential amino acids, such as methionine, cysteine, and tryptophan, are very low in the root and arginine, glutamic acid, and aspartic acid are abundant (Harris et al., 2011). About 50% of the crude protein in the roots is whole protein and the remaining 50% is free amino acids (mainly glutamic and aspartic acids) and non-protein components such as nitrite, nitrate and cyanogen compounds.

2.3 Minerals and Vitamins

Cassava roots have high levels of calcium, iron, potassium, magnesium, copper, zinc and manganese comparable to those of many legumes, except soybeans. The calcium content is relatively high compared to that of other staple crops and is between 15 and 35

mg / 100 g edible portion. Vitamin C (ascorbic acid). the content is also high and between 15 to 45 mg / 100 g of edible portions. Cassava roots contain low amounts of vitamin B i.e. thiamin, riboflavin, and niacin. The contents of minerals and vitamins are lower in cassava roots than in sorghum and maize. Protein, fat, fiber and minerals are found in greater amounts in the skin of the root than in the peeled root. But the carbohydrates, determined by the nitrogen-free extract, are more concentrated in the peeled root (central cylinder or pulp) (Mulualem., 2012). Table 2 shows the mineral concentration and content level of cassava roots. The highest concentration of iron, calcium and magnesium is found in cassava. Zinc is highest in Irish potato and manganese in cocoyam. Cassava and cocoyam are good sources of minerals, and African yam and Irish potato are the second. With the exception of magnesium, water yam contains the lowest concentration of minerals. Cassava leaves contain rich minerals such as iron, zinc, manganese, magnesium, and calcium. Some variation in the amino acid content of the leaves can be attributed to differences in leaf maturity, sampling, analytical methods used, and ecological conditions. Cassava leaves are richer in thiamine (vitamin B1, 0.25 mg / 100 g) than legumes and leafy legumes, with the exception of soybeans (0.435 mg / 100 g).

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Table1: Nutritional value of cassava

Proximate	Cassava	References
Moisture (%)	65.58±0.022	(Abiola et al., 2020)
Protein (%)	4.01±0.018	
Fat (%)	6.54±0.010	
Fiber (%)	5.31±0.008	
Ash (%)	243±0.005	
Carbohydrate (%)	22.07±0.011	
Manganese (ppm)	0.34	(Adugno et al., 2019)
Iron (ppm)	18.80	
Zinc (ppm)	0.00	
Calcuim (ppm)	1.11	
Magnesuim (ppm) (mg/g)	12.54	
Vitamin C (ppm)	90.2	(Carolyne et al., 2016)
Beta Carotene (ppm)	88	

3 Anti-nutritional aspect of cassava

According to the analysis of the nutritional value of cassava, its roots are good in carbohydrates and its leaves are good in minerals, vitamins and sources of fiber for humans. Although it is good in nutrients, it contains anti-nutrients which are toxic and interfere with the digestibility and absorption of certain nutrients. The most toxic substance limiting the consumption of cassava roots and leaves is cyanide. The level of cyanide contained in cassava leaves varies from 53 to 0.01300 kg / kg of dry matter. Consumption of 500 to 1000 mg of cyanide is acute, toxic and fatal for adults. Reduced cyanide consumption is not fatal, but long-term consumption can cause serious health problems like tropical neuropathy. People who ingest cyanide and large amounts of nitrates and nitrites are at risk of developing stomach cancer. People who eat cassava have a high amount of thiocyanate in their stomachs due to the body's detoxification of cyanide, which can catalyze the formation of carcinogenic nitrosamines. Phytate is another anti-nutrient found in cassava roots (624 mg / 100 g) that binds cations like Mg, Fe, Ca, Zn, Mo, interfering with the absorption of minerals, a use that can affect its needs and bind proteins preventing their enzymatic digestion (Bayata, 2019). Oxalates are anti-nutrients affecting the bioavailability of Ca and Mg and form complexes with proteins, which inhibit peptic digestion. The oxalate ranges from 135 to 288 mg / 100 g of dry matter for cassava leaf flour. (Ngiki et al., 2014).

3.1. Cassava toxicity

The most toxic substances found in the roots and leaves of cassava are cyanogenic glycosides. The level depends on the genotype and environmental factors, in cases of drought. Acute poisoning after consumption of cassava is rare (Burno et al., 2012). Chronic poisoning follows long-term consumption of cassava with a high content of cyanogenic glycosides. The release of HCN during cyanogen hydrolysis has been reported to be highly toxic to all aerobic organisms, including humans, as HCN binds to cytochrome oxidase, which is the last step in mitochondrial respiration, thereby preventing oxygen uptake (Burns, Gleadow, Cliff, Zacarias & Cavagnaro, 2010). Therefore, consuming cassava without proper processing can lead to serious illness or death of consumers.

3.2. Diseases

High consumption of cyanogenic foods and insufficient amount of protein from improperly processed cassava products can cause irreversible spastic paraparesis (weakness of the legs) due to upper motor neuron injury, resulting in konzo (Burns et al., 2010) ; Nzwaloet et al., 2011). Sulfur amino acids (methionine and cysteine) are needed to detoxify cyanide in humans. In cassava diets, cassava roots are a poor source of protein and cassava leaves are eaten as a source of protein which is deficient in sulfur amino acids with high cyanogenic glycoside content, hence cyanide poisoning are most common among consumers (Burns et al., 2010). Acute poisoning and death from cassava consumption are rare. Chronic poisoning follows long-term consumption of cassava with a high content of cyanogenic glycosides. Chronic cassava poisoning manifests itself as tropical neuropathy, goiter and cretinism (Cliff et al., 2011). In Mozambique, konzo is the most frequently reported cassava poisoning. Patients with Kouzo have been found to have high levels of thiocyanete in their urine. Thiocyanete remains in the body as a result of cyanide detoxification. It is stored in the stomach, and patients with konzo are also at risk of developing stomach cancer.

3.3 improving the nutritive value of cassava products through physical process

Drying s the most widely used practice for reducing the cyanide content of cassava. However, sun drying s the best method for removing this cyanide. As for oven drying it is also good but unlike drying n the sun, cyanide s n contact with linamarase for a long period of time (Ngiki et al., 2014). Boiling cassava removes certain cyanide content. Thus boiling the cassava for 15 minutes eliminates 90% of free cyanide during ebullition but also remove 55% of cyanide after 25 min of boiling. Okoli et al. (2012) by their observation affirmed that the physicochemical and HCN compositions of processed cassava vary according to the different types of methods used.

3.3.1 Rale (Roasted cassava roots)

Rale is the traditional name for toasted fermented cassava roots and is ready to eat.

It can be eaten as a snack with tea or as a staple food with cooked vegetables or meat. The vegetable or meat is often curry. Although rale accounts for only about 1% of excessive consumption of cassava products, it is also 20% in the southern region (Donavan et al., 2011). At the end of the working day there is a celebration or reward (Donavan et al., 2011; Hagglades et al., 2012). Mahewu is a fermented non-alcoholic drink made from sweet and bitter cassava. The manufacture of cassava manehu has not been documented. It has been observed that in Mozambique the root or soil of fresh cassava was cooked from a pulp that was cooled and then fermented. Traditionally, bread, sorghum, millet and malt or wheat are fermented in a stater culture. The fermentation takes 24 to 36 hours at room temperature. Generally, it has been found that sugar is added to sweeten the mahewu before consumption.

3.3.2 Cooked Cassava

About 10% of the total consumption consists of cooked cassava, mainly sweet varieties (Donavan et al., 2011). Due to the high temperature reached during cooking, the enzyme linamarase can inactivate cyanide in bitter cassava roots. Cassava leaves are generally cooked into a dark green vegetable that looks like spinach and can be flavored with various spices.

Table2: Antinutritional aspect of cassava (discuss about each antinutritional factors)

Approximate	Cassava	References
Tannins (mg/100g)	1	(Ojo et al., 2013)
Phenol (mg/100g)	0.3	
Saponin (mg/100g)	1.2	
Glycoside (mg/100g)	0.04	
Trypsin (mg/100)	0.03	(Oluwaseum et al., 2015)
Phytate (mg/100g)	0.02	
Oxalic acid (mg/100g)	0.09	

4. PROCESSING TECHNIQUE OF CASSAVA

4.1 Peeling

Peeling cassava roots involves removing the dark, rough skin from the cassava roots. it can be done manually using the knives with the help of Women and children. But this manual operation s however a slow and tedious method due to the irregular shapes and sizes of the cassava roots. The manual peeling operation s also used n cassava processing facilities. However, various models of peelers exists (Oluwole. 2013). The peel s refreshed by an abrasive or cutting mechanism which have an efficiency ranging from 75 to 97%. The difference between these two methods s that the abrasive peeling method requires a lot of water for washing than the cutting methods.

4.2 Size Reduction

Fresh cassava roots undergo size reduction operations, namely chipping, chopping, grating, drying, fermenting and extracting starch. These size reduction methods not only dehydrate cassava roots but also improve the biochemical detoxification of cassava roots by releasing natural enzymes that catalyze the conversion of toxic cyanogenic glycosides like linamarin and lotaustralin into less material toxic like glucose and cyanohydrin in the presence of water. Doporto et al. (2012) claim that the cassava root size reduction method results in a color difference in unfermented cassava flour. This color difference n the grated cassava root s less light than that of sliced cassava root.

4.2 Fermentation

The fermented foods from cassava are lafun, fufu, agbelima, chickwanghe, attiek, kivunde and gari in Africa, tape in Asia, and cheese bread and coated peanut in Latin America. There are 2 types of fermentations: Submerged fermentation (SmF) and Cassava fermented food products through SmF. SmF is a process in which the growth and anaerobic or partially anaerobic decomposition of the carbohydrates by action of microorganisms in a liquid medium with ample availability of free water takes place. Ezekiel et al. (2010) studied the performance of Trichoderma viride (ATCC 36316) in protein enriched cassava peels by SmF and also investigated the effect of enzyme pre-treatment prior to the fermentation process on the enriched product. The fermentation (for three to four days) showed eight fold (4.2 to 37.6 per cent) increase in crude protein content of cassava peels.The cyanogenic glycosides content in tubers and freshly harvested leaves of cassava vary between 137 and 1515 ppm. After the traditional fermentation of tubers and leaves of cassava, the cyanogenic glycosides contents are reduced significantly by 70 to 75 per cent (Dhellot et al., 2015). Lambri et al. (2013) investigated a drying procedure with and without the fermentation process for elimination of cyanogens in cassava tubers (pressed pulp). The process of fermentation was carried out in the presence of Saccharomyces cerevisiae; detoxification was found effective. In drying conditions, a temperature of 60ºC, even for a shorter duration (say eight hours), lowered the cyanide content (> 90 per cent).

4.3 Dewatering or Pressing

Dry cleaning involves fermented cassava puree with the aim of reducing the humidity level by less than 30%. The press can be mechanical screw or hydraulic power. Their capacities vary depending on the salary scale. Kolawole et al. (2012) reported an integrated machine capable of combine the wet cassava puree n order to transport t, dehydrate t, pulverize t and sift it into one a machine unit. This machine reduces the moisture content of the 68% to about 47% pressed puree.

5. Drying or Dehydration

Dehydration or drying s often used at the end of processing of fresh cassava. The moisture content of cassava puree s reduced 10-14% on a wet weight basis. Drying cassava is a critical operation affecting the quality of the final product. But it depends on certain drying conditions such as drying temperature, drying time, drying method and many other parameters. However, longer temperatures and drying times result in increased granular modification of the starch and a change in functional properties based on starch.

5.1 Dry Milling

Milling is an intensive operation aimed at producing flours with particle size less than 400 μm. And is carried out mechanically using milling machines. As for milling machines, the most used types of milling machines are wear and hammer mills (Nwaigwe et al., 2012). Adesina et al., (2013) studied the effect of milling. Even f these authors did not give the moisture content and size of ground cassava chips, but they claimed that the milling impacted flour yield and mill recovery. However, milling of cassava chips at 11.5% results in a lower flour yield for rolls than that obtained at 15.9% humidity.

Table3: Processing effect on cassava

	Ca	Cu	K	Mg	Mn	Zn	Moisture	Ash	Protein	Lipid	Carbohydrate	References
Raw Cassava (mg 100 g-1)	502	40.1	781	150	20.3	5.0	29.9	2.03	10.2	1.64	56.3	(Taco, 2011)
Cooked Cassava (mg 100 g-1)	488	37.6	181	133	18.8	4.6	12.2	0.66	4.66	1.88	80.6	
Fermented Cassava (mg 100 g-1)	458	29.1	57.8	116	15.7	4.0	11.1	0.54	4.64	1.07	82.6	

6. VALUE ADDED CASSAVA BASED PRODUCTS

6.1 Krupuk

Krupuk or keropok is another product that originated in Southeast Asia and s made from starch and protein. The steps involved in this treatment process are the mixing of the ingredients, kneading, baking, chilling, slicing and drying (Taewee, 2011).

6.2 Cassava Chips and Pellets

Cassava chips and pellets are a widespread practice and very effective which make it possible to satisfy the market demand (Adamade et al., 2013). However, chips and pellets have a very low moisture content which allows to avoid the loss of quality and quantity of cassava after harvest (Adamade et al., 2013). Pellets and chips are practically the same. But the only difference is that the pellets have a lower moisture content about 9%. That is the main reason for a longer storage life of granule than the chips (Falade et al., 2010).

6.3 Lafun and Agbelima

Lafun is a fermented cassava flour product originating n the southwest Nigeria; t s prepared n the form of porridge and eaten with soup (Falade et al., 2010). The process of making lafu s done as follows: first we have the manual shelling of cassava, the peeling aimed at making the fermentation more efficient and detoxifying the root. The cassava tuber s then soaked n a large amount of water for 2 to 3 days to ferment t. Then the mash s wiped and dried a maximum of 3 days before packaging for consumption or marketing (Falade et al., 2010).

Agbelima, it is a traditional staple food of some African countries namely Ghana, Togo and Benin. It consists of grating and fermenting the cassava tuber with inoincula, but the process used degrades the taste and texture of the cassava tuber.

6.4 Gari

Gari is the most commercialized and useful product of all cassava products. It is a very high calorie food with a slightly acidic taste (falade et al., 2010). It is processed from fresh cassava roots according to the following process: Firstly the pulp s grated and put into bags made from polypropylene. These bags are then placed under stones or between piles of wood from 3 to 4 days to dry out the pulp n order to make fermentation possible (Falade et al., 2010).

6.5 Peujeum

Peujeum is a delicacy that comes from Indonesia. The transformation process is done as follows: First the cassava roots are peeled and steamed so they can be softened. After softening the roots are cooled and crushed. Then the cooled puree is inoculated in order to initiate the fermentation. The inoculated puree is then put in banana leaves for two days for total fermentation (Tamang et al., 2010).

6.6 Tapioca

Tapioca is a common breakfast n many African countries. The preparation method of tapioca porridge s as follows: firstly the grits are soaked for 30 minutes in order to soften them, then heat over low heat until the desired consistency s obtained. This resulting boil can be tasted with sugar and milk to taste (John et al., 2012)

6.7 Placali

Placali is the second cassava-based product mainly consumed n Côte d'Ivoire. Placali is produced just like lafun which is made from fermented cassava. The preparation mode is as follows: the flour s boiled n water, stirring with a wooden ladle, until cooked, which becomes a thick white suspension. This suspension s kneaded and shaped (Koko et al., 2012; Soro-Yao et al., 2013).

Table4: cassava value added products

Common name	Description	Location	Use	References
Chips and pellets	Dried regular slices of root	Nigeria	Industrial purposes	Adamade et al., (2013)
Wafer	Fried cassava starch n oil	India	Consumer food	Falade et al., (2010)
Unfermented fufu	Boiled and pounded dough	West Africa	Consumer food	
Ampesi Grated	Mashed boiled root	Brazil	Consumer food	
Cassava puddings	Grated cassava root and mixed with banana	Indonesia	Consumer food	
Banu or Uala	Distilled liquor from crushed cassava root	Uganda	Consumer drink	
Lafun	Cassava porridge	Nigeria	Consumer food	
Fermented products Cassava bear	Flour mixed with water and yeast and made to ferment	Uganda	Consumer drink	
Gatot	Dried cassava cut nto pieces	Cameroun	Consumer food	
Gari	Pregelatinized granulated mash	West Africa	Consumer food	Fadeyibi (2012)

8. OTHER USED OF CASSAVA

8.1 Lactic Acid and Yeast

(Wang et al., 2010) reported production of Lactic acid from cassava starch. Cassava starch s a favorable medium of producing of Lactic acid. That lactic acid s used n food, n cosmetic, pharmaceutical, plastics and textiles industries (Wang et al., 2010).

8.2 Bioethanol

The production of bioethanol can be done according to two processes. The first process s a transformation process consists of using a co-culture of Bacillus subtilis and acetone to which s added Clostridium butylicum in order to improve the production of Acetone, Butane and industrialized ethanol (Tran et al., 2010). The second method of manufacturing bioethanol s done from cassava chips. This method involves boiling and enzymatic liquefaction of the cassava root (Nguyen et al., 2010). Bioethanol is a very valuable product in the pharmaceutical, beverage and chemical industries. It is also used as additive for fuel, gasoline enhancer and recently as an alternative fuel source (Ogbonna et al., 2010). However, due to its high starch content and ease of extraction, cassava occupies a very important place n bioethanol production (Shanavas et al., 2011).

8.3 Adhesives

Adhesives generally used by the paper, textile and packaging industries are made from corn starch. However, during the last two decades, we have been more interested n the use of alternative sources of starch such like HQCF. Cassava-based adhesives being smooth, clear with fine textures without spots, more viscous, stable and neutral make their use more advantageous (Gunorubon, 2012).

8.4 Glucose syrup

Glucose syrup s a concentrated aqueous solution of glucose maltose and other nutritious saccharin made from edible starch. However, glucose s found naturally in sweet fruits and is used extensively quantities n bakery, pharmaceutical and brewing products.

9. Conclusion

Cassava due to its various components must be incorporated into functional food products. However it is necessary to determine to analyze the antioxidants present n cassava and to determine their various effects on human and animal health. Cassava, however, contains very interesting components including antioxidants like cyanide. As cassava s consumed by different age groups, more scientific attention is needed to justify and modify its nutraceutical status in geriatric and pediatric diets. The research of this fact makes it possible to determine new functional compounds n cassava in order to extract these components n fractions and incorporate them n food products. Thus the upgrading of cassava transformation processes and its derivatives must be worked on in order to ensure their proper use and thus contribute to the growing nutritional demand.

10. References

1. Adamade, C. and Azogu, . 2013. Comparison of proximate composition, physio–mechanical properties and economics of production of cassava pellets derived from cassava chips and mash. J Agricul. Engg Technol., 21: 18–26.
2. Adesina, B.S. and Bolaji, O.T (2013) Effect of milling machines and sieve sizes on cooked cassava flour quality. Nigerian Food Journal, 31(1): 115–119.
3. Avoaja D, Eze V, Owunna N (2013) Microbiological and physicochemical characteristics of soil receiving palm oil mill effluent n Umuahia, Abia State, Nigeria. J Nat Sci Res 3:163–170. Doi: 10.12691/jaem-3-1-4
4. Babatunde, B.B., 2013. Effect of feeding cassava wastes on the performance and meat quality of broiler chickens. Malay. J. Anim. Sci., 16: 63-73
5. Blagbrough, .S., Bayoumi S.A.L., Rowan M.G., Beeching J.R. 2010. Cassava: An appraisal of ts phytochemistry and ts biotechnological prospects. Phytochemistry 71, 1940–1951.
6. Blench, R. 2014. The .diffusion of cassava n Africa: lexical and other evidence. 45.
7. Donavan C, Hagglade S, Salrgua AV, Cuambe C, Mudema J, Tomo A, (2011), cassava commercialization in Mozambique. MSU International development working. 120:1-59

8. Doporto, M.C., Dini,C., Mugridge, A.,Vina, S.Z. and Garcia, M.A. (2012) Physicochemical, thermal and sorption properties of nutritionally differentiated flours and starches. *Journal of Food Engineering*, **113**: 569–576.
9. Falade, K. and Akingbala, J. 2010. Utilization of Cassava for Food. Food Reviews nternational, 27: 51-83.
10. Falade, K. O., & Akingbala, J. O. (2010). Utilization of cassava for food. Food Reviews nternational, 27, 51–83.
11. Fadeyibi, A. 2012. Storage methods and some uses of cassava n Nigeria. Continental J Agricul Sci., 5: 12–18.
12. FAO, (2013). Food and Agricultural Division of the United Nations, Statistical Division. FAO http://faostat3.fao.org/faostat-gateway/ go/to/download/Q/QC/E.
13. Flibert, G., Donatien, K., Hagrétou, S.L., *et al*. 2016. Hygienic Quality and Nutritional Value of Attiéké from Local and mported Cassava Dough Produced with Different Traditional Starters n Burkina Faso. *Food and Nutrition Sci.*, 7: 555.
14. Guédé SS (2013) Assessment of Cyanide Content n Cassava (Manihot esculenta Crantz) Varieties and Derived Products from Senegal. nt J Nutr Food Sci 2:225. doi:10.11648/j.ijnfs.20130205.12
15. Gunorubon, A.J. (2012) Production of cassava starch-based adhesive. *Research Journal n Engineering and Applied Sciences*, **1(4)**: 219–214.
16. Igbeka J. C. (2013). Agricultural Processing and Storage Engineering, University of badan Press. SBN: 978-978-8456-07-0
17. Khempaka, S., R. Thongkratok, S. Okrathok and W. Molee, 2014. An evaluation of cassava pulp feedstuff fermented with A. oryzae, on growth performance, nutrient digestibility and carcass quality of broilers. J. Poult. Sci., 51: 71-79.
18. Koko CA, Konan A, Tetchi F, Assidjo E, Amani G, Quality of fermented cassava flour processed nto placali, nternational Journal of Biological and Chemical Science, vol. 6, no. 1, pp. 415-420, 2012.
19. Kolawole, P.O., Agbetoye, L., Ogunlowo, A.S., Sanni, L. and Abass A. (2012) nnovative development of cassava processing machine as solution to crisis against agricultural systems. *Tropentag, Göttingen, Germany, 19–21* September.
20. Iyer, S., Mattinson, D.S. & Fellman, J.K. (2010). Study of the early events leading to cassava root postharvest deterioration. *Tropical Plant Biology*, 3, 151-165.
21. Nambisan B (2011) Strategies for elimination of cyanogens from cassava for reducing toxicity and mproving food safety. Food Chem Toxicol 49:690–693. doi:10.1016/j.fct.2010.10.035.
22. Ngiki YU, gwebuike JU, Moruppa SM. Utilization of cassava products for poultry feeding: a review. nt J Sci Tech 2014; 2(6):48e59.
23. Nguyen, T.L.T., Gheewala, S.H. and Sagisaka,M. (2010) Greenhouse gas savings potential of sugar cane bio-energy systems. *Journal of Clean Products*, 18: 412–418.
24. Nguyen, T.H.L., 2012. Evaluation of local protein sources for growing pigs n Central Vietnam. PhD thesis, Wageningen University, Wageningen, the Netherlands. 155 pages, SBN 978-94-6173 283-5.

25. Nwaigwe, K.N., Nzediegwu, C. and Ugwuoke, P.E. (2012) Design, construction and performance evaluation of a modified cassava milling machine. Research Journal of Applied Sciences, Engineering and Technology, 4(18): 3354–3362.
26. Obueh HO, Odesiri-Eruteyan E (2016) A Study on the Effects of Cassava Processing Wastes on the Soil Environment of a Local Cassava Mill. J Pollut Eff Cont 4: 177. doi: 10.4176/2375 4397.1000177.
27. OECD, 2016. Chapter three of the B Safety assessment of transgenic organisms n the environment: OECD consensus documents^, volume 6 © OECD 2016
28. Ogbonna, C.N. and Okoli, E.C. (2010) Conversion of cassava flour to fuel ethanol by sequential solid state and submerged cultures. *Process Biochemistry*, **45(7)**: 1196–1200.
29. Okoli C, Okparaocha CO, Chinweze CE, Udedibie ABI. Physicochemical and hydrogen cyanide content of three processed cassava products used for feeding poultry n Nigeria. Asian J Anim Vet Adv 2012; 7:334e40.
30. Oladunjoye, .O., O. Ojebiyi and O.A. Amao, 2010. Effect of feeding processed cassava (manihot esculenta crantz) peel meal based diet on the performance characteristics, egg quality and blood profile of laying chicken. Agric. Tropic. Subtropic, 43: 119-126.
31. Oluwole, O.O. and Adio, M.A. (2013) Design and construction of a batch cassava peeling machine. Journal of Mechanical Engineering and Automation, 3(1): 16–21.
32. Salim, H., & Nuryanti, S. (2011). Perspektif ekonomi global kedelai dan ubi kayu mendukung swasembada. Paper presented at National Seminar on Legume and Tuber Crops n Malang, November 15. Simatupang, P. (2012). Meningkatkan daya saing ubi kayu, kedelai, dan kacang tanah untuk meningkatkan pendapatan petani, ketahanan pangan, nilai tambah dan penerimaan devisa. Prosiding Seminar Hasil Penelitian Tanaman Aneka Kacang dan Umbi.
33. Shanavas, S., Padmaja, G., Moorthy, S.N., Sajeev, M.S. and Sheriff, J.T. (2011) Process optimization for bioethanol production from cassava starch using novel eco-friendly enzymes. *Biomass and Bioenergy*, 35(2): 901–909.
34. Somendrika, M. A. D., Wickramasinghe, ., Wansapala, M. A. J., Peiris S. 2016. Analyzing Proximate Composition of Macro Nutrients of Sri Lankan Cassava Variety “Kirikawadi”. Pakistan Journal of Nutrition, vol. 15, no. 3, p. 105-108.
35. Soro-Yao, A.A., Brou, K., Koffi-Nevry, R., et al. 2013. Microbiology of vorian fermented products: A review. Asian J.
36. Taco. Universidade Estadual de Campinas 2011. Tabela brasileira de composição de alimentos. 4. ed., Campinas: NEPA UNICAMP, 2011. pp. 161.
37. Taewee, T.K. (2011) Cracker “Keropok”: A review on factors nfluencing expansion.
38. Tran, H.T.M., Cheirsilp, B., Hodgson, B. and Umsakul, K. (2010) Potential use of *Bacillus subtilis* n a co-culture with *Clostridium butylicum* for acetone–butanol–ethanol production from cassava starch. *Biochemical Engineering Journal*, 48(2): 260–267. *nternational Food Research Journal*, 18(3): 825–836.

39. Tamang, J. P., & Samuel, D. (2010). Dietary culture and antiquity of fermented foods and beverages. n J. P. Tamang & K. Kailasapathy (Eds.), Fermented foods and beverages of the world (pp. 1–40). New York, NY: CRC Press.
40. Uchechukwa-Agua, A.D., Caleb, O.J. and Opara, U.L. 2015. Postharvest handling and storage of fresh cassava root and products. *Food Bioprocess Technol*., **8**: 729-48.
41. Wang, L., Zhao, B., Liu, B., Yang, C., Yu, B. *et al*. (2010) efficient production of l-lactic acid from cassava powder by *Lactobacillus rhamnosus*. *Bioresource Technology*, **101(20)**:7895–7901.
42. Zhu W, Lestander TA, Orberg H et al (2015) Cassava stems: a new resource to ncrease food and fuel production. GCB Bioenergy 7: 72–83. doi:10.1111/gcbb.12112.