

Cashew Processing for Economic Development in Nigeria

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Abstract: Cashew is a drought resistant crop that can grow successfully in areas with a very distinct dry season or where the annual rainfall is as low as 50 cm. It can also grow well in areas with high levels of rainfall (as much as 350 cm annually) provided the soil is well drained. Cashew grows >12 m high and has a spread of 25 m. Its extensive root system allows it to tolerate a wide range of moisture levels and soil types. However, commercial production is advisable only in well-drained, sandy loam or red soils. Cashew grows almost everywhere in Nigeria but its cultivation is concentrated primarily in the South and Middle Belt regions in small holder farms and plantations. Products from cashew fruits include: Liquor, vinegar, juice, juice concentrate, jam, beverages, pickle, chutney and candied products. Cashew nut shell contains inedible Cashew Nut Shell Liquid (CNSL) while the nut contains Cashew Nut Kernel Oil (CNKO) which is a sweet edible oil. The pressed kernel cake from CNKO extraction process is suitable for use in human and animal feeds. This study examines cashew processing in Nigeria and its potentials for economic development as well as the nutritional and health benefits of different cashew products.

Key words: Cashew, cashewnut, CNSL, cashew kernel, cashew apple, processing, value chain

INTRODUCTION

Cashew (*Anacardium Occidentale*) is a drought resistant crop that can grow successfully in areas with a very distinct dry season or where the annual rainfall is as low as 50 cm. It can also grow well in areas with high levels of rainfall (as much as 350 cm annually) provided the soil is well drained. Cashew grows >12 m high and has a spread of 25 m. Its extensive root system allows it to tolerate a wide range of moisture levels and soil types. However, commercial production is advisable only in well-drained, sandy loam or red soils.

The processing of agro raw materials such as cashew into various innovative products promotes market acceptability and gives the products high economic value which consequently brings higher income to the producer. Processing also expands the horizon of human participation in the production process and therefore creates awareness for employment generation in the downstream activities such as packaging, marketing, retail, exports, etc.

Agriculture is evolving towards a global system requiring high-quality, competitive products and organized in value chains. Agricultural value chain links the steps a product takes from the farmer to the consumer and includes input suppliers, production, processing, marketing and finance. The value chain approach has become an increasingly important framework for examining change in the global trade commodities and

their implications for primary producers. Commodity value chain encompasses the whole lot of activities from production, processing distribution and marketing of specific traded commodity and identifies the main stakeholders involved at each stage, including research and development.

Cashew grows almost everywhere in Nigeria but its cultivation is concentrated primarily in the South and Middle Belt regions in small holder farms and plantations. It has industrial, medicinal, investment and export potentials. Products from cashew fruits include: Liquor, vinegar, juice, juice concentrate, jam, beverages, pickle, chutney and candied products. Cashew nut shell contains inedible Cashew Nut Shell Liquid (CNSL) while the nut contains Cashew Nut Kernel Oil (CNKO) which is sweet edible oil. The pressed kernel cake from CNKO extraction process is suitable for use in human and animal feeds (FAO, 1992). Cashew nuts have high medicinal and pharmaceutical potency (Streets and Troup, 1962). The CNSL contains high proportions of phenolic compounds which are used in industries as raw materials for making vehicle brake lining compounds, water proofing agents, preservatives, manufacture of paints and plastics; type-writer rollers, oil and acid-proof cements and for making industrial floor tiles (FAO, 1992). Also, cashew apple residue left after juice extraction which is about 30-40% of apple weight can be used to recover low methoxyl pectin or as cattle feed after drying. In the Goa region of India, an alcoholic preparation called fenni is

Table 1: Food value 100 g⁻¹ of fresh cashew apple

Food value 100 g ⁻¹ of fresh cashew apple*	Values
Moisture	84.4-88.7 g
Protein	0.101-0.162 g
Fat	0.05-0.50 g
Carbohydrates	9.08-9.75 g
Fibre	0.4-1.0 g
Ash	0.19-0.34 g
Calcium	0.9-5.4 mg
Phosphorus	6.1-21.4 mg
Iron	0.19-0.17 mg
Carotene	0.03-0.742 mg
Thiamine	0.023-0.03 mg
Riboflavin	0.13-0.4 mg
Niacin	0.13-0.539 mg
Ascorbic acid	146.6-372.0 mg

*Analyses made in Central America and Cuba (Morton, 1987)

Table 2: Top 10 cashew nut production countries in 2010

Countries	Quantity (ton)
Vietnam	1,159,600
India	613,00
Nigeria	594,000
Cote d'Ivoire	370,000
Indonesia	174,300
Philippines	134,681
Brazil	102,002
Guinea-Bissau	91,100
Benin	69,700
Mozambique	67,200

made by fermentation and distillation processes of the cashew apple juice (Okafor, 1992). The sweet scented flowers of cashew tree attract honey bees hence cashew plantations could be a good site for apiary development (FAO, 1982).

Cashew apple: Cashew apple is 10 cm long, red or yellow in colour, fibrous but juicy, sweet, pungent and high in vitamins A and C (Table 1). Per 100 g of fresh fruit, the cashew apple has more vitamin C than guavas, mangoes and oranges (Behrens, 1996).

Cashew nut: The true fruit of the cashew tree is a kidney shaped drupe that grows at the end of the cashew apple. The drupe develops first on the tree and then the pedicle expands to become the cashew apple. Within the true fruit is a single seed, the cashew nut. The world's top 10 cashew nuts production countries in 2010 are shown in Table 2.

MAJOR PRODUCTS FROM CASHEW

Dried cashew nut: Raw cashew nut when picked from the orchards has high moisture content and need to be dried before processing and/or storage. They are marketed as raw materials for cashew nut processing factories and they can also be exported directly. The technology for

drying is simple. A cement concrete drying yard is used for sun drying and the only equipment needed is shovel and pokers for frequent turning of the nuts in the drying yard. Drying protects the kernel from pests and fungus attack.

Cashew kernels (nuts): Cashew kernels (nuts) are ready to eat products. They are also the basic raw material in the production of cashew nut butter. Further value addition to the kernels is possible by roasting and salting or sugar coating the nuts. It is estimated that 60% of cashew kernels are consumed in the form of snacks while the remaining 40% are included in confectionery. The various cashew nuts processing steps differ in accordance with the scale of operation. In some cases, all steps of the processing are manually carried out by small-scale processors. In commercial processing, various pieces of equipment are used. The cashew nut processing operations consist of cleaning, roasting, shelling, separation, drying, peeling, grading and packing.

Cashew nut is a popular desert, eaten out of hand; with other mixed nuts and used in baking and confections about 60% of cashews are eaten as salted nuts (Rosengarten, 1984). It is also made into cashew butter and nut milk. The nut is high in protein, oil and vitamins, especially thiamin. The nut make up is 47% fat, 21% protein and 22% carbohydrate (Ohler, 1979). In comparison with eight other leading nuts, the cashew is lowest in fat (Morton, 1970). Of all nuts, cashew is second only to almond in commercial importance (Rosengarten, 1984).

Cashew Nut Shell Liquid (CNSL): Cashew nut processing allows for the development of an important by-product which can increase its added value. The liquid inside the shell, CNSL, represents 15% of the gross weight and has some attractive possible medicinal and industrial uses. Cashew shells (waste from the processing of cashew nut) is used for manufacture of cashew shell resin or used as fuel in the processing unit itself. CNSL is used in the manufacture of brake linings, industrial belting and clutches, reinforcing synthetic rubber for oil and acid resistance in lacquers in electrical insulation material as a metal anti-corrosive material for waterproofing and as an adhesive. CNSL exhibits potent antibacterial activity against gram-positive bacteria and weak antifungal activity against molds. Traditionally, it is used to treat ailments such as scurvy, sores, warts, ringworm and psoriasis. It could be a source of new antimicrobial agents, especially for use in foods and cosmetics.

Cashew juice, cashew apple candy and jam: Until recently, the potential of cashew apple had not been investigated

due to its highly astringent and acrid taste which is believed to originate in the waxy layer of the skin and which causes tongue and throat irritation after eating. Cashew fruit can be made suitable for consumption by removing the undesirable tannins and processing the apples into value-added products such as juices, syrups, canned fruits, pickles, jams, chutneys, candy and toffee. Cashew apple is rich in vitamin C (5-7 times more than that of oranges). Cashew apple juice, jam and candy are therefore rich sources of vitamin C and can find ready market. The residue (pomase) after juice extraction can be used as animal feed ingredient. Cashew apples should be processed within 2-3 h of picking, since they undergo rapid deterioration when kept for a longer time.

Cashew apple wine: Cashew apple juice is fermented to produce wine. Wine is further concentrated to produce Cashew apple brandy. The potential of using cashew apples to produce juice, wines, marmalades, pickles and in particular ethanol is high.

NUTRITIONAL AND HEALTH BENEFITS OF CASHEW NUT

Nutritional benefits: Cashew nut is high in calories. About 100 g of nuts provide 553 calories. It is packed with soluble dietary fiber, vitamins, minerals and numerous health-promoting phyto-chemicals that help protect from diseases (Table 3).

The nut is rich in heart-friendly mono-unsaturated fatty acids like oleic and palmitic acid that help to lower LDL cholesterol and increase good HDL cholesterol. Research studies suggest that Mediterranean diet which is rich in mono-unsaturated fatty acids helps to prevent coronary artery disease and strokes by favoring healthy blood lipid profile.

Cashew nuts are very rich source of minerals. Minerals, especially manganese, potassium, copper, iron, magnesium, zinc and selenium are concentrated in the nuts. A handful of cashew nuts a day in the diet would provide enough of these minerals and prevent deficiency diseases. Selenium is an important micronutrient which functions as co-factor for antioxidant enzymes such as Glutathione peroxidases, one of the most powerful antioxidant in the body. Copper is a cofactor for many vital enzymes including cytochrome c-oxidase and superoxide dismutase, other minerals function as co-factors for this enzyme are manganese and zinc. Zinc is a co-factor in many enzymes that regulate growth and development, sperm generation, digestion and nucleic acid synthesis.

Table 3: Cashew nut nutrition value 100 g⁻¹

Principle	Nutrient value	RDA (%)
Energy	553 Kcal	28
Carbohydrates	30.19 g	23
Protein	18.22 g	32.5
Total fat	43.85 g	146
Cholesterol	0 mg	0
Dietary fiber	3.3 g	8.5
Vitamins		
Folates	25 µg	6
Niacin	1.062 mg	6.5
Pantothenic acid	0.864 mg	17
Pyridoxine	0.417 mg	32
Riboflavin	0.058 mg	4.5
Thiamin	0.423 mg	35
Vitamin A	0 IU	0
Vitamin C	0.5 mg	1
Vitamin E	5.31 mg	35
Vitamin K	4.1 µg	3
Minerals		
Sodium	12 mg	1
Potassium	660 mg	14
Calcium	37 mg	4
Copper	2.195 mg	244
Iron	6.68 mg	83.5
Magnesium	292 mg	73
Manganese	1.655 mg	72
Phosphorus	593 mg	85
Selenium	19.9 µg	36
Zinc	5.78 mg	52.5
Phyto-nutrients		
Carotene-β	0 µg	-
Crypto-xanthin-β	0 µg	-
Lutein-zeaxanthin	22 µg	-

USDA National Nutrient data base

Cashew is also rich in many essential vitamins such as pantothenic acid (vitamin B-5), pyridoxine (vitamin B-6), riboflavin and thiamin (vitamin B-1). These vitamins are essential in the sense that the body requires them from external sources to replenish and they are essential for metabolism of protein, fat and carbohydrates at cellular levels.

The nuts also contain small amount of Zea-xanthin, an important flavonoid antioxidant which are selectively absorbed into the retinal macula lutea in the eyes. It is thought to provide antioxidant and protective UV ray filtering functions and helps prevent Age-related Macular Degeneration (AMD) in the elderly.

Health benefits: The cashew tree's leaves and bark as well as the popular cashew apple possess herbal health benefits that include killing bacteria and germs, stopping diarrhea, drying secretions, increasing the libido, reducing fever, blood sugar and pressure. Like other nuts, cashew has obesity and gallstones fighting property. Presence of high amount of magnesium in the nut ensures healthy bones and teeth structure, while copper produces energy and increases capability of antioxidant defenses. Examples of medicinal application of cashew includ:

Diet and weight management: Cashew nuts do have a relatively high fat content but it is considered good fat.

This is due to the agreeable fat ratio in the nut, 1:2:1 for saturated, mono-unsaturated and poly-unsaturated, respectively which is the ideal ratio for optimal health. Cashew nuts also have a fatty acid profile that contributes to good health through phytosterols, tocopherols and squalene, all of which lower the risk of heart disease, combined with the nut's 0% cholesterol content.

Cardiovascular and circulatory health: With no cholesterol, cashew nuts are a healthy fat food for patients with heart condition.

Magnesium: In the raw form, cashew contains 21% of the daily recommended value of magnesium. Magnesium is good for the heart, it also protect against high blood pressure, muscle spasms, migraine headaches, tension, soreness and fatigue. Magnesium also works with calcium to support healthy muscles and bones in the human body.

Antioxidants: The high copper content in cashew nut helps the body utilize iron, eliminate free radicals, develop bone and connective tissue and produce the skin and hair pigment melanin. Copper which is an essential component of the enzyme superoxide dismutase is also vital in energy production and antioxidant defense producing greater flexibility in blood vessels, bones and joints.

Diabetes: Recent clinical trials have shown that cashew and other nuts research with a person's lipid profile to have a beneficial effect on those with diabetes or at risk for diabetes. With 37.7% of the daily recommended value of mono-unsaturated fats, cashews can reduce triglyceride levels in diabetics, protecting them from further complications.

Gallstones: All nuts, including the cashew nut have been associated with a reduced risk of gallstone disease.

Dental health: Chemicals in cashew nuts kill gram positive bacteria that cause tooth decay, acne, tuberculosis and leprosy.

Topical uses: Cashew nut also has astringent qualities that are now used in topical creams and gels used for warts, moles and other skin growths.

CASHEW PRODUCTION AND PROCESSING IN NIGERIA

Production: The first Nigerian cashew plantation dates back to 1954 with 800 ha in the present Enugu State and 200 ha in the Western part of the country. Since, the

liberalization of the commodity market in 1986, many companies have ventured into cashew nut processing. Nigeria has recognized the potential economic value of cashew and has made a concerted effort to improve the production of the crop. Cashew is found both in the wild and under cultivation in 16 out of 36 states of Nigeria, with average annual production of 176,000 ton of cashew nuts in 2000. In its efforts to increase cashew production, the federal government initiated a Cashew Development Programme under the Tree Crop Development Programme (FMARD, 2001). The programme initiated in 2001 was aimed at:

- Rehabilitating and resuscitating moribund plantations and expansion programme
- Training of extension staff and farmers
- Providing and distributing inputs such as seedling, agro-chemicals, etc.
- Quality control at primary (farm) level
- Strengthening the management information system in the cashew sector

In 2002, Nigeria produced 30,000 ton of cashew nut from a total holding of 50,000 ha which are mostly under smallholdings. The average growth of cashew nut production increased to 555,000 ton in 2004. These were planted with varieties whose yield was estimated at 1,000 kg ha⁻¹ (NEPC, 2002). In 2010, Nigeria ranked 3rd among the top 10 world cashew nut producers with a production of 594,000 ton.

Nigeria produces a limited variety of cashew consisting mainly of the yellow and red varieties. However, high yielding cashew varieties with low gestation period and bigger nuts have been introduced. The Cocoa Research Institute of Nigeria (CRIN) with mandate to research into cashew has developed an improved variety of cashew called Brazilian Jumbo with nuts maturing within 1 year in contrast to the local wild varieties which mature after 5 years (CRIN, 2001).

Factors influencing production and harvest performance include: Old trees, deforestation, low yield varieties, dominance of small holdings and wild varieties, land acquisition, high cost of inputs, climatic conditions, disease, pest and fire outbreaks, post harvest loses, infrastructural constraints, quality, market price of the product and competition amongst the local buying agents.

Processing: Value addition through processing has been found to improve income and shelf-life of agricultural produce (Lawal and Jaiyeola, 2007). Three types of

cashew processing are practiced in Nigeria, viz: Small cottage processing, processing for export and processing for the local market.

Small cottage processing involves manual processing of cashew nut carried out by small cottage industries. Rudimentary method such as roasting is adopted by this group of processors. The inner shells are broken by hand and the kernel heated to remove the skin. The quality of kernels obtained through this process is not standardized, presenting lots of differences in size, finishing and roasting. The product is mostly sold by hawkers.

Processing for export started after the liberalization of the commodity market in 1986. Many companies ventured into cashew nut processing and installed processing plants to process kernels for export. Japanese and Indian technologies are the most common technologies commonly imported by these investors. These technology systems entail nuts cleaning, calibration and storage by grade, washing and humidification, roasting, centrifugation and cooling. They also involve shelling and kernel shell separation, kernel drying, peeling, grading, sorting and packaging.

Processing for the local market targets the middle and high income domestic consumers. Realizing the huge potential for cashew nut market in Nigeria this group of processors uses some level of technology to meet local demand. The kernels produced are salted, flavoured and packaged in attractive packs to appeal to the target market. The kernels produced are of high quality with approval from the regulatory authority (National Agency for Food and Drug Administration and Control). The products are sold in supermarkets and shops.

Cashew kernel is the most common cashew product. Machine involved in processing cashew nut include: Raw nut size sorting machine, steaming machine and bucket elevator, nut humidification machine, drying kiln, shelling machine, peeling machine, grading vibrator and bucket elevator, roaster, cashew nut decorticator, dryer, packaging machine, etc.

Processing in Nigeria is influenced by factors such as Post harvest loses, quality of the nuts, technological difficulties, competition from exporters of raw nuts, demand situation in the international market and infrastructural constraints.

EFFORTS OF RMRDC IN THE DEVELOPMENT OF CASHEW PROCESSING IN NIGERIA

Recognizing the economic importance of value addition to agricultural commodities, the Raw Materials

Research and Development Council (RMRDC) has initiated the establishment of cashew processing clusters in the cashew belt of Nigeria. The council in collaboration with the Kogi State University, Anyingba established a mechanized 1 ton day⁻¹ cashew nut processing plant within the university. The establishment of the processing plant is part of the Council's strategy to promote entrepreneurship development, emergence of enterprise focused knowledge centres in tertiary institutions as well as the establishment of raw materials processing clusters. The plant has employed >200 women and youths within the community and has been in operation since 2010.

The success of the cashew nut processing plant in Kogi State University has catalyzed the establishment of four 500 kg day⁻¹ cashew processing plants in the 3 senatorial districts of Kogi State by the State Government in collaboration with the Bank of Industry. The council has also installed researcher 1 ton day⁻¹ cashew nut processing plant at the Federal University of Agriculture, Abeokuta. More of such establishments are being planned for other cashew belts of the country in collaboration with state and local government and through Public Private Partnership (PPP).

CONCLUSION

Presently in Nigeria, the potentials of cashew nut and apple for income generation are still under-utilized. Huge post harvest loses is usually recorded during the harvest period, especially with regards to the apple. There is need therefore to improve processing and transformation opportunities through introduction of appropriate technologies to diversify the products from cashew. Potential also exist in improving the profitability of processing through diversifying the product range through commercial utilization of the readily available waste and by utilization of other by-products such as CNSL and cashew apples for biogas generation. This will create opportunities for employment generation and wealth creation at all levels of the value chain.

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