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PRODUCTION AND ASSESSMENT OF THE PHYSICOCHEMICAL PROPERTIES OF PASTA USING *AGRA BANKYE* FLOUR

Fraikue, F. B.[1], Deha, C. I.[2], Tawiah, V.[3] and Barnes, R. S.[3]
[1, 2, 3&4] *Department of Hospitality Management, Takoradi Technical University, Takoradi, Ghana.*
[1]*frances.fraikue@ttu.edu.gh*

ABSTRACT

Purpose: This aimed to assess the physicochemical properties of agra bankye for pasta production. The main objective was to determine the formulation ratio and physicochemical properties of agra bankye pasta.

Design/Methodology/Approach: Through experimental research design, agra bankye flour was produced using oven-drying. The product was peeled, grated, arranged onto baking sheets and dried at a temperature of 80ºC for 2 hours, then milled to produce the flour. The pasta dough was prepared using a series of experiments to develop a standard recipe using a combination of cassava flour, salt, water, and egg.

Findings: Eleven proximate and mineral components in agra bankye pasta were fat, protein, crude fibre, carbohydrate, starch, energy, calcium, iron, manganese, moisture and ash, affirming the product as healthy for human consumption. Agra bankye flour has more starch and less fibre, making it stable for pasta production.

Research Limitation: Only the pasta's physicochemical properties were assessed so that the results could be used to convince consumers of the healthy intake of agra bankye pasta.

Practical Implication: Agra bankye pasta is very nutritious, especially because, it has high calcium and less crude fibre. The high starch granules in agra bankye flour enable the product to be stretchy, unlike other cassava, while less moisture influences the shelf life. Since it is highly nutritious, more usage of agra bankye pasta for food production with diverse nutritional fortification should be encouraged and marketed.

Social Implication: This study had immense academic benefits, bridging the knowledge gap regarding the available literature needed to support the use of agra bankye for pasta production. The study also created awareness of the different cassava varieties and the type(s) suitable for pasta production.

Originality/Value: This has brought to the fore an innovation where a recipe is available for pasta production using cassava flour and not blending it with other cereals.

Keywords*: Agra bankye. cassava. formulation ratio. physicochemical. proximate*

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INTRODUCTION

Carbohydrates, the main energy source in most human diets, comprise about 40–80% of calorie intake and play an enormous role in human physiology. They are the paramount energy source consumed by the human body (Schulz & Slavin, 2021; Caffall & Mohnen, 2009). The body breaks and converts most carbohydrates into sugar glucose. Some vital organs and cells, like the brain and the red blood cells, mainly utilise glucose (Asif et al., 2011). Carbohydrates generally give our bodies the utmost energy demanded in our day-to-day lives, both for usual body functions such as heartbeat, breathing and digestion and for physical activity and exercise (Quayson, 2012). These mainly include tubers and cereals, of which most families plan their meals around (Marcin, 2019; Kitts, 2022; Eli-Cophie et al., 2017).

Starchy root and tuber vegetables are hearty and nourishing. Roots and tubers have been known to be an important food for thousands of years (Berkeley, 2015). They are described as nature's buried treasures, roots, tubers, geophytes and a botanical term for plants with their growing point beneath the soil. They are parts of a plant that usually grow downward, anchoring the plant into the ground, where they absorb moisture and nutrients. These root vegetables include carrots, sweet potatoes, and turnips. Tubers form at the base of roots and store energy in the form of starch to support new stem growth for the plant. The most common tubers are cassava potatoes, Jerusalem artichokes, and yams (Berkeley, 2015; Li et al., 2017). As these crops are grown underground, they take in a significant amount of nutrients from the soil. They are filled with a high concentration of antioxidants, Vitamins A, B, C and iron, helping to cleanse one's system (Mueller, 2014).

Cassava (*manihot esculenta*), from the perennial sturb belonging to the family *Euphorblaceae*, is one of the most important staple crops found in Ghana and many other tropical countries (Anoma & Thamilini, 2016). Cassava is the third-largest source of food carbohydrates in the tropics, after rice and maize (Freitas et al., 2015). It is a major staple food in the developing world, providing a basic diet for over half a billion people (Freitas et al., 2015). Dresden (2021) affirmed that cassava is a rich and affordable source of carbohydrates prepared and eaten in various ways in different parts of the world, with baking and boiling being the most common methods (Li et al., 2017). Mashed cassava (fufu), cassava chips, cassava cake and cassava pasta are some dishes that can be derived from cassava.

Over the years, many Agricultural programs and projects have developed and released over 25 new cassava varieties (Acheampong et al., 2021). These new cassava varieties,

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which have unique maturity period use and resistance needed for alternative food production, have scarcely been researched into their state of versatility (Aristizábal et al., 2017). Promoting a specific variety of local cassava flour instead of imported wheat flour for pasta production ought to be investigated. Similarly, assessing the physicochemical properties that could help marketers promote pasta made from 100% local cassava is unavailable. Furthermore, one surety to motivate people on the intake of cassava pasta was to have a fair idea of the nutritional contents. Against this backdrop, the study's main objective was to produce and assess the physicochemical properties of agra bankye used for pasta production.

LITERATURE REVIEW

General Overview of Cassava

Cassava is a woody shrub native to South America of the spurge family, Euphorbiaceae (Acheampong et al., 2021). It appears to have originated in Brazil and Paraguay, but it had spread throughout the tropical areas of South and Central America long before the arrival of Columbus (Cruze, 2017). It is now one of the tropical countries' most important food crops. Cassava ranks as the sixth most important food crop worldwide, even though in Western countries, it is little known or used (Li et al., 2017; Mueller, 2014). However, a perennial plant, cassava is extensively cultivated as an annual crop in tropical and subtropical regions for its edible starchy tuberous root and as a significant source of carbohydrates (Li et al., 2017). Cassava is predominantly consumed in boiled form, whilst substantial quantities are used to extract cassava starch, called tapioca.

Production of Cassava

In 2018, global cassava root production was 278 million tonnes, with Nigeria as the world's largest producer, having 21% of the world total. Other major growers known were Thailand and the Democratic Republic of the Congo (Anyanwu, Ibeto, Ezeoha, & Ogbuagu, 2015). Cassava is one of the most drought-tolerant crops that can be successfully grown on marginal soils and give reasonable yields compared to many other crops that do not grow well (Harish & Pragati, 2016; Hillocks, 2002). These conditions are common in certain parts of Africa and South America. Cassava is a highly productive crop, considering daily food calories produced per unit of land area. Cassava is harvested by hand by raising the lower part of the stem, pulling the roots out of the ground, and removing them from the base of the plant. The upper parts of the stems with the leaves are plucked off before harvest (Cruze, 2017). Cassava is propagated by cutting the stem into sections of approximately 15 cm planted before the wet season (Li et al., 2017).

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Cassava undergoes post-harvest physiological deterioration (PPD) once the tubers are separated from the main plant. The tubers, when damaged, normally respond with a healing mechanism. However, the same mechanism, which involves coumaric acids, starts about 15 minutes after damage and fails to switch off in harvested tubers. It continues until the entire tuber is oxidized and blackened within two to three days after harvest, rendering it unpalatable and useless. The PPD is one of the main obstacles preventing farmers from exporting cassavas abroad and generating income (Simonyan, 2014). Cassava can cause acute poisoning when not properly cooked because of the naturally occurring cyanide content in the raw state. If not prepared properly, tubers that are rich in carbohydrates can even cause paralysis or death (Balagopalan, 2017).

Importance of Cassava

Cassava-based dishes are widely consumed wherever the plant is cultivated; some have regional, national, or ethnic importance (Cruze, 2017). The root of the sweet variety has a delicate flavour and can replace potatoes. It can be made into flour in breads, cakes and cookies (Aristizabal et al., 2017). Cassava, yams, and sweet potatoes are important tropical food sources (Eli-Cophie et al., 2017). The cassava plant gives the third-highest yield of carbohydrates per cultivated area among crop plants, after sugarcane and sugar beets (El-Sharkawy & Mabrouk, 2015). As does Africa, no continent depends as much on root and tuber crops to feed its population. In Ghana, for example, cassava and yams occupy an important position in the agricultural economy and contribute about 46 percent of the gross domestic product (Kolawole & Akingbala, 2010). Raw cassava is 60% water, 38% carbohydrates, 1% protein, and has negligible fat (Anyanwu et al., 2015). In a 100-gram, raw cassava provides 670 kilojoules (160 kilocalories) of food energy and 25% of the Daily Value (DV) of vitamin C. Cooked cassava starch has a digestibility of over 75% (Opie, 2008). The traditional methods of processing cassava roots into food have been adapted to suit the attributes of the plant, such as root yield, spoilage, cyanide content, nutrient content, and processability (Filbert et al., 2017).

Cassava is often used as a substitute for wheat flour, especially to make bread, cakes, pasta and dumplings (Cruze, 2017). It is also used to make starchy custards and puddings. In countries where wheat has to be imported and is in limited supply, bread is made by mixing cassava flour with wheat flour (James, 2012). Cassava flour's starchy texture makes it an excellent thickener, and it is used to thicken soups, baby foods, puddings, sauces and gravies (Harish & Pragati, 2016). According to Kolawole and Akingbala (2010), cassava is made into fermented and unfermented products. Fermented products include cassava

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bread, flour, fermented starch, fufu, lafun, akyeke, agbelima, and gari. In contrast, the unfermented products include tapioca, cassava chips and pellets, unfermented cassava flour and starch. Food uses of cassava include flour in gluten-free or gluten-reduced products like bread, biscuits, and many more.

Varieties of Cassava

Numerous cassava varieties have unique cycles, uses, yields and CMV resistance. As others are starchy and floury, others are used for breakfast dishes and baking. They are used in the fresh (boiled and eaten as whole or pounded) and the processed state (grits, chips, flour, fermented dough, grated and dry fried). Also, some are tolerant, susceptible and resistant and, among all, have the highest yield, such as CRI-Agra bankye, dudzi and abrabopa (FAOSTAT 2019; MoFA, 2019; Acheampong et al., 2021; Adjei-Nsiah & Sakyi-Dawson, 2012; Castro, 2017; Venturini et al., 2016; Zidenga, 2012; Willy, 2010; Abass et al., 2014). Table 1 exhibits some varieties and yield uses.

Table 1: Cassava Varieties Released in Ghana and their Characteristics
Crop: Cassava (Manihot Esculentum Crantz)

Name	Cycle (month)	Yield (t/ha)	Uses	CMV Resistance
Afisiafi	12-15	28-35	Starch, flour, gari	Tolerant
Abasafitaa	12-15	29-35	Starch, flour, gari	Tolerant
Tekbankye	12-15	30-40	Fufu, Ampesi, gari	Susceptible
Dokuduade	12	35-40	Starch, gari	Resistant
Agbelifia	12	40 – 45	Starch, gari	Resistant
Essam Bankye	12	40 – 50	Flour, Gari	Resistant
Bankyehemaa	9 – 12	40 – 50	Flour, Gari, Fufu	Resistant
Capevars Bankye	9 – 12	40 – 50	Flour, Gari, Fufu, Starch	Resistant
Bankyebotan	12-15	25-30	Flour, gari, starch	Tolerant
Eskamaye	15-18	16-23	Tuo, konkonte	Tolerant
Filindiakong	15-18	16-20	Tuo, konkonte	Tolerant
IFAD	12-15	30-35	Starch, fufu	Tolerant

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Ampong	12	40-50	Flour, Starch, fufu	Resistant
Broni Bankye	12	40-50	Flour, bakery product	Resistant
Sika Bankye	12	40-50	Flour, Starch	Resistant
CRI-Duade Kpakpa	12-15	60	Poundable, Flour, starch	Resistant
CRI-Amansan Bankye	12	57	Flour and Bakery product	Resistant
CRI-Agra Bankye	12	63	Starch, Flour	Resistant
CRI-Dudzi	12	49	Starch, Flour	Resistant
CRI-Abrabopa	12-15	40	Starch, Flour	Resistant
CRI-Lamesese	12	50	Poundable, Beta Carotene, Flour	Tolerant

Source: FAOSTAT (2019); MoFA (2019); Acheampong et al. (2021); Adjei-Nsiah & Sakyi-Dawson (2012); Castro (2017); Venturini et al. (2016); Zidenga (2012); Willy (2010); Abass et al. (2014)

Description of Agra Bankye

Agra bankye, also known as CRI-Agra Bankye is a compact plant in shape with cream pulp and cortex colour. It has a potential yield of 35-60 t/ha and a dry matter of 32% (Parma et al., 2017). The petiole of Agra bankye, the leaf's stalk attaching to the stem's blade, is purple. Also, it has a light brown colour stem and root skin (Acheampong et al., 2021). Agra bankye is highly resistant to CMD. Moreover, it is best cultivated in forest and coasted savannah areas and is ideally used for starch and flour. It also has a high-keeping quality as it contains less fibrous properties and can hold moisture (Kubala, 2022; Sachdev, 2021).

Nutritional Components of Cassava

Nutritional components of cassava comprise carbohydrates, protein, fat, vitamins, minerals and water. Table 2. exhibited a compilation of nutrients from authors (USDA nutrient database, 2020; Bradbury & Holloway, 2013; Tsuen et al., 2013; Favier, 2013; Lancaster et al., 2013; Kubala, 2022 & Sachdev, 2021).

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Table 2: Nutritional Value of Cassava

Food Nutrients	Quantity
Energy	130kcal - 160kcal
Carbohydrates	31g - 39.2 g
Sugars	1.5g - 1.9g
Dietary fibre	1.3g - 1.9g
Fat	0.1g - 0.3g
Protein	1.0g - 1.4g
Thiamine (Vitamin B1)	0.72mg - 0.087mg
Riboflavin (Vitamin B2)	0.34mg - 0.048mg
Niacin (Vitamin B3)	0.048mg - 0.854mg
Vitamin B6	0.088 mg
Folate (Vitamin B9)	27 µg
Vitamin C	20.6 mg - 33mg
Calcium	16 mg - 26 mg
Iron	0.27 mg - 3.5mg
Magnesium	21 mg
Phosphorus	27 mg - 47mg
Potassium	271mg
Sodium	14 mg
Zinc	0.34 mg
Water	60 ml

Sources: USDA nutrient database (2020); Bradbury & Holloway (2013); Woot - Tsuen et al. (2013); Favier (2013); Lancaster et al. (2013); Kubala (2022); Sachdev (2021)

Production of Pasta

Pasta is an ancient food, defined as a type of dough extruded or stamped into various shapes for cooking (Anyanwu et al., 2015). It is economical, easy to prepare, has a longer shelf life, and is consumed worldwide in many different ways. Pasta products are normally made from amber durum wheat, milled into semolina, and mixed with water, salt, eggs, vegetable oil, and sometimes vegetable colouring (Anyanwu et al., 2015; Cruze, 2017).

In recent days, pasta formulations including non-wheat ingredients like sweet potato flour and tapioca starch have been reported. The dough is made into different shapes and sizes and then dried and stored (Harish & Pragati, 2016).

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Pasta is a type of food typically made from an unleavened dough of wheat flour mixed with water or eggs, formed into sheets or other shapes, and then cooked by boiling or baking (Padalino, Conte & Del Nobile, 2016). Rice flour or legumes such as beans are sometimes used instead of wheat flour to yield a different taste and texture or as a gluten-free alternative (Harish & Pragati, 2016; Laleg, Cassan et al., 2016).

Regarding nutrition, cooked plain pasta is 31% carbohydrates, 6% protein, and low in fat, with moderate amounts of manganese, but pasta generally has low micronutrient content (USDA, 2012). Pasta is divided into two broad categories: dried (pasta secca) and fresh (pasta fresca) (Dreselen, 2021). Most dried pasta is produced commercially through extrusion, although it can be produced at home. Fresh pasta is traditionally produced by hand, sometimes with simple machines (Marcella, 2018). Both dried and fresh pasta come in some shapes and varieties. Pasta is made using hand-rolled or extruded methods (Cruze, 2017). Most types of pasta contain two simple ingredients: flour and eggs. Alternatively, it is sometimes made with just flour and water. The flour and egg (or water) are kneaded until it forms a dough, then rolled out and cut into various shapes (James, 2012). This sums up the first method. The second method, extrusion, is how most types of pasta sold commercially are made (Martinsdottir, 2010). The dough is put through a machine that cuts the pasta into various shapes, long or short. The recipe may vary, but the egg is typically omitted for water, and semolina flour is often used instead of all-purpose flour (James, 2012).

Types of Pasta

There are so many types of pasta. Luckily, they are grouped into a handful of categories: short pasta, long pasta, sheet pasta, stuffed pasta, and dumpling pasta (Grafiati, 2023). Long pasta can be hand-rolled or made with an extruder, but many types of short pasta (not all) have to be made with an extruder to create their unique shapes (Simonyan, 2014). Long Pasta is long, thin ribbons and strand pasta shapes. They are best when cooked with creamy sauces with only very small, chunky ingredients (Cruze, 2017). Examples of long pasta are Angel’s hair, Bucatini, Fettuccine, Spaghetti, Linguine, Pappardelle, Tagliatelle, and Vermicelli (Li et al., 2017). Shorter noodles come in a variety of shapes. It works great with thicker and chunkier sauces with meat and vegetables (Laleg et al., 2016). Because of their unique shapes, most short types of pasta are made with an extruder machine that cuts the shapes with a mould (Cruze, 2017); some long pasta is a radiator, rotini, elbows, penne, rotelli, rigatoni (Li et al., 2017). Sheet pasta is sheet pasta noodles that are thin and flat, like a sheet of paper (Laleg et al., 2016; James, 2012). examples of sheet pasta are lasagne, filled pasta, and jumbo shells.

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METHODOLOGY

The research design adopted for the study was experimental, and specifically, laboratory work was undertaken to ascertain the physicochemical properties of agra bankye pasta. Agra bankye was explicitly purchased from CSIR, Fumesua in Kumasi, Ashanti Region, Ghana and other raw materials; egg and salt were purchased from the local market. Production of Agra bankye flour began when it was washed, peeled, grated onto a baking sheet and allowed to dry in the oven for two hours at a temperature of 80ºC. As the product turned crispy, it was removed, cooled and milled to attain the flour needed for pasta production. With some modifications, this recipe was adapted from Kolawole (2021) and Fraikue, Barnes and Tawiah (2022).

Production of Agra bankye pasta was adopted from Dagostino (2020), Grafiati (2023), Padalino et al. (2016), Cruze (2017) and James (2012) with some moderations. Specifically, the recipe used for agra bankye pasta was adopted from James (2012). The researchers went through laboratory work to assess the physicochemical properties of Agra bankye pasta to ascertain the proximate and mineral properties. The product was analysed and discussed using frequency and distribution tables.

Production of Cassava Pasta from Agra Bankye

Ingredients

Agra bankye flour	400g
Salt	1.5gram
Egg	25ml
Water	175ml

Method

*Pour Agra bankye flour into a bowl and salt.
*Bind the flour with egg and water to form a dough.
*On a clean, flat surface, knead the dough and allow it to rest.
*Grate dough to get fine granules or pass it through the chip machine for desired shapes.
*Arrange it on a baking sheet and dry it in an oven of 80^0C for 2 hours.
*When dried, allow it to cool
*Blend to get a smooth texture for laboratory assessment

Source: Researcher Recipe 2023: James (2012)

Determination of the physicochemical properties of a product is broadly dependent on two main groups of nutritional properties. These include the proximate and mineral analyses (Al et al., 2022). The proximate analysis mainly assesses a product's protein, fat, crude fibre,

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carbohydrate moisture and ash (NCBI, 2014). The mineral content depends on the specific minerals present in a product (Drago, 2017). Proximate analysis of flour products affects their functional properties and performance in different food applications. According to Tian, Wang, Wang, Sun, Wang, Ma and Qian (2022), flour product sizes are often associated with improved mixing, hydration and textural attributes of food products.

Protein content determination is a significant component of flour products and contributes to their structural and functional properties. Protein content affects dough elasticity, texture and the formation of gluten, which is crucial for bread making and other baked goods (Awuchi et al., 2019). Moisture content determination: According to Ojo et al. (2017), the moisture component of flour products influences their shelf life, storage stability and texture. Optimal moisture levels are essential to prevent microbial growth, enzymatic activity and undesirable changes in product quality.

Determining starch contents and properties is the primary carbohydrate component of flour products. The starch content and its properties, such as gelatinisation temperature, swelling power, and viscosity, impact flour-based foods' textural characteristics, stability, and cooking properties (Cornejo-Ramirez et al., 2018).

Fat content determination of flour products affects their sensory attributes, such as taste, texture and mouthfeel. Fat also contributes to the functional properties of dough, including its rheological behaviour and gas retention during baking (Rezaian, 2013). According to Czaja et al. (2020), Ash content determination indicates the presence of inorganic elements, such as calcium, magnesium, potassium and iron, which contribute to nutritional value and functionality.

The mineral content plays a significant role in the physicochemical properties of flour products. Minerals are inorganic substances essential for the proper functioning of the human body and are required in small quantities for various physiological processes (Dereje et al., 2020). In flour products, minerals contribute to the overall nutritional values and can influence the final product's texture, colour, and flavour (Aidoo et al., 2022).

Iron content determination is one crucial mineral found in flour products. Iron is essential for forming haemoglobin in red blood cells, which carry oxygen to different body parts. In flour, iron can affect the colour of the product, giving it a slightly darker appearance. It also contributes to the overall nutritional content, making the flour more beneficial for individuals with iron-deficiency anaemia (Field et al., 2021).

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Calcium content determination is another important mineral found in flour products. Calcium plays a vital role in bone health and is necessary for properly functioning muscles and nerves (Shkembi & Huppertz, 2021). In flour, calcium can contribute to the product's texture, affecting its moisture absorption and retention properties. It also helps form gluten, a protein that gives dough elasticity and structure (Codina et al., 2018).

Phosphorus content determination is another mineral component of flour products. It is involved in energy metabolism, DNA synthesis and bone mineralisation. In flour, phosphorus contributes to the flavour and colour of the final product. It also plays a role in the leaving process, as it interacts with leavening agents such as yeast to promote fermentation and gas production, leading to a light and airy texture in baked goods (Cordell et al., 2009).

RESULTS AND DISCUSSION

This production of agra bankye flour began with cleaning, peeling and grating of the cassava onto a baking sheet. This was baked for two hours at a temperature of 80ºC. After the product was dried, it was milled and sifted into flour. Later, agra bankye pasta dough was made from the formulation ratio of 400 grams agra bankye flour: 1.5 grams salt, 25 millilitres egg and 175 millilitres water. This was further grated into grits and then oven-dried for two hours at a temperature of 80ºC. The agra bankye pasta grits sent to the laboratory assessed the physicochemical properties. Here, two samples sent to the laboratory produced two different results, as seen in Table 3. The results revealed that there were eleven (11) parameters present in agra bankye pasta. Out of the eleven, eight (8) were categorised under proximate nutrients: fat, protein, crude fibre, carbohydrate, starch, energy, moisture and ash, while three, calcium, iron and manganese, were mineral nutrients. This indicated that agra bankye pasta was nutritious like other cereal and tuberous pasta. The average gramme, microgramme, and millilitres of the dual results from the laboratory assessment were further compared to basic cassava used for pasta.

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Table 3: Physicochemical Properties of Agra Bankye Flour

Parameter	Method	Unit	Result
Moisture	Based on AOAC 32.1.03 Modified	l/100ml	8.23 8.17
Ash	Based on AOAC 32.1.05	g/100g	2.87 2.84
Total Fat	Based on AOAC 4.5.01	g/100g	1.76 1.50
Protein	Based on AOAC 4.2.09	g/100g	3.67 3.80
Crude Fibre	Based on Pearson's Composition and Analysis of Foods 9th Edition	g/100g	0.93 1.18
Total Carbohydrate	By difference	g/100g	82.54 82.61
Energy	Based on Atwater factor	Kcal/100g	362.68 358.74
Iron	Based on 2,2-bipyridyl Colorimetric	mg/100g	13.13 12.81
Calcium	Based on AOAC 4.8.03	mg/100g	63.82 63.44
Starch	Based on Ewer's	g/100g	70.06 70.52
Manganese	Based on AOAC 9.1.01F	g/100g	0.71 0.81

Field Survey, 2023

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Table 4. revealed a comparative study of nutrients between agra bankye and cassava. Comparatively, as agra bankye contained eleven nutrients, cassava contained nine nutrients. Agra bankye contains ash of 2.86g/mg and manganese of 0.76g/mg, but cassava does not. The study showed that agra bankye pasta had more starch (70.29g/mg) than cassava flour (12.16g/mg). This confirmed what was cited by Lancaster et al. (2013), Kubala (2022), and Sachdev (2021), who attested that CRI-Agra bankye contains starch and flour. The lower fibre content in agra bankye (1.06g/mg) promotes the keeping quality of agra bankye pasta, which enables it to last longer and makes it stable better than cassava (1.3g/mg - 1.9g/mg).

Table 4. Comparison between Agra Bankye Pasta and Cassava Nutrient

Parameter	Unit	Agra bankye	Fresh Cassava
Moisture	ml /100ml	8.2	60
Ash	g/100g	2.86	----
Total Fat	g/100g	1.63	0.1 - 0.3
Protein	g/100g	3.69	1.0 - 1.4
Crude Fibre	g/100g	1.06	1.3 - 1.9
Carbohydrate	g/100g	82.58	31 - 39.2
Energy	Kcal/100g	360.71	130 - 160
Iron	g/100g	12.97	0.27 - 3.5
Calcium	mg/100g	63.63	16 - 26
Starch	g/100g	70.29	12.16
Manganese	g/100g	0.76	-------

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Still on Table 4, agra bankye pasta contained substantially higher nutrients of moisture, iron, protein and total fat. Additionally, the difference between the nutritional gap for calcium (63.63g/mg), carbohydrate (82.58g/mg), and energy (360.71Kcal/g) for agra bankye has cassava producing one-third of the same nutrients for calcium (16 - 26g/mg), carbohydrate (31 - 39.2g/mg) and energy (130 - 160Kcal/g). Nonetheless, the study's findings affirmed that minerals such as magnesium, potassium, sodium, zinc and many others, which were present in other cassava, according to literature, were not available in agra bankye pasta. This was evident in the review outlined by the authors, USDA nutrient database (2020), Bradbury & Holloway (2013); Woot- Tsuen et al. (2013); Favier (2013); Lancaster et al. (2013); Kubala (2022) and Sachdev (2021). Calcium in agra bankye pasta provides a stretchy state that helps form gluten and gives the dough its structure of elasticity.

CONCLUSION

Agra bankye, resistant, starchy and floury, can be used alone (100%) to produce pasta. Eggs, milk, beans or any other protein can be added to the production to increase the protein content. The physicochemical properties of agra bankye contained eleven (11) nutritional parameters. Although agra bankye is deficient in magnesium, potassium, sodium and zinc as compared to other cassava flour, it is nutritious and convenient to use for pasta. Furthermore, it is also established that agra bankye is a suitable cassava variety for pasta production due to its starchiness and less fibrous status of this species. Additionally, less moisture content in agra bankye influences the shelf life. Practically, agra bankye has high calcium and less crude fibre. The starch granules enable it to be stretchy, unlike other species of cassava, and it has a longer shelf life due to its less moisture content. Since it is highly nutritious, there is more usage of agra bankye pasta for food production with diverse. Socially, agra bankye pasta has also created awareness that cassava alone can be used for pasta production without thinking of using it as a composite, unlike the other types. The unique feature of this type of cassava is that it is cheap, produced locally, readily available, not affected by weevils and has a better keeping quality, unlike the wheat used for pasta.

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