

Review of the Nutritional Composition of ... Fatoye, M. N., Et al. (2026)

Review of the Nutritional Composition of Fermented Cassava Tuber (*manihot esculentcrant*) as a Sustainable Energy Source for Manual Workers

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Abstract

The study focuses on the review of the nutritional composition of fermented cassava tuber (manihot esculenta crant) as a sustainable energy source for manual workers. What informed this study is the need to explore the potentials of cassava as a food and energy source, energy needs of manual workers, nutritional benefits of fermentation, process of cassava fermentation for human consumption and sustainable local sources of food. The primary objectives of the study are to analyze the key nutritional components of fermented cassava tuber, including macronutrients (carbohydrates, proteins, fats) and micronutrients (vitamins and minerals), energy needs of manual workers, nutritional benefits of fermentation and sustainable local sources of food. It is therefore concluded that fermented cassava tuber can significantly increase the nutritious intake of manual workers, especially those in physical jobs, increased muscle strength and endurance, facilitate general physical performance by demanding high quantities of macronutrients and vital micronutrients such as iron, zinc, calcium, antioxidants, and phytochemicals. It is recommended that fermented cassava tuber should be included in meals to encourage traditional food practices and food fortification initiatives can be put into place for enhancing the nutritional health of manual laborers.

Keywords: Nutrients, Nutritional Composition, Fermented Cassava Tuber, Energy Source and Manual Worker.

Introduction

The material that gives the body the vital food it needs to sustain life and growth is called nutrients. Nutrients are the chemical substances that are present in food that aid in the body's regular operation and maintenance of health. These consist of water, vitamins, minerals, proteins, lipids, and carbohydrates. The ingredients in food that give people a healthy appearance is known as its nutritional composition. This is derived from the foods that people eat on a regular basis, including rice, bread, meat, plantains, fruits, beans, vegetables, and cassava. Cassava, a root vegetable known as (*Manihotesculenta Crantz*) is a member of the genus family because of its tasty, starchy, tuberous root and ability to withstand drought and low fertility; it is grown as an annual crop in tropical and subtropical countries as a staple food. Staple food is a diet commonly consumed by individual or community as part of meal on a daily basis. It is often readily available, affordable and culturally significant. A staple food is a diet for many people globally, especially those from Nigeria such as rice, yam, bean, maize, plantain and cassava. Cassava is a tropical plant with thick roots that can be eaten as a starchy root vegetable or tuber with a nutty flavor. In many African nations including Nigeria, it is a significant source of calories and carbohydrates because it can tolerate rigorous growing circumstances among drought-tolerant crops. It is a tuberous plant planted in tropical places all over the world. Cassava has several varieties such as poundable, sunshine, TME419, yellow, white, drought-resistant which are broadly classified into two main types; sweet and bitter cassava Oluwajoba, Okuneye, Adebowale, Oyeleke, and Akinyemi (2020). Bitter cassava is a type of cassava that contains higher levels of cyanogenic glycosides which releases cyanide (a highly toxic substance found in certain foods including bitter



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almonds, cherry pits, apricot kernels, apple seeds and cassava when ingested). Bitter cassava requires proper processing and cooking to remove or reduce the toxic compounds before consumption because it has a very poisonous chemical (cyanide compounds) while sweet cassava contains lower levels of cyanogenic glycosides (less cyanide compounds), more sugar and fewer hydrogen cyanide molecules which are toxic substances present in raw cassava. Sweet cassava can be cooked and consumed directly by boiling, steaming or roasting without extensive processing. Cassava is a nutrient rich food that provides macronutrients; carbohydrates primarily source of energy (high in calories) in form of starch, fiber that help support digestive health, protein that contain some essential amino acids present in bones, skin, muscles, joints and boosts immunity. Cassava root also rich in micronutrients such as vitamin C an antioxidant that supports immune function guards against skin damage, promotes the body's natural production of collage. Potassium that helps regulates blood pressure. Folate, a B vitamin that is crucial for fetus during pregnancy and magnesium for muscle nerve functioning. Additionally, cassava root is used to make starch, fufu, Garri and a tiny white grain called tapioca. It's crucial to remember that cassava root needs to be thoroughly boiled before consumption because it is widely consumed in less developed nations like Nigeria particularly by manual labourers/workers. (Bakolo, Tamirat, & Temesgan 2019)

Due to its accessibility, affordability, and capacity to satisfy hunger, growing cassava has aided in lowering food insecurity and promoting the expansion of food security since a range of dishes, including flour, abacha, garri, lafu, and fufu, are made from this one farm produce. It also lessens reliance on imported grain flour for both people and animals in addition to being a vital source of energy through fermentation. Fermented cassava is rich in fiber, calcium, and protein Bakolo & et al (2019). Starches are broken down into simple sugars during the fermentation process, which can improve the nutritional content and bioavailability. The cassava's starch is broken down by natural bacteria during fermentation, giving it a sour taste and a minor boost in nutritional value from the creation of specific vitamins and minerals. Garri, fufu, and lafun are fermented foods made from cassava that are minerals for energy production, iron metabolism, synthesis, immune system enhancement and protection of muscles, joints and skin damage. Although, there are resistant starch, a form of dietary fiber that is complex to digest and may serve as a prebiotic, encouraging a growth of advantageous intestinal bacteria found in considerable amounts in fermented cassava tubers such as fufu Ogbonnaya, Nwosu, Agbakoba, Njoku, Iheonu, Okoro, Okorie & Nwude (2022). Chijoke, Madu, Okeye, Ogunka, Ejechi, Ofoeze, Ogbele, Njoku, Ewaziem, Kalu, Onyemanuwa, Ukeje, Achowa, Forsythe, Fliede & Egesi (2021) define fufu as a wet paste that is ranked second after Garri. It is generally acknowledged, particularly by manual workers, that approximately 45–60% of the Nigerian cassava harvest is used to produce fufu. According to Alphonse, Kaale, Rweyemamu, and Millinga (2019), cassava is the second most important source of carbohydrates and is beneficial for manual workers due to its ability to produce energy, low protein content, provide vitamins and minerals for optimal function, and protect against obesity and diabetes. The main ingredient in fufu is fermentation, and it is processed by households and rural areas. In Igbo land, Nigeria, fermented cassava (fufu) is consumed with various traditional Nigerian soups, such as bitter leaf soup, ora soup, egusi soup, ogbolo soup, vegetable soup, pepper soup, veronica comforter soup and the like which are suitable for consumption of fermented cassava by the manual workers.

Manual worker is a person who performs strenuous physical labour with their hands. They are classified as individuals who work hard, put forth a lot of energy using their hands to conduct physical labour or muscular exertion regardless of the equipment or tools employed. These people get paid for their job. Their diet requires a lot of energy, restoration of worn-out tissue, maintenance of bones, and ease of digestion of foods. A manual worker is a person who works primarily in physical labour, utilizing their hands, muscles, and physical effort to accomplish tasks. These duties are frequently repetitious or physically demanding, requiring both physical exertion and hands-on effort. According to International Labour Organization (2020) those who "perform tasks that primarily involve physical effort rather than mental or intellectual work are refer to as manual laborers. A manual worker is someone who performs physical tasks using their hands and bodies such as construction workers, farm workers, transportation workers, factory workers, construction, manufacturing, mining, agricultural, and trade people. These individuals typically do not work in an office setting and rely on physical labour to complete their job. Manual workers' dietary needs are Carbohydrates to provide energy, water to replace dehydration in perspiration, Salt (NaCl): to replace salt lost in perspiration, Iron, to carry oxygen, oxidize glucose, etc. Individuals who do manual work need to consume more food than those who do sedentary work. Limit fat intake from



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animal foods. The diet should contain a wide variety of foods as possible, e.g., cereals, legumes, roots/tubers, fruits, vegetables, fish, lean meat, and local cheese (wara). (Chijoke et al 2021).

Halake & Chinthapalli (2020) stated that the microorganism responsible for fermentation of fufu include lactobacillus callobiosus, lactobacillus bulgaricus, lactobacillus brevis, lactobacillus plantarum leuconostoc esenteriodes and yeast in candida fermenta. The change in aroma and flavor in fermented cassava is a result of many volatile substances such as organic acid aldehyde, alcohol alkanes, and ketone generated during fermentation. The traditional fermentation of cassava also involves the lactic acid bacteria (LAB) community. Fermentation is crucial for enhancing a product's flavor, aroma, and safety, particularly by lowering its harmful cyanogenic glucosides. (Madi & Ugo 2021).

Nutritional Composition of Fermented Cassava Fufu

Macronutrients

Carbohydrate: Several researchers have examined the carbohydrate content of fermented cassava fufu, a staple diet in many parts of Africa. 70–80% carbohydrates mostly starch, depending on the source and processing techniques. Carbohydrate content in fermented cassava (fufu's) varies, although it typically ranges between 65 and 72 percent of its dry matter. Starch is the primary ingredient of carbohydrates, along with soluble fiber and resistant starch in considerable amounts. A 2020 study examined the nutritional makeup of Nigerian fermented cassava fufu and was published in the Journal of Food Science and Technology. According to the study, roughly 64.4% of the total dry matter (TDM) was made up of carbohydrates. Additionally, according to the study, the starch content was approximately 43.1% of the TDM (Adebowale, Ogunsanwo, & Afolabi, 2020). The chemical makeup of fermented cassava fufu from Ghana was examined in a different study that was published in the Journal of Cereal Science in 2021. According to the study, starch made up the majority of the carbohydrate content, which was almost 71.5% of the TDM (Asuming, Owiredu, Amoako, Owusu, & Kyei, 2021). The nutritional makeup of fermented cassava fufu from Cameroon was examined in a 2022 study that was published in the Journal of Food Science and Technology. According to the study, there was a considerable amount of resistant starch and the carbohydrate content was almost 69.5% of the TDM (Nsogang, Kameni, Tchana, & Fokou, 2022). Ethiopian fermented cassava fufu's nutritional makeup was examined in a 2023 study that was published in the Journal of Food Science and Technology. According to the study, there was a considerable amount of soluble fiber and roughly 67.2% of the TDM in the form of carbohydrates (Ayenew, Lemma, & Yimer, 2023). It is impossible to overestimate the significance of the carbohydrates in fufu as an energy source for physical laborers. Because they provide energy, prevent exhaustion, support muscular function, maintain blood sugar levels, and promote general physical and mental health, carbohydrates are crucial for manual laborers.

Protein: Protein is necessary for the body's tissue growth and repair. A staple cuisine in many regions of the world, especially Africa, is fermented cassava fufu. The type of cassava used, the fermenting method, and the inclusion of other ingredients are some of the variables that might affect the protein level of fermented cassava fufu. According to a study in the Journal of Food Science and Technology 2022, fermented cassava fufu prepared from the "Akarawa" a type of cassava had an average dry weight protein level of 6.3% (Oche, Ademiluyi, & Ogunleye, 2022). Fermented cassava fufu made from the well-known African variety of cassava (*Manihot esculenta*) had an average protein content of 4.5% on a dry weight basis. According to research by Oguntoyinbo, Ojo, and Afolayan (2020), published in the Journal of Food Science and Technology. The protein content can vary depending on the type of cassava used and the fermentation process.

Fat: - A staple cuisine in many regions of the world, especially Africa, is fermented cassava fufu. According to a study by Nwosu, Okeke, and Okoro (2024) that was published in the Journal of Food Science and Technology, fermented cassava fufu produced from several types of cassava had an average dry weight fat content of 0.8%. (Ugboma, Nwosu, and Ojmelukwe 2020). According to a 2022 study in the Journal of Food Science and Technology, fermented cassava fufu produced from the "Akarawa" variety of cassava had an average dry weight fat content of 0.6%. Fermented cassava fufu has comparatively low-fat content, usually between 0.3% and 1.2% on a dry weight basis. It is important to remember that the type of cassava used and the fermenting procedure can affect the fat content.

Fiber: Depending on the fermentation process, the kind of bacteria employed, and other variables, the amount of fiber in fermented cassava can change. High-fermentation (80%) cassava had higher fiber content than non-fermented cassava, according to a 2022 study published in the Journal of Food Science and Technology. With a mean value of 4.2% against 2.1%, respectively, the study discovered that the fiber content of fermented cassava was substantially higher than that of



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non-fermented cassava .Kumar, Mishra, and Kumar (2022) According to a different study that was published in the Journal of Food Engineering in 2022, the type of bacteria used had an impact on the amount of fiber that fermented cassava contained, and it rose as fermentation levels increased. With a mean value of 3.8% compared to 1.8% for non-fermented cassava, the study discovered that the fiber content of fermented cassava was substantially greater. Zhang, Li, Wang, Chen, and Zhang (2020). Because they require a lot of energy, manual laborers need macronutrients. In addition to preventing fatigue, a balanced diet that contains enough fat, protein, and carbs can also boost muscle function, improve performance, lower the chance of injury, and improve general health.

Micronutrients: Vitamins and minerals are important micronutrients for sustaining general health and productivity in manual workers. Energy levels can be raised, immune system support, bone health, muscle function, injury risk reduction, and general well-being can all be improved with a balanced diet that contains enough micronutrients. Micronutrients are necessary nutrients that the body needs in trace amounts. (Kumar & et al 2022)

Minerals are inorganic substances necessary for many body processes, including energy production, neuron function, and bone health, whereas vitamins are organic molecules necessary for immune function, growth, and energy production, because of their greater energy requirements, micronutrients have a slightly higher recommended dietary allowance (RDA) than the general population.

Antioxidants are compounds that assist shield cells from oxidative stress brought on by free radicals, which are unstable molecules. In order to stop free radicals from damaging cells and tissues, antioxidants neutralize or absorb them. Flavonoids, phenolic acids, and alkaloids are among the many antioxidants found in fermented cassava fufu. By reducing the starches and boosting the antioxidants' bioavailability, fermentation is a technique that can raise the antioxidant content of cassava fufu. In order to shield manual laborers from the damaging effects of oxidative stress, antioxidants are essential. A diet high in antioxidants can help strengthen the immune system, prevent chronic diseases, increase endurance, speed up recovery, and lessen muscle damage. A balanced diet that includes a range of foods high in antioxidants should be the goal for manual laborers in order to promote their general health and wellbeing. Oxidants are abundant in fermented cassava fufu. Fermented cassava fufu's precise antioxidant content can change based on a number of variables, including the kind of cassava used, the conditions and length of fermentation, and the processing techniques employed. According to a 2020 study in the Journal of Food and Nutrition Research, fermented cassava fufu had significant concentrations of beta-carotene, vitamin C, and vitamin E, among other antioxidants. According to the study, fermented cassava fufu had more antioxidant activity than raw cassava fufu. High concentrations of antioxidants, including as polyphenols, flavonoids, and phenolic acids, were discovered in fermented cassava fufu, according to a study published in the International Journal of Food Science and Technology (2022). According to the study, fermented cassava fufu has a stronger antioxidant activity than other starchy meals like potatoes and rice. According to the International Journal of Food Science and Technology (2022), fermented cassava fufu's antioxidants can offer manual laborers a number of advantages, such as defense against oxidative stress, decreased inflammation, strengthened muscles, improved immunity, and improved general health.

Phytochemicals: In order to defend themselves against environmental stressors, illnesses, and pests, plants naturally develop a wide range of molecules known as phytochemicals. They are present in whole grains, legumes, fruits, vegetables, and other plant-based diets. Additionally, it includes phytochemicals with anti-inflammatory and anti-cancer activities, like saponins. When it comes to shielding manual workers from these harmful impacts, phytochemicals can be extremely important. According to Food Chemistry (2022), phytochemicals are a crucial component of a manual laborer's diet. They can enhance post-exercise recovery and offer protection against oxidative stress, inflammation, and muscle damage. Manual workers can lower their chance of developing chronic illnesses and enhance their general health and well-being by including foods high in phytochemicals in their diet. Considering factors such as digestibility, safety, and cultural acceptance (Asuming et al 2021).

Process of cassava fermentation for human consumption

Step 1: - The cassava tuber is peeled, washed, and cut into smaller sizes before it is submerged in a big bowl or drum of water for about 4-6 days depending on the species of the cassava. The reason for peeling is to make the end product, which is fufu to have an attractive white colour that is appetizing to consumers. Most time, some people prefer to soak it unpeeled especially for mass production because of time consumption, but the end product is not appetizing like the peeled cassava except if soaked in running water.



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Step 2: - When the fermentation process is completed, the cassava is decanted and the fermented cassava tuber is washed thoroughly before sieving, the suspension is allowed to sediment, the supernatant water is removed, then the slurry is poured into a bag, and allows water to drain out and dry.

Step 3: - The pressed mass is cooked to fufu or akpu with the traditional method, gently mix the fermented cassava to give a smooth paste, pour into the pot and begin to stir continuously till the fufu is set for about 15-20 minutes, allow steaming for about 5 minutes and wrapping to the desired size.

Another method of cooking fermented cassava is by pouring the wet paste into a bowl and mixing vigorously to achieve average consistency, then put the fermented cassava in nylon, place it in a pot, add water, then place it on the fire. Allow to boil for about 5 minutes, bring it down, and mix thoroughly, then wrap in white nylon and allow cooking for about 15 minutes.

Step 4: - Pound in mortal and pestle till it is smooth and lump-free pliable dough is achieved, then wrap in white nylon and ready to be served.

Benefits of fermented cassava tuber to manual workers

1. **Boost energy levels:** Fermented cassava is high in carbohydrates, which give manual workers an immediate energy boost that keeps them stable and energized throughout the day. It is also a great source of energy for manual labourers. Workers can continue their physical performance for longer time, thanks to the high starch content, which helps to give a rapid and consistent release of energy. (Kim., Almera, Brianna. 2023).
2. **Better digestion:** Cassava's complex carbohydrates are broken down into simpler ones through fermentation, which helps enhance nutrient absorption and digestion. This can guarantee that employees are getting the most out of their diet and help avoid stomach problems. By enhancing digestion and nutritional absorption, this can guarantee that manual laborers get the nutrients they need to sustain their physical activity. The comparatively easy digestion of fermented cassava fufu is crucial for manual worker who require nourishment that would not slow them down or create digestive discomfort.
3. **Improved absorption of nutrients:** Fermented cassava is high in potassium, iron, and vitamin C. In addition to being crucial for preserving general health, these nutrients might assist prevent deficits in manual workers, whose physical labour may raise their nutrient requirements.
4. **Decreased inflammation:** Fermented foods have anti-inflammatory qualities; they can help manual workers feel less sore and less irritated. This can speed up recuperation and lower the chance of overuse injuries.
5. **Increase energy level:** Fermented cassava's carbohydrates give manual workers a fast energy boost that helps them stay energized throughout the day and complete activities more quickly. When performing physically demanding tasks, manual workers can quickly get their energy from carbohydrates.
6. **Improved recuperation and less exhaustion:** Vitamins and minerals included in fermented cassava can aid in lowering inflammation, accelerating muscle repair, and easing weariness. By doing this, manual workers can recuperate from physical strain faster and continue to give their best effort every day.
7. **Packed with micronutrients** Iron, zinc, and B vitamins are among the micronutrients found in fermented cassava fufu, which are crucial for sustaining vitality and general health.
8. **Improved immune function:** Foods that ferment, such as cassava, include good bacteria that help boost immunity and promote gut health. This can help manual workers stay healthy and productive by lowering their risk of infection and illness. Fermented cassava still contains protein, which is essential for muscle growth and repair, although it is not as high as other proteins found in meat or legumes.
9. **Fermented cassava's vitamins, minerals, and antioxidants** can offer a variety of health advantages, including as better cardiovascular health, less inflammation, and increased general wellbeing. By ensuring that manual workers are healthy and capable of doing their jobs as effectively as possible, this can increase their overall effectiveness and efficiency. Studies have looked into how fermented cassava fufu affects manual workers. Fermented cassava fufu's antioxidants and phytochemicals may lessen oxidative stress and exhaustion brought on by hard exertion.
10. **Low cost:** Fermented cassava fufu is frequently made locally and can be an affordable meal choice for manual workers with tight finances (Kim. et al 2023).

Conclusion



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Fermented cassava tuber is a staple food in many regions of the world, has a special nutritional makeup that may help manual workers. A significant concentration of macronutrients, vital micronutrients like calcium, zinc, and iron, antioxidants, and phytochemicals were found in the fermented cassava tuber. According to the study, fermented cassava tuber can significantly increase the nutritious intake of manual workers, especially those in physically demanding jobs. Increased muscle strength, endurance, and general physical performance can be facilitated by the high quantities of macronutrients and vital micronutrients including iron, zinc, calcium, antioxidants, and phytochemicals. Furthermore, by improving the nutrients' bioavailability, the fermented product might lessen weariness and lower the risk of chronic illnesses including osteoporosis and anemia. It is advised that manual workers, especially those in underdeveloped nations where access to nutrient-dense foods may be restricted, include fermented cassava tuber in their diets. The study emphasizes how crucial it is to investigate traditional food items like fermented cassava tuber as a possible way to enhance the dietary health of manual workers.

Recommendations

1. Fermented cassava tuber should be included in meals, as a source of protein, fiber, and vital micronutrients, fermented cassava tuber can be included in the diets of manual workers.
2. Encourage traditional food practices to improve the nutritional content of staple foods, initiatives should be taken to encourage traditional food practices like fermentation.
3. Nutritional education is important to inform manual workers about the nutritional advantages of fermented cassava tuber and how to include it in their meals, educational initiatives should be put in place.
4. Food fortification, by increasing the nutritional value of fermented cassava tuber, food fortification initiatives can be put into place, making it an even more potent instrument for enhancing the nutritional health of manual laborers.

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