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PRODUCTION OF FERMENTED BEVERAGE USING TIGER NUT MILK, COCONUT AND COCONUT WATER

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ABSTRACT

This study sought to explore the possibilities of creating a fermented drink from coconut and tiger nut which can be used as a beverage, to conduct a sensory evaluation on the product and observe the shelf-life of the product. By this new product the study sought to address the problem of non-communicable diseases in Ghana. A descriptive study design was employed in which a sample of 50 untrained respondents (consumer panel) was selected by simple random to assess the product's sensory characteristics and indicate their preferences. Data was collected using a structured sensory questionnaire administered to each respondent to assess and express their acceptance of the product in terms of its taste, colour, flavour and appearance. The study revealed that respondents expressed high acceptance for the taste, colour, flavour and overall appearance of the product. In all, 76 per cent of sampled respondents liked the drink as against only 4 per cent expressing their dislike of it by its taste. A significant proportion (24%) could not form an opinion about the drink. Regarding both flavour and colour, an overwhelming 90 per cent of respondents liked the drink, however, those who '*liked it very much'* by its colour (64%) were more than by its flavour (50%). By its overall appearance, (i.e. colour, size, shape, packaging) 90 per cent liked the drink as compared to eight per cent who disliked it. Another eight per cent could not express an opinion about the product's overall appearance.

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INTRODUCTION

A very complex interrelationship exists between food nutrient intakes and health; which complex also exists between people and food. Nevertheless, all living organisms including man require food to provide them with nutrients for survival and which they obtain from the foods consumed. Provision of healthier foods, e.g. fruits and vegetables do not normally come cheap and changing people's dieting habits is not easy either; because, learned habits are not easy to change. Food people eat form an integral part of their cultural identity, and are especially influenced by their social relationships, because of that they lack absolute control over what they will habitually eat. Healthy dietary habits guarantee healthy life both in the short-term and long-term (Bleich *et al*, 2015). Therefore, poor eating habits, i.e. excessive consumption of one nutrient or more; or inadequate intake of one or more over time will lead to malnutrition.

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These foods can either be taken in liquid forms referred to as beverages or drinks. Basically a beverage is a type of liquid which one can consume for sustenance, energy or hydration. The wide variety of beverages that we now have available means we can satisfy our thirst or cravings on countless different ways (Liu, 2016). Beverages are classified into two: alcoholic and non-alcoholic. Alcohol beverage usually will contain 62% - 75% ethanol which is produced when yeast cells are introduced into metabolise carbohydrates such glucose, sucrose, etc into ethanol also called ethyl alcohol. Non-alcoholic beverage on the other hand contains no alcohol. Tiger nut (Cyprus esculentus) is a member of the cyperaceae family with several local names including "chufa", zulu nut and yellow nut sedge (Pascual *et al*, 2000; Ruber *et al*, 2011). In Ghana Gas call it Atungme, "Atadwe" by the Akans and "nansaxa" by Dagamba (Dokosi, 2008). Tiger nut is cultivated across several continents including Africa. Asia and Europe are the other known countries that have extensively engaged in the production of tiger nut for years because of its food value and commercial importance (Torell et. al., 2003). Spain has well established industry with a lot of experience on tiger and its products; as a result has seen continuous production outputs ranging between 15 tons to 20 tons over the years (Mosquera *et al*, 2006; Pascaul *et al*, 2000, cited in Sanchez-Zapata et. al,

2012). According to CRDO (2012, cited in Sanchez-Zapata et. al, 2012), about 5300 tons of tiger nut tubers valued at approximately 5 million Euros was produced in Valencia Region in Spain in 2009. Serrallach (2007) tubers of tiger nut were found in Sarcophagi and Egypt tombs of the first Dynasties, and from Egypt the cultivation of tiger nut spread throughout North Africa reaching the Iberian Peninsula and Sicily with Islamic waves of middle ages. Coconut is abundantly available in Ghana, particularly across all the five Coastal regions (i.e. Volta, Western, Greater Accra, and Central). It is usually eaten as a snack and comes in two forms: the immature green type normally carted on trucks by vendors around the streets of towns and villages for sale to the consuming public. The other type, the mature ones with brown hairy hard shells is also sold by vendors commonly eaten with 'agbolokaklo'. The various edible components of coconuts contain vital nutrients essential body health. Coconut water for instance, is a rich source of minerals such K, Ca, etc. which function as electrolytes in the body. Coconut milk is known to provide essential fats, medium chain fatty acids which aid in weight loss; it strengthens the human defense system and particular constituent responsible islauric acid; it supplies vitamin C, iron, magnesium, protein, fat, carbohydrates, etc. (Eske, 2018). Ginger (or more precisely ginger root) is a rhizome of a flowering plant with the same name ginger. Their roots have been in use as a spice and as medicine since the ancient times. Ginger first appeared in the South part of Ancient China. From where, it spread to India, Maluku Islands (so called Spice Island), rest of Asia and West Arica (Ravindran, 2016).

Problem Statement: Both tiger nut and coconut have long been promoted for having a variety of health benefits. Coconut and tiger nut juice are each taking separately as a nourishing milk and helps to provide nutrients required by the human body. This study therefore will help the less privilege like children and people with gum problem to have a taste of the product and enhance its consumption. According to Masson (2005), the nut helps to prevent heart attack and cancer especially, of the colon. They are taught to be beneficial to diabetics and to those seeking to reduce cholesterol, lose weight due to its high fibre content combined with a delicious taste, and make them ideal for health eating. Recent studies suggest that tiger nut and coconut consumption have potential to cause weight loss, maintain normal blood pressure and other form of sicknesses. However, coconut and tiger nut are still among the under utilised food commodities in Ghana. It is against this background that this study sought to produce a fermented drink from tiger nut and coconut as a way of diversifying their utilisation.

Objectives: The main objective of the study was to attempt using tiger nut milk and coconut with its water to produce a fermented beverage and conduct sensory evaluation on it.

Literature: Coconut or products from it, i.e. coconut flesh, coconut water, coconut oil, and coconut cream each provide one or more health benefits to those consuming them. Coconut oil for instance, is considered the best and safest oil used for cooking; it is safer than olive oil when it comes to giving the body what it needs for optimum health. Unlike other fats or oils commonly used for cooking and baking, coconut oil does not form by-products hazardous such as trans fatty acids in our bodies, which have negative health consequences to man. Coconut oil can give the body vital antioxidants that can help build stronger cells and improve overall health and well-being. Coconut water is completely pure, sterile and contains the highest concentration of electrolytes than anything else found in nature; for which reason, it can be used for blood transfusions (Paniappan, 2002). Tiger nuts have been cultivated by humans for many centuries. It has cylindrical tubers of several species of black, brown and gold. Today, tiger nut is widely used all over Africa, the tuber called 'nut' is unearthed in winter and summer; distributed and commercialized all over the world. The high fibre content of the chufa makes it effective agent in aiding bowel movement and colon cleanser (Nomah, 2018). Fermentation is an anaerobic somehow complex biochemical process by which minute organisms, usually single-celled produce ATP from a range of organic molecules without using oxygen. Almost all food commodities (both plant and animal origin) are capable of undergoing fermentation. Food fermentation is not a recent phenomenon; it has been with us from ancient times. However, many different techniques, raw commodities and microbes have been used to produce fermented foods and beverages across the different regions of the world. Fermentation has been one major technique which people of old adapted as a means of ensuring food security during harsh long periods of unfavourable which reduced crop yields.

Even though globally today, fermentation is widely in use not only for extending the keeping quality of food, but because there is growing desire by consumers for the organoleptic characteristics of fermented food. Fortunately, there is a wide variety of food commodities that can be fermented. They range from cereals, roots and tubers to vegetables as well as animal foods, typically, fish and meat. Fermented cereals and fermented roots and tubers are consumed throughout Africa, Asia, and Latin America, in various forms including breads, porridges, gruels, and pickles. Fermentation as a technique of food production is highly regarded in many regions of the world; for instance, to those of the underdeveloped world, it is important in extending the shelf-life of their food enabling them to keep food at ordinary air temperatures. It also generally contributes to dietary variety, enhance nutrient quality and safety. A wide range of grains, fruit and vegetables are also used to manufacture beverages, both thirst quenching products (mostly nonalcoholic), and those which are generally alcoholic and consumed on special occasions, including festivals. The former include tea, coffee, juices, nectars, syrups, and carbonated soft drinks. In some countries these are also used on special occasions, whereas in others alcoholic beverages, which may or may not be distilled, are preferred. In most countries, the market for alcoholic and non-alcoholic drinks is specific with regard to religious and cultural taboos.

Fermentation as a technique of food processing is basically the conversion of carbohydrates into a variety of organic acids, alcohol and carbon dioxide by the action of microbes, typically bacteria, yeasts, or rarely moulds, or their combination. It is regarded a desirable action of microbes in food, which process is used to produce both alcoholic and nonalcoholic beverages such as wine and beer and a variety of foods. Generally, there are two main types of fermentation: lactic acid fermentation and alcoholic fermentation. Lactic acid bacteria play a key role in food fermentations where they contribute to the development of desired sensory properties in the final product. The lactic acid bacteria activity brings about the production of organic acids; which organic acids are responsible for not only the shelf-stable properties to fermented foods, but for

contributing to their flavours, taste, etc. In lactic acid fermentation, simple carbohydrates are converted to pyruvic acid, subsequently to lactic acid; a type of fermentation carried out by the starter culture bacteria during yogurt manufacture. As part of post-mortem or periods of extraneous physical activity in man, muscles also carry out this type fermentation (anaerobic respiration) which, in the live animal can lead to muscle cramps, fatigue, etc; however, in carcasses its occurrence may be desirable depending on the extent. In alcoholic fermentation, pyruvic acid changes to alcohol and carbon dioxide. This type of fermentation is carried out by yeasts and some bacteria. It is used to make bread, alcoholic beverages as well as biofuels (Godbey, 2014). Singh (2011) there are two processes of making fermented drink: spontaneously or continuous fermentation. In spontaneous, the beverage to be fermented is put in a container and left for a maximum of 3 days, within which period natural bacteria in the environment will grow in it; feeding on carbohydrates and other constituents in the beverage. However, in controlled fermentation, specific strains of bacteria will be added to the beverage stored under controlled temperature for a certain number of hours for fermentation to occur.

MATERIALS AND METHODS

Fermented tiger nut coconut beverage recipe

- A reasonable quantity of tiger nuts are obtained from the market clean by removal of unwanted substances, i.e. stones, sand and rotten or nearly rotten tiger nuts; wash and soak for at least 24-hours (or until the nuts are soft enough).
- Break the coconut(s) (mature type) and pour their juice (water) into storage container and allow fermenting for a later use.
- Shred the hard edible part of the mature coconut and add to your tiger nuts.
- With a little ginger (as flavor), mill the tiger nuts and your shredded coconut together into a smooth mixture.
- Add a little amount of water to aid in sieving the liquid from the solids.
- Sieve the smooth mixture using a fine cloth or sieve.
- Add your fermented coconut water to the liquid extract.
- Bottle your drink and it is ready for consumption; or you can allow for further fermentation if the coconut water was not adequately fermented.

The study utilized a simple random sampling technique to select a sample size of 50 respondents to constitute the sensory panel. Each of the sensory panelists selected was presented with a sample of the drink to taste and give their opinion about the fermented mixed tiger nut milk and coconut. This population was appropriate because of its heterogeneous characteristics and as a replica of the population under study. Structured sensory evaluation questionnaires were used to obtain views of respondents on the colour, taste and packaging of the fermented drink made from coconut and tiger nut. The questionnaire as a research instrument was designed to aid respondents in expressing their preferences for the beverage by its organoleptic characteristics (i.e. taste, flavour, texture, colour, etc.).

RESULTS AND DISCUSSION

An analysis of the study respondents regarding their opinions about the product showed it is most likely to see high patronage, should the product be marketed. Out of a total of the 50 respondents, 52 per cent liked the drink very much, 20 per cent liked it moderately; 24 per cent said they neither like nor dislike the beverage colour whilst the remaining 4 per cent disliked it. In a comparative study, Sanful (2009) revealed that a higher proportion (95 per cent) of respondents liked a non-roasted tiger nut beverage by its taste than the current study finding of 76 per cent. This could be attributed to a difference in their processing procedures which most likely reason why the two beverages would exhibit different organoleptic characteristics. That is, in the current study the beverage was fermented which was not the case in Saufl's study which was also not made from a mixture of products. The flavour of the fermented tiger nut and coconut beverage was assessed and the findings show that overall, 90 per cent of respondents liked it with none expressing their dislike for it. However, 10 per cent were not decided.

Flavour as a composite variable comprising both taste and aroma, in the current study there was a higher acceptance for the fermented beverage flavour (90 per cent) as against Sanful (2009) in which 85 per cent accepted the beverage. The study has already established in literature, that many people across the different regions of the world process food by fermenting because of the accompanying new flavours that come with it; and therefore, this difference can be attributed to the fermentation of the beverage of the current study. The colour (appearance) of the fermented beverage as assessed by the sampled respondents revealed that out of a total of 50, 64% of the respondents indicated they moderately liked it whereas 26 per cent liked it very much (a total of 90 per cent liking the beverage); unlike Sanful, where a little less than 100 (98 per cent) accepting the beverage. Fermentation apart from the new flavours it may imparts on products, it also may affect their turbidity, particularly beverages. Therefore, the difference in the proportions of those who accepted the beverage in the previous study and current may be attributed to this. The respondents who neither like nor dislike the beverage were 8 per cent whereas only 2 per cent disliked it. Results from the sampled respondents evaluation of the product's packaging (size, shape, colour, inscribed information on the package) are

Table 1. Study respondent's preferences for beverage by its organoleptic characteristics

Preference level	Colour	Flavour	Taste	Packaging
	# (%)	# (%)	# (%)	# (%)
Like very much	26 (13)	50	26(52)	26 (52)
Like moderately	64 (32)	40	12 (24)	16 (32)
Neither like nor dislike	8 (4)	10	10 (20)	4 (8)
Dislike moderately	2 (2)	0	0	4 (8)
Dislike very much	0	0	0	0
Total	50 (100)	50 (100)	50 (100)	50 (100)

Source: Field data, June, 2019

In all, 90 per cent accepted the beverage as against 8 per cent disliking it. Another 8 per cent neither liked nor disliked the beverage based on the packaging.

Conclusion and recommendation

The main objective of the study was to use tiger nut and coconut in the production of fermented drink and conducting sensory on it. It was revealed that flavour, colour, packaging/ appearance, and taste were all likeable. Except for the taste, the remaining three eating quality attributes par in the overall respondents preferences.

Conclusion

The tiger nut and coconut have a lot of health benefits. The study showed that they have very vital and well known health benefits and thus makes the product worth promoting. Based on the result, the tiger nut and coconut beverage is most likely going to compete well other similar beverages currently on the consumer market. Based on the literature findings the tiger and coconut beverage should be incorporated into Ghana school feeding programme and served as a nutritious snack to all senior high school students who currently are receiving one-hot meal each day. As a way to reducing unemployment, government should support the youth in its commercial production.

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