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Improvement of Quality Attributes of Nuggets Using Banana Trunk (Musa Balbisiana)

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Abstract

Nuggets are one of the fast foods designed for commercial resale, with a strong emphasis on service speed. It is a commercial term, limited to food sold in a restaurant or store with frozen, preheated or precooked ingredients. Developing banana trunk innovations into nuggets with a satisfying taste will attract the public to try a healthier and more affordable product. This study aims to identify the sensory properties of banana trunk nuggets at four different levels: control, 100%, 90%, and 80%. For identifying the key attributes of control and banana trunk nuggets, samples were evaluated by an untrained panellist using 6 attributes from the hedonic test. The test was carried out by 40 untrained panellists from Tun Syed Nasir Syed Ismail Polytechnic, Johor, who were students enrolled in Food Technology semester 4. Statistically significant differences ($p < 0.05$) evaluated by the untrained panellists were found in the taste, flavour, and overall acceptability scores among the F1, F2 and F3. Sensory evaluation showed that banana trunk nuggets with a 100% banana trunk addition were the most well-accepted. In conclusion, the implementation of various formulations for banana trunk nugget products has the potential to revolutionize the industry and expand its marketing reach globally.

Keywords: - Banana trunk, nugget, sensory characteristics

1. Introduction

The majority of the world's tropical nations are responsible for producing bananas as their primary crop. Nearly sixty per cent of the biomass of bananas is wasted after harvesting. Around 114.08 million metric tons of bananas are thrown away every year, which contributes to a variety of environmental problems, including an excessive release of greenhouse gases. It is possible to obtain bioplastics, organic fertilizers, and biofuels such as ethanol, biogas, hydrogen, and biodiesel from these wastes because they contain a high content of substances that are of the utmost significance to the industrial sector. These substances include cellulose, hemicellulose, and natural fibres. The cultivation of bananas in Malaysia makes it the country's second most frequent fruit crop. Statistics from Malaysia's Ministry of Agriculture show that in 2016, the country's banana plantations occupied over 30,320 hectares and yielded 321,810 tonnes of fresh banana fruit. A banana tree only has to blossom once to bear fruit. Once the fruit is harvested, the entire plant is thrown away. Every tonne of bananas produced results in over 100 kg of waste. Banana farmers would benefit greatly if this enormous amount of waste could be recycled into usable material. Taking these factors into account, it is clear that the production of activated carbon from banana waste is beneficial to farmers in two ways: it increases revenue and significantly reduces waste.

Banana Trunk has been reported source of polyphenols or antioxidants, such as catechin, protocatechuic acid, caffeic acid, ferulic acid and cinnamic acid trunk is a rich source of fibre and helps in heart diseases. Pseudostem has a low glycemic index and a high content of fibre and antic which is good for diabetes. Banana stems are a rich source of fibre, total carbohydrates and cellulose (Amutha et al., 2020). The increased reliance on fast food has significantly

decreased the intake of fruits, vegetables, and legumes, leading to a change in lifestyle. This is because the diet plan has much less fibre than what is recommended in modern society. The majority of the studies examined the many advantages of consuming fibre in relation to weight loss and obesity management, which is a contributing factor to cardiovascular, diabetes, neoplastic, and metabolic disorders. Researchers are demonstrating interest in developing fibre-enriched food products by adding fruits, vegetables, or extracted fibre from other sources to meals, due to the numerous advantages of fibre intake. It is advisable to prioritize obesity control by incorporating a greater quantity of fruits, vegetables, and fibre-rich foods into the diet plan (Sarker & Rahman, 2017).

The banana stem is a cost-efficient food product as it is usually considered a waste product and brings waste in use which has so many characteristic qualities. The pseudostem central core is rich in fibre and it helps to relieve constipation (Dixit, 2019). Nuggets are a type of food that vegetarians eat. All this time, the nuggets consumed by vegetarians are mushroom nuggets, which are basically nuggets made of oyster mushrooms as their main ingredients (Hasbiyati et al., 2019). The minerals, volatile chemicals, and free amino acids (especially glutamic acid and aspartic acid) that are abundant in mushrooms influence their flavour (Bach et al., 2017; Eguchi et al., 2015; Mau, 2005; Mau et al., 1997). The flavour of mushrooms was discovered to consist of water-soluble taste components, such as 5'-nucleotides and free amino acids, which contribute to the umami taste of mushrooms. Monosodium glutamate (MSG) typically absorbs the umami flavour, sometimes referred to as a pleasant taste (Chun et al., 2020). However, sooner or later the flavour of mushroom nuggets can be boring (Tepsongkroh et al., 2019). A banana trunk can be one of the new innovations to substitute the main ingredients of nuggets originating from plants while maintaining taste consistency.

The banana plant is one of the crops of the community with the most potential, but as far as the community is aware, the fruit from the banana plant is only used as a snack food and sold to collectors; the leaves are used for manufacturing packaging containers cookies and other items; and the banana stems have only been used as animal feed so far. Even when considering the health benefits of banana trunks for humans, it is worth noting that they can treat and cure various kinds of diseases, such as detoxification of the system, digestion, weight loss, control of cholesterol and blood pressure, curing stomach acid, and stabilising blood sugar. There are still many benefits of the stem bananas for health (Lestari et al., 2023).

The objective of this study was to identify the specific sensory characteristics that impact consumer satisfaction with various nuggets made from banana trunks, as well as establish a connection between these features and the ingredients and manufacturing techniques employed.

2. Materials and Methods

2.1 Materials

The main ingredient used in this study was the centre core of the banana trunk (Musa balbisiana). The banana trunk was obtained from the supplier. Essential high protein flour, textured vegetable protein (TVP), gram dhal flour, minced chicken, soya chunk and other ingredients were purchased from L&L Best Supermarket Pagoh, Johor.

2.2 Preparation of Banana Trunk Paste

The method described by Sundari et al. (2022) was utilised in the preparation of banana trunk paste; nevertheless, modifications were made to the methodology. To get rid of any traces of sand that could have been left behind, the banana trunk paste was swiftly washed under running water. Following the washing process, the trunks of the bananas were immersed in salt, stirred thoroughly and then set aside. The trunk of the banana was then chopped into three to four sections so that it was not excessively long (1.5 – 2.0 m). For the purpose of making banana trunk paste, pieces of banana trunk were ground thoroughly in a food processor (Panasonic, model MK-5087M, Malaysia).

2.3 Preparation of Nugget Samples

At three percentages (100%, 90%, and 80%), the banana trunk was used in place of minced chicken in the nugget samples, as shown in Table 1. All the raw materials were added and the ingredients were thoroughly mixed in a mixer (Kenwood Mixer, model KM336, Malaysia) until a desired consistency was obtained. Next, the mixture was moulded into a round shape of 20 g per sample. Nugget samples were kept in a blast freezer (Techfrost, model JOF-23, Malaysia) for 20 minutes at - 30 o C. Nugget samples were coated with batter and bread crumbs. Then, the nugget samples were frozen in a blast freezer (Techfrost, model JOF-23, Malaysia) at -18°C for 15 minutes. The nugget samples were packed in polyethylene (PE plastic) and kept at - 18°C in a chest freezer (Pensonic, model PFZ-203, Malaysia).

Table 1. Formulation of Banana Trunk Nuggets Added with Different Percentages of Banana Trunk (Musa balbisiana)

Ingredients	Formulations (%)			
	C (0%)	F1 (100%)	F2 (90%)	F3 (80%)
Minced chicken	57	-	-	-
Banana trunk	-	57	52	45
Textured vegetable protein (TVP)	11	11	16	23
Gram dhal flour	9	9	5	13
High protein flour	9	9	13	5
Potato starch	8	8	8	8
Kurma powder	3	3	3	3
Salt	0.9	0.9	0.9	0.9
Black pepper	0.7	0.7	0.7	0.7
Sugar	0.6	0.6	0.6	0.6
Sodium tripolyphosphate (STPP)	0.4	0.4	0.4	0.4
Garlic powder	0.3	0.3	0.3	0.3
Monosodium glutamate	0.1	0.1	0.1	0.1

C (control) = 100% Minced chicken, F1 = 100% Banana trunk, F2 = 90% Banana trunk, F3 = 80% Banana trunk

2.4 Sensory Evaluation of Banana Trunk Nuggets

The hedonic test was conducted to evaluate the degree to which the banana trunk nuggets, compared to the commercial chicken nugget (control nugget), were liked overall. The sensory analysis was conducted to compare the different perceptions. 40 untrained consumer panellists were used for the evaluation at the Sensory Laboratory C12, Tun Syed Nasir Syed Ismail Polytechnic. The panellists were asked to rate four samples based on the degree of liking on a nine-point hedonic scale (1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = Neither like nor dislike, 6 = like slightly), 7 = like moderately, 8 = like very much, 9 = like extremely, respectively. The panellists were asked to indicate their level of acceptance in the nine-point hedonic scale questionnaire, comprising colour, shape, taste, texture, flavour and overall acceptance. All the nugget samples were deep-fried for 104 seconds, cut into the same size and arranged on a plate while a cup of water was served for mouth rinsing. There were four different samples given at each sensory evaluation session. Each test sample was coded with a three-digit random number to avoid bias. The panellists evaluated the nugget samples based on a hedonic scale of 9 points ranging from 1 (extremely dislike) to 9 (extremely like).

2.5 Statistical Analysis

All tests were run in triplicate with the exception of the sensory analysis, which used a total of forty samples. The experimental design was entirely randomized, and a statistical analysis instrument was utilized to evaluate the analysis of variance (ANOVA) on the experimental data (SPSS Statistics 26). In Duncan's multiple range tests, the significance of the difference between the means was established at the level of 0.05.

3. Result and Discussion

3.1 Sensory Evaluation of Banana Trunk Nuggets

The term "hedonic scale" refers to a scale that measures the degree to which respondents have an overall preference for something or dislike it. An example of this might be a product that they tried (Baba et al., 2016). According to the untrained panellists' data, there were statistically significant ($p < 0.05$) improvements in taste, flavour, and overall acceptability scores between the 100%, 90%, and 80% banana trunk. Nevertheless, the panellists noted that using high-protein flour as a filler resulted in delectable banana trunk nuggets. In general, using a smaller proportion of high-protein flour led to a higher taste rating for banana trunk nuggets. Fig. 1 provides a more comprehensive representation of the taste measurement outcome. Previous research has indicated that the primary determinant of the taste of chicken nuggets is the seasoning, including sodium chlorides, polyphosphates, and sugar (Barbanti & Pasquini, 2005).

Several factors influence consumer decisions to purchase nuggets, including the product's visual appeal, flavour, scent, and texture. Typically, people prefer meat products that are of superior quality and are safe to ingest. These goods should also possess natural flavours and fragrances (Aymerich et al., 2008). The flavour of meat products is primarily influenced by two factors: taste and scent. Consumers regard flavour as the most significant factor that shapes their behaviours and preferences when purchasing meat products before consumption (Sitz et al., 2005). In the past twenty years, chicken has been increasingly popular as a result of its distinct flavour and texture in comparison to those of other types of meat. Due to the increased nutritional profile of poultry meat and the widespread use of chicken in the food business, this type of meat comes highly recommended for use in a variety of

chicken-based products (Rebezov et al., 2021). In addition to this, it has a natural balance and an enhanced nutritional profile, making it a different food in comparison to others with characteristics such as a profile of amino acids, a high protein content with a lower fat content, and the presence of a variety of minerals and vitamins (Pinto da Rosa et al., 2021). Chicken-based foods, such as burgers, sausages, and nuggets, have broad economic appeal and widespread consumer acceptance. High levels of water and nutrients in fresh chicken flesh make it very perishable and reduce its shelf life (Candan & Bağdatlı, 2017). Consumer preferences in the vicinity of food production have shifted dramatically in recent years. Foods today is developed not only to satiate human appetite and provide necessary nutrients, but also to treat nutritional disorders and boost both physical and mental well-being (Siró et al., 2008). Functional foods can be classified as either industrially processed or natural food products. When consumed as part of a diverse diet in sufficient quantities, these foods have the potential to offer significant health advantages beyond their necessary nutritional value (Alongi & Anese, 2021).

However, the addition of banana trunk did not have a significant impact ($p > 0.05$) on the colour, shape, or texture of the nuggets. Scores for overall acceptance, aroma, flavour, and taste were all different (Fig. 1). Zaini et al. (2020) proposed that incorporating fibre-rich components, such as 2% banana peel powder, into food products can enhance its sensory properties and overall consumer acceptance. The study conducted by Zaini et al. (2019), which demonstrated that fish patties containing a 2% concentration of banana peel powder exhibited the highest level of overall acceptability based on sensory evaluation, aligns with the findings. The texture of processed meat products, such as chicken nuggets, has a crucial role in determining consumer acceptability of the product. According to Robbins et al. (2003), taste is not the only key component for consumer satisfaction when it comes to texture. Tenderness and juiciness are also crucial aspects. Juiciness is a metric that measures the amount of liquid in a product, a preference for products that are juicier due to the improved sensation in the mouth. Das et al. (2013), attribute the decreased moisture retention and increased shrinkage in thinner meat products to their lower juiciness percentage compared to thicker meat. One of the processed meat products is nuggets. Nugget is a form of ground meat product that is seasoned, covered with flour adhesive, breading, and fried half-cooked and then frozen to maintain its quality during storage. Nuggets, like processed meat products, generally have the disadvantage of low fibre content. The ability to bind water influences the texture and liking of nuggets. Texture has a great influence on the yield, a compact texture on the nugget will increase the yield percentage. Yield is the weight percentage of nuggets produced. Chicken nuggets are generally considered a fatty and unhealthy food. A study published in the American Journal of Medicine analyzed the composition of chicken nuggets from two American fast-food chains. It was found that less than half of that material was skeletal muscle, with fat occurring in equal or greater proportions (deShazo et al., 2013). Other components include epithelial tissue, bone, nervous tissue and connective tissue. The process of making nuggets requires an emulsifier for the stability of the dough. The emulsifier that plays a role in the dough is a protein that functions as a binder of fat and water in an emulsion system. One of the ingredients used in making nuggets is flour. The function of flour is as a filler and binder to improve emulsion stability, reduce shrinkage due to cooking, give a bright colour, increase product elasticity, form a dense texture, and draw water from the dough (Kumar & Tanwar, 2011).

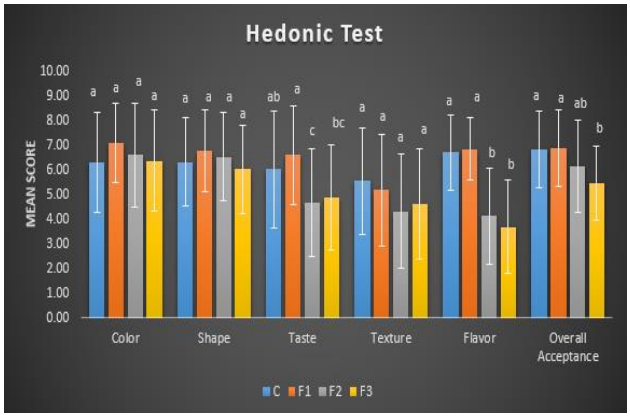

Fig. 1. Hedonic test of banana trunk nuggets

Allergies to poultry are uncommon. However, we may underestimate the impact of this allergy. The fact that chicken is the most often named offender likely reflects people's eating patterns. One or more of the following may be true: an allergy to fish, an allergy to eggs (bird-egg syndrome), or an allergy to both birds and eggs. Poultry allergies can appear in a variety of ways, and it would be a mistake to ignore the stomach symptoms (Wanniang et al., 2022). A vegetarian is someone who chooses to follow a plant-based diet and avoids consuming animal products. According to a study conducted in the United States, those who follow a vegetarian diet exhibit better overall health, have a longer lifespan, and have a slower ageing process. Additionally, they are exempt from cardiac illness. Researchers have found that a vegetarian diet positively impacts blood pressure reduction in individuals with hypertension and prevents the development of hypertension in healthy individuals. This study also demonstrates that vegetarian women who have reached menopause have a reduced likelihood of developing heart disease, endometrial cancer, and breast cancer in comparison to women who follow a typical diet. Vegetarian cooking involves the use of plants and non-animal ingredients, excluding meat as a cooking component (Rahayu, 2017).

4. Conclusion

Based on the research findings, it is possible to conclude that the formulation that yields the highest acceptance level for banana trunk nuggets is the one that uses 100% banana trunk (F1). The utilization of banana trunks in the production of nuggets was found to have the potential to result in a formulation that was both successful and novel.

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