UTILIZATION AND EVALUATION OF SWEETPOTATO (*IPOMEA BATATAS*) AS FILLER IN MEAT LOAF FORMULATION

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Abstract

Fillers and additives are made from meat and non-meat products. They are added to increase the bulk of the food, to extend shelf life and to improve flavor and texture. This study was conducted to determine the acceptability of meat loaf as affected by varying levels of sweetpotato in terms of color, aroma, taste, texture, flavor and general acceptability; to determine the physico-chemical characteristic of meatloaf with varying levels of sweetpotato as filler; to evaluate the browning and yellowness indices of the finished product; to assess consumer acceptability of the formulated product and to determine the production cost of meatloaf as affected varying levels of sweetpotato. The study was composed of six (6) treatments with sweetpotato levels ranging from 0 to 125 grams. The finished product was subjected to sensory evaluation, color analysis, physico-chemical analysis, consumer testing and cost analysis. Results of the study showed that the highest level of sweetpotato obtained the highest acceptability rating in terms of color, aroma, taste, texture, flavor and general acceptability with ratings of 7.44, 7.49. 7.56, 7.49, 7.38 and 7.93 respectively. Likewise, physico-chemical analysis showed that highest level of sweetpotato in the formulation resulted to the highest total soluble solids (TSS) of 21°B and the lowest pH of 6.69. Similarly, highest level of sweetpotato resulted in lowest browning index, highest yellowness index and the lowest production cost. The meatloaf formulation with the highest level of sweetpotato was liked by 84% consumers while only 16% disliked the product. Generally, highest level of sweetpotato in meatloaf formulation resulted to a lower production cost and increased volume of production.

Keywords: Meatloaf, filler, yellowness index, browning index, sensory evaluation

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Introduction

Fillers and additives, which are made from meat or non-meat ingredients, are added to food products to enhance appearance, specifically to enhance size, or to extend shelf life (Choi et al., 2012)

Non-meat filler sources include flour, starches, and breadcrumbs. On the other hand, meat sources may come from deboned chicken meat or turkey (Ali et al., 2021). The original intention of incorporating fillers into food products was to reduce costs; however, it later served a more useful purpose of prolonging food shelf life or simply enhancing the food's textural characteristics (Choi et al., 2012). A commonly found example is meatloaf, which is primarily made from ground pork or beef combined with various fillers and extenders later formed into a loaf shape (Huda et al., 2020).

The onslaught of African Swine Fever (ASF), however, leads to a threat and devastation in the meat economy, leading to a decrease in the available supply (U.S. Department of Agriculture, 2022). This resulted in higher pork prices, which subsequently impacted the livelihoods of vulnerable consumers and severely affected local farmers (Fabian, 2021). With the limited supply of meat available, there is a need to find another possible source for additives and fillers.

On the other hand, sweetpotatoes (*Ipomoea batatas* L.) remain a staple food across many parts of the world. They are highly regarded as an excellent source of fiber, potassium, vitamins, and other essential nutrients (Alam, 2021). Furthermore, sweetpotatoes are notably rich in the antioxidant beta-carotene, which is highly effective at increasing blood levels of Vitamin A, a particularly crucial benefit for children (Low et al., 2017). Overall, sweetpotatoes are recognized for being nutritious, high in fiber, very filling, and palatable, making them an ideal candidate for food product development (Alam, 2021).

Thus, the extension of meat and meat products with sweet potatoes will not only reduce production costs and improve their nutritional quality but also help solve the problem of pork shortages brought about by the ASF. Hence, this study was conducted.

Objectives of the Study

Generally, this study aimed to develop and evaluate the quality of meatloaf as affected by varying levels of sweet potato.
The specific objectives are:

1. To determine the acceptability of meat loaf as affected by varying levels of sweet potato in terms of color, aroma, taste, texture, flavor, and general acceptability;
2. To determine the physico-chemical characteristics of meatloaf with varying levels of sweet potato as filler;
3. To evaluate the browning and yellowness indices of the finished product;
4. To assess consumer acceptability of the formulated product.

5. To determine the production cost of meatloaf as affected by varying levels of sweet potato.

METHODOLOGY

Materials

The materials and tools used in the conduct of the study were the following: mixing bowls, chopping board, metal tray, knife, pot, frying pan, meat grinder, digital weighing scale, yellow colored sweet potato, potable water, ground pork, slotted spoon, autoclave, blender, and glass jars.

Experimental Treatment

The study was composed of six (6) experimental treatments, namely: T0- 0g sweetpotato, T1- 25g sweetpotato, T2- 50g sweetpotato, T3- 75g sweetpotato, T4- 100g sweetpotato, T5- 125g sweetpotato

Meat Loaf Formulation and Preparation

Meatloaf formulation followed the beef loaf ingredients and procedure of Ribeiro et al, (2023) with slight modification and substituting beef with pork. The ingredients include the following: Stuffing mixture (Mashed sweet potato), Ground Meat, Onion, pepper, milk, egg, ketchup, Worcestershire sauce, paprika, salt, oregano, ground mustard, Phosphate, Monosodium Glutamate, and Prague powder.

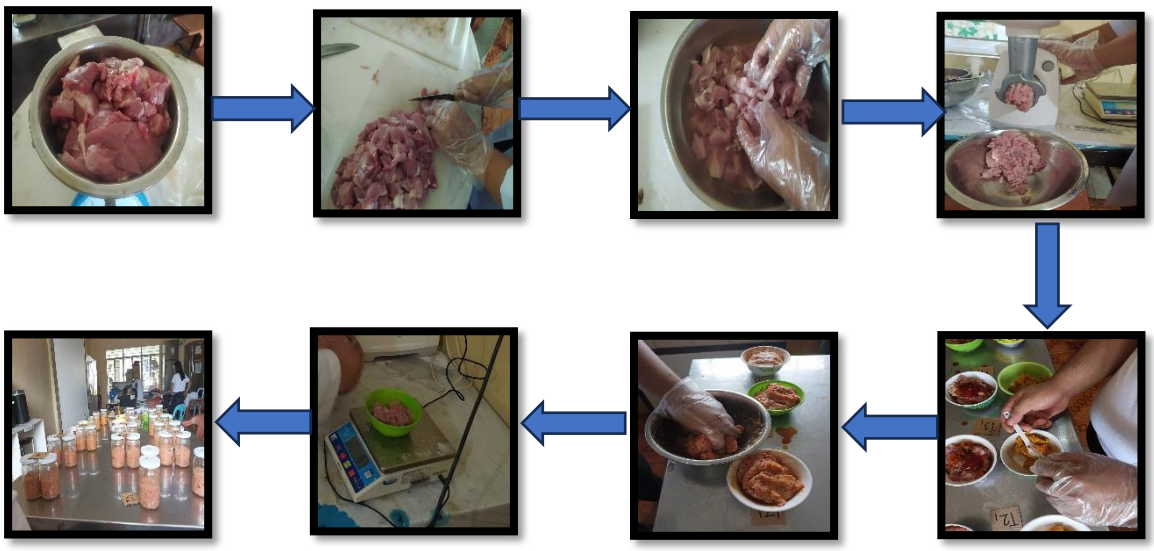

Figure 1. Process flow of meat loaf formulation

Sensory Evaluation

Meat loaf with varying levels of sweet potato as an extender was subjected to sensory evaluation to determine which treatment is acceptable in terms of color, aroma, taste, flavor, texture, and general acceptability using the 9-point Hedonic Scale. A quality scoring method was used to describe the attributes of the finished product (Hilapad et al., 2020).

Physico-Chemical Analysis of Sweetpotato as Extender for Meat Loaf

The pH and Total Soluble Solid (TSS) of Meat Loaf as affected by varying levels of sweet potato was determined with the use of a pH meter and a handheld refractometer, respectively.

Color Analysis of Meat Loaf as Affected by Varying Levels of Sweetpotato

The Hunter *L*, a* and b** values of meat loaf was measured using a colorimeter. The dimension L* means lightness, a* value indicates redness when positive and greenness when negative and b* value represents yellowness when positive and blueness when negative.

Browning index was calculated following the formula of Shimizu et al (2021):

$$BI = 100 \times \frac{X-0.31}{0.17}$$

Where:

$$X = \frac{a* + 1.75L*}{(5.645L* + a* - 3.012b*)}$$

Yellowness index was calculated following the formula:

YI = 142.86b*/L*

Consumer Acceptance Testing

Formulation which was found most acceptable among laboratory panelists was subjected to consumer testing employing one hundred (100) consumers composed of one hundred college students of Capiz State University Mambusao Satellite College.

Cost Analysis

Production costs was determined by recording all the expenses incurred per formulation. Computation of prices of raw materials and ingredients is based on the time of the purchase and not on the current price.

Statistical Tools and Analysis

Results of the sensory evaluation was analyzed statistically using the Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) was employed to locate significant difference among treatments (Agbangba et al, 2024).

RESULTS

Sensory Evaluation

Table 1.0 Summary of mean acceptability ratings of meat loaf as affected by varying levels of sweetpotato

Treatment	Levels of Sweetpotato (g)	Color	Aroma	Taste	Texture	Flavor	GA
0	0	6.79c	6.97c	6.84e	6.83b	6.83d	7.33c
1	25	6.90cd	7.17b	6.93d	7.09b	7.16bc	7.56b
2	50	7.00c	7.00c	7.10c	7.00b	7.12c	7.63b
3	75	7.33b	7.28b	7.19c	7.28a	7.29ab	7.83a
4	100	7.36a	7.22b	7.42b	7.34a	7.23b	7.89a
5	125	7.44a	7.49a	7.56a	7.49a	7.38a	7.93a

Means followed by the same letter are not significantly different from one another at p≥0.01

The meat loaf made from different treatments were subjected to sensory evaluation to determine its acceptability and description for each attribute and the data is presented in Table 1.0. Meat loaf containing 125 g sweetpotato consistently obtained the highest mean acceptability rating in terms of color, aroma, taste, texture, flavor and general acceptability while meat loaf without sweetpotato in the formulation obtained the lowest ratings in all parameters being evaluated. The quality descriptions of meat loaf were yellowish brown for color, slightly perceptible sweetpotato aroma to well blended sweetpotato and meat aroma, just right to slightly sweet taste, moderately soft and tender to just right texture and slightly perceptible sweetpotato flavor. The yellowish-brown color of meat loaf was attributed to the yellow color of the sweetpotato which was used in the study. According to Ivane et al, (2024), anthocyanins in sweet potato, possess desirable characteristics for food coloring, including, low toxicity, vibrant color, and beneficial biological properties. The data suggest that as the level of sweetpotato increased, its acceptability also increased. Its color and sweet taste contribute to the high sensory acceptability of sweet potato, commonly cooked and prepared by boiling, frying, steaming, and baking (Hadero, 2018; Qin et al, 2022). Statistical analysis showed that meat loaf containing 125 grams of sweetpotato was significantly different from treatment without sweetpotato and up to 75 grams in the formulation.

Physico-chemical Characteristics of meat loaf with varying levels of sweetpotato

Table 2.0 Total Soluble Solids and pH of meat loaf as affected by varying levels of sweetpotato

TREATMENT	LEVELS OF SWEETPOTATO (g)	TOTAL SOLUBLE SOLIDS ^{ns}	pH^{ns}
0	0 g	10.3	7.10
1	25 g	9.5	6.97
2	50 g	12.7	6.70
3	75 g	15.4	6.93
4	100 g	15.3	6.87
5	125 g	21.0	6.67

ns- not significantly different from one another at p≥0.05

the method for estimation of total soluble solids (TSS) are used for testing of sugar content in syrup, fruit and vegetable juices or dairy products and total concentration of monosaccharides and disaccharides in any solutions (Slosar et al, 2019).

Meat loaf containing 125 g sweetpotato obtained the highest Total Soluble Solids (TSS) content of 21.0 while treatment 1 which contained 25 g sweetpotato had the lowest TSS content of 9.5. The higher TSS was attributed to the amount of sweetpotato added in the formulation which was responsible for its sweet taste. However, meat loaf containing 125 g sweetpotato had the lowest pH content of 6.67.

Color Analysis

Table 3.0 Browning index and yellowness index of meat loaf as affected by varying levels of sweetpotato

TREATMENT	LEVELS OF SWEETPOTATO	BROWNING INDEX ^{ns}	YELLOWNESS INDEX ^{ns}

0	0 g	120.2	70.0
1	25 g	67.2	85.7
2	50 g	112.0	68.4
3	75 g	98.5	89.3
4	100 g	111.3	92.3
5	125 g	32.0	91.8

ns- not significant at p≥0.05

The Browning index and yellowness index of meat loaf as affected by varying levels of sweetpotato is presented in Table 3.0. The data shows that meat loaf formulation without sweetpotato had the highest browning index. The high browning index was due to the color of the meat which was slightly brown when cooked (Divatkal and Menderrata, 2004). The result obtained was in consonance with the findings of Cho et al (2021), which showed an increase in browning index as the cooking temperature of meat was increased. Whereas, meat loaf formulation containing highest amount of sweetpotato had the highest yellowness index. The result showed that the yellow color of sweetpotato used in the study influenced the resulting color of the finished product. Color criteria is also an important factor that influences the consumers impression when selecting and accepting food (Cai et al., 2020; Sinkovic et al., 2024). However, statistical analysis showed no significant difference among treatments.

Consumer Testing

Meat loaf containing 125 grams sweetpotato was subjected to consumer testing to determine its acceptability among consumers. Result revealed that 84% of the consumers liked the meat loaf while only 16% disliked the product.

Cost Analysis

Table 4.0 Cost of production of the meat loaf as affected by varying levels of sweetpotato

Treatment	Level of Sweetpotato (g)	Cost per Formulation (PhP)
0	0 g	103.00
1	25 g	96.00
2	50 g	89.00
3	75 g	82.00
4	100 g	75.00
5	125 g	68.00

Table 4.0 shows the production cost of meat loaf from different formulations. The data revealed that the addition of sweetpotato in the formulation resulted in the decrease of its production cost by almost 50 percent.

Conclusions

Based on the results of the study, researchers have drawn the following conclusions:

1. Meat loaf containing 125 grams sweetpotato obtained the highest acceptability ratings in terms of color, aroma, taste, texture, flavor and general acceptability.

2. Meat loaf containing 125 grams sweetpotato had the highest Total Soluble Solids Content and the lowest pH.
3. Meat loaf without sweetpotato had the highest browning index while meat loaf containing 125 grams sweetpotato had the highest yellowness index.
4. Meat loaf containing 125 grams sweetpotato was liked by 84% of the consumers and disliked by 16%.
5. Meat loaf containing 125 grams sweetpotato had the lowest cost of production while those without sweetpotato had the highest production cost.

Recommendations

Based on the results of the study, the researchers recommended the following;

1. Use 125 grams of sweet potato in the meat loaf formulation.
2. Conduct shelf-life testing of the most acceptable formulation.
3. Nutritional analysis of the most acceptable product is highly recommended.
4. Encourage farmers to plant more sweet potatoes to have a steady supply of the commodity.

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