



# Unconventional Composite Feed Ingredients on Storage and Sensory Attributes of Chicken Meat

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

**Aim:** The present study investigated the effect of unconventional (*Carica papaya*, *Manihot esculenta* leaf and *Brassica oleracea* var. *capitata* leaves) Composite Feed Ingredients on storage and sensory attributes of chicken meat.

**Study Design:** Quasi Experimental

**Place and Duration of Study:** Department of Animal Production and Health Technology, Department of Nutrition and Dietetics and Department of Science Laboratory Technology, Imo State Polytechnic Umuagwo-Ohaji, June 2020-April, 2021.

**Methodology:** Arbor Acres broiler reared with unconventional composite feed ingredients, consisting of 0%, 2.5%, 5%, 7.5% proportions of Homogenized Vegetable Meal (HVM) was used. After six weeks, the broilers were slaughtered, cleaned and stored in the freezer at the temperature of 3°C. Nutrient Agar (NA), Mac Conkey Agar (MCA) and Sabouraud Dextrose Agar (SDA) were the media used for the determination of bacterial and fungi growth on chicken meats during

storage. Sensory evaluation of chicken meats was determined after 14 days of storage.

**Results:** The result revealed low ( $3.4 \times 10^5$ - $8 \times 10^5$ ) microbial and fungi ( $2.1 \times 10^5$ - $7 \times 10^5$ ) growth on the chicken meat samples. There was no significant difference ( $P=0.05$ ) in the sensory attributes (taste, colour, aroma and general acceptability) tested. The chicken meats were generally (7.6 - 7.8) acceptable by the taste panel members after 14 days of storage.

**Conclusion:** The inclusion of unconventional (leave) ingredients in broiler feed did not affect the storage of chicken meat, rather some sensory attributes (aroma and colour) of chicken meat were improved.

*Keywords: Broiler; chicken-meat; composite-feed; microbial count; sensory-attributes; unconventional.*

## 1. INTRODUCTION

Poultry meat, especially chicken is one of the widely consumed animal protein in Nigeria. According to Temidayo [1], Nigeria consumes about two million tons of poultry meat annually, 70 per cent of which are imported and a lot heavily smuggled into the country. Poultry production is usually being restricted by several environmental factors including the high cost of conventional feed ingredients. Due to the high cost of conventional feed, the poultry industry is inclined to including a small amount of the cheapest ingredients to improve the nutritive value of feeds and to maximize profit [2].

Leaf meal supplementation has been included in the diet of poultry as means of reducing the high cost of conventional protein source and improving profit margin [3,4]. As reported by Omenka and Anyasor [5], vegetables are rich nutrient sources, potentially good for supplying essential amino acids, minerals and antioxidants to birds, comparatively inexpensive, easily available, easy to process and pose less risk of disease contamination. Beyond making a profit, the storage and acceptability of chicken meat produced with unconventional composite feed materials are very paramount, to ascertain the full potential (safety and sensory quality) of producing chicken with unconventional feed ingredients.

Generally, food storage is a very important segment of food production. According to Dave and Ghaly [6], rapid quality deterioration is observed in improperly stored meat. There are different forms of storage materials and facilities depending on the food type. High moisture/perishable food materials are best stored in the refrigerator or freezers to prevent or reduce microbial food contamination. Storing chicken in the fridge helps to slow bacterial growth as bacteria tend to grow slower in temperature below  $40^{\circ}\text{F}$  ( $4^{\circ}\text{C}$ ). However, the raw chicken piece is best stored in a leak-proof container and

can be stored in the freezer for up to 9 months, while a whole chicken can be frozen for up to one year [7]. Microbial food contaminants reduce the shelf-life of food and also affect the sensory attributes of food from the consumer point of view.

Descriptive sensory analysis is an analytical sensory evaluation method that involves the discrimination and description of sensory components of products by a trained panel [8]. These characteristics may also serve as references during the selection of foods [9]. The use of sensory analysis is to allow producers to identify and respond to consumer preferences more efficiently, thus increasing their competitiveness and segmenting their specific market [10]. Sensory analysis report has shown that consumers prefer the chicken meat of broilers exclusively fed with vegetable sources as they feel it is tastier, juicy, and tender [11]. Similarly, Wanwisa and Ta-Jui [12] confirmed that descriptive sensory analysis provides more detailed and objective information about the textural attributes between commercial broiler (BR) and Taiwan native chicken (TNC) meat.

There is a need for a collaborative effort to enhance opportunities in poultry production. This research evaluated the storage and sensory qualities of chicken meat produced with the composite feed of conventional and unconventional (Homogenized Vegetable Meal) ingredients. A multi-disciplinary approach to improving poultry production will not only create new opportunities for farmers but will provide affordable animal protein source for the teeming population of Nigeria.

## 2. METHODOLOGY

### 2.1 Materials

Chicken meat of Arbor Acres broilers reared with conventional and Homogenized Vegetable Meal (HVM) composite feed ingredients at a different

ratio of 0%, 2.5%, 5% and 7.5% were procured from the Animal Production and Health Technology Department of the Imo State Polytechnic, Umuagwo (collaborative research); salt and pepper were purchased from student's mini-market at the Imo State Polytechnic, Umuagwo-Ohaji.

## 2.2 Equipment/Facilities

Equipment (cooking gas, pots, plates, spoons, knives etc.) and facilities (Food laboratory, Taste Panel Room and Chemical laboratory) in the School of Sciences, Imo State Polytechnic, Umuagwo-Ohaji were used for the processing, and in assessing the sensory and microbial evaluation of chicken meat samples.

## 2.3 Sample Preparation

Four healthy broilers (one from each treatment) were slaughtered, dipped into hot water (100°C) for 5 minutes, cleaned by removing feathers and intestines of the broilers to obtain a processed chicken. The chicken meats were washed thoroughly and packaged in airtight polythene bags tagged with samples A (control 0% HVM), B (2.5% HVM), C (5% HVM) and D (7.5% HVM). The polythene bags were doubled to ensure no contamination from the surrounding environment and stored in a freezer (30°C) for 14 days for the determination of Microbial growth and Sensory Evaluation.

## 2.4 Microbial Evaluation

### 2.4.1 Sample collection

Parts of processed chicken meats were randomly cut and evaluated for Microbial (bacteria and fungi) growth count daily for 14 days.

## 2.5 Procedure

### 2.5.1 Serial Dilution

Serial dilution technique described by Johnson and Case [13] was adopted.

### 2.5.2 Media preparation

Microbial growth media used were Nutrient Agar (NA), Mac Conkey Agar (MCA) and Sabouraud Dextrose Agar (SDA). Each of the media was prepared by measuring out a definite amount of the powder according to the manufacturer's directives, suspended in the corresponding volume in distilled water and sterilized in the autoclave. The media were allowed to cool to 45°C before use.

## 2.5.3 Inoculation of Samples on media

Approximately 0.2ml of the 1:1000 dilution was transferred into a clean dry petri dish in the pour plate technique as described by Patrick and Talaro [14]. All the inoculated plates were incubated upside down at 37°C for 24 hours. After inoculation, the developed colonies were counted, applying the mathematical formula for the estimation of microbial load [13].

$$\text{Estimated Microbial Load} = \frac{\text{No of Colonies}}{\text{Vol. of inoculum}} \times \text{Inverse of dilution factor}$$

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## 2.6 Sensory Evaluation

### 2.6.1 Procedure

After two weeks of storage, chicken meat samples were cooked with mild seasonings (salt and fresh red pepper) till soft and served to thirty trained 30-member (aged-20-50) taste panel drawn from the staff of the polytechnic community who are familiar with chicken meat.

Ten gram (10 g) of each of the coded chicken meat sample were rated for appearance, taste, aroma and general acceptability on a nine-point (1- extremely poor; 2- very poor; 3- moderately poor; 4-poor; 5- neither good nor poor; 6-good; 7-moderately good; 8- very good; 9-extremely good) Hedonic scale of rating [15].

Clean water was provided for the taste panel members to drink and rinsed their mouth after evaluating each sample to avoid bias. The sensory evaluation was conducted in a standard Taste Panel Room with individual booths, under good ventilation and well lighted. Scores obtained from the sensory evaluation were statistically analyzed to determine the acceptability of the chicken meat samples.

## 2.7 Statistical Analysis

Data generated from sensory evaluation analysis were subjected to Analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS) package (Version 20.0). Scores from daily bacteria and fungi growth counts were computed on an excel spreadsheet to obtain average weekly microbial growth on chicken meats.

## 3. RESULTS AND DISCUSSION

Table 1 revealed that chicken samples stored in the freezer at 3°C for two weeks contain fungi

( $2.1 \times 10^5$ - $7 \times 10^5$ ) and bacterial ( $3.4 \times 10^5$ - $8 \times 10^5$ ) counts. The rate of microbial growth in the chicken meats during storage was similar, no significant difference ( $P=0.05$ ) was found in the chicken of broilers fed with conventional and unconventional feed materials. Generally, fungi and microbial counts were found to increase in the second week of storage. The highest bacteria count was found in the Mac-Conkey Agar media ( $5.3 \times 10^5$ - $8 \times 10^5$ ), while Nutrient Agar media had the lowest bacteria count ( $4.2 \times 10^5$ - $7.2 \times 10^5$ ) during the second week of storage.

The sensory evaluation scores obtained for the chicken meats were high, ranging from 7.3-7.9 (taste); 7.5 -7.6 (colour); 7.4-7.7 (aroma) and 7.6-7.8 (general acceptability) as shown in Table 1. From the result, the acceptability of chicken meat from broiler fed with conventional feed was similar to chicken meat from boiler fed with unconventional feed in almost all the parameters tasted. A significant difference ( $P=0.05$ ) was only found in the taste of chicken meat in sample A (0% HVM) and C (7.5% HVM). Heights sensory score was observed in the colour and aroma of chicken meat in sample D (7.5% HVM).

#### 4. DISCUSSION

The rate of fungi and bacterial growth found in the taste chicken meats was not significant ( $P=0.05$ ) to the control chicken meat. According to International Committee on Microbial Specification for Foods (ICMSF) [16], the fungi and microbial growth found in chicken samples were within the safe limit. The increase in the microbial count as the days extend could be attributed to the non-steady power supply as the time of storage.

It was found that unconventional feed ingredients did not affect the general acceptability of chicken; rather they improved the aroma and colour of chicken meats. Birds that eat the highest proportion of unconventional feed (sample D) scored highest in colour (7.63) and aroma (7.7), though not significant ( $P=0.05$ ). Unfortunately, the texture was skipped from the sensory evaluated form but taste panel members commented positively on the tenderness and crispiness of chicken meat samples, especially, sample A (chicken meat of broilers fed with conventional feed ingredient) and sample D (chicken meat fed with 7.5% HVM). This finding confirms the report of Mendes [11] on consumer preference of the meat of broilers exclusively fed with vegetable sources as they feel it is tastier, juicy, and tender. The colour of the test chicken meats were more acceptable to the test panel than the control chicken meat (Table 2). This improvement in the colour of the test chicken meats may be attributed to the vegetable (Cassava, cabbage and paw-paw) composition of the feed ingredients as the highest score was found with the chicken of broilers that consumed the highest (7.5% HVM) proportion of unconventional feed. It has been established that the colour of poultry skin is provided by carotenoid pigments that are added to the diets of broilers and are subsequently deposited in the skin and fat [17].

Interestingly, it was found that the sensory attributes of chicken meat were not affected after two weeks of storage, even with the unsteady power supply experienced at the time of storage. This finding corresponds with the report of Marcinkowska-Lesiak et al. [18] where the sensory attributes of chicken meats were not affected by storage at  $20C \pm 0.05$  temperature for 5, 10 and 15 days.

**Table 1. Mean total variable count of bacteria and fungi on chicken meat samples**

Sample	Week	Total Variable Count (TVC) (cfu/g)		
		Nutrient Alagar (NA)	Mac-Conkey Agar (MCA)	Sabouraud Dextrose Agar (SDA)
A	1	$4.9 \times 10^5$	$5.4 \times 10^5$	$3 \times 10^5$
B		$3.8 \times 10^5$	$5 \times 10^5$	$2.1 \times 10^5$
C		$3.5 \times 10^4$	$6.5 \times 10^5$	$6.2 \times 10^5$
D		$3.4 \times 10^5$	$5.1 \times 10^5$	$5 \times 10^5$
A	2	$5.3 \times 10^5$	$7.8 \times 10^5$	$6 \times 10^5$
B		$7.5 \times 10^5$	$5.4 \times 10^5$	$4 \times 10^5$
C		$7.2 \times 10^5$	$5.3 \times 10^5$	$7 \times 10^5$
D		$4.2 \times 10^5$	$8 \times 10^5$	$6 \times 10^5$

\*Samples: A= (control 0% HVM), B = (2.5% HVM), C = (7.5% HVM) and D= (7.5% HVM)

**Table 2. Mean sensory evaluation of chicken meat**

Sample	Parameters			
	Taste	Color	Aroma	General/Accept.
A	7.9 <sup>a</sup> ± 0.8	7.53 <sup>a</sup> ± 1.2	7.46 <sup>a</sup> ± 1.2	7.83 <sup>a</sup> ± 0.9
B	7.73 <sup>ab</sup> ± 1.1	7.6 <sup>a</sup> ± 1.1	7.5 <sub>a</sub> ± 1.3	7.7 <sup>a</sup> ± 0.9
C	7.33 <sup>b</sup> ± 1.2	7.6 <sup>a</sup> ± 1.5	7.43 <sup>a</sup> ± 1.3	7.6 <sup>a</sup> ± 1.2
D	7.7 <sup>a</sup> ± 1.1	7.63 <sup>a</sup> ± 1.2	7.7 <sup>a</sup> ± 0.9	7.8 <sup>a</sup> ± 1.1
P-value	0.19	0.99	0.81	0.83

\*Mean of the same superscript are not significant at  $p=0.05$ . Samples: A= (control 0% HVM), B = (2.5% HVM), C = (7.5% HVM) and D= (7.5% HVM)

**5. CONCLUSION**

Production of broiler with unconventional composite feed ingredients has no negative effect on the storage (two weeks) and sensory qualities of chicken meat. The vegetable (cassava, cabbage and pawpaw leaves) components in the composite feed ingredients may have improved some of the sensory (aroma and colour) attributes of the chicken meat. Chicken meats were highly acceptable after 14 days of storage.

**6. RECOMMENDATION**

The researchers recommend inclusion of up to 7.5% and maybe 10% of (HVM) especially, pawpaw (*Carica papaya*) leave, cassava (*Manihot esculenta*) leave and waste cabbage vegetable (*Brassica oleracea var. capitata*) in conventional/commercial feeds to boost broiler production, without harmful effect.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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