



Analysis of the Proximate Composition and Microbial Load of Chicken as Influenced by Oven Drying

¹Oladimeji S. T., ¹Azeez, A. A., ²Ezenwogene, R. C., ¹Onatola, I. T., ¹Ugama, E. E., ¹Ate, J. T. and ¹Ajekiigbe, D. A.

¹Department of Agricultural and Bio-Environmental Engineering, Federal College of Agriculture, Moor Plantation, Apata, Ibadan

²Department of Agricultural and Bio-Environmental Engineering, Federal College of Agriculture, Ishiagu

Abstract: Meat products undergo changes during drying and storage that changes their quality however, it is essential to minimize these changes while maximizing process efficiency. The effect of oven drying on some quality attributes of meat including sensory properties (like colour, flavor, taste, texture, tenderness, juiciness and overall acceptability) and physical properties (like cooking loss, pH and water holding capacity) have been reported but there is dearth of information on the degree of influence of oven drying on outstanding quality parameters of meat hence the need for this study. The study was carried out at the Institute of Agriculture Research and Training, Moor Plantation Apata, Ibadan, Southwest, Oyo State. 10kg of frozen chicken was placed in warm water for about 15 minutes in order to defreeze. After the defreezing, the chicken was cut into pieces and then cooked for about 45 minutes to soften it. The chicken was deboned and the lean meat was grinded minced using mortar and pestle. The minced chicken meat was poured into a big bowl, then 213.97g of butter was added together with 85.67g of red chili pepper, 44.24g of Nut Meg, 120.06g of Green pepper, 85.33g of Ginger, 350g of corn flour, Onion and garlic powder of 1g, Maggi and salt were all added to the minced chicken. Samples were dried in the oven at 70 and 85°C and the proximate composition determined include crude protein, crude fat, crude fibre Proximate Product Yield, Lipid oxidation, while the microbial loads of the sausage was also carried out and monitored at day 0, 3, 6, and 9 consecutively. The results showed that the oven dried sausage raised the shelf life proximate attributes by increasing the crude protein, crude fat, crude fibre and ash content. Samples dried at 70°C for 40 minutes, 85°C for 50 minutes and 85°C for 60 minutes gave best chicken quality.

[Oladimeji S. T., Azeez, A. A., Ezenwogene, R. C., Onatola, I. T., Ugama, E. E., Ate, J. T. and Ajekiigbe, D. A. **Analysis of the Proximate Composition and Microbial Load of Chicken as Influenced by Oven Drying.** *N Y Sci J* 2022;15(3):28-33] ISSN 1554-0200(print);ISSN 2375-723X (online) <http://www.sciencepub.net/newyork>. 3. doi:10.7537/marsnys150322.03.

Keywords: Chicken, meat processing, quality, proximate, microbe

1. Introduction

One of the most important fundamentals for the development of civilization was food preservation and storage (Ogunlade and Aremu, 2019; 2020). The transformation of raw materials to stable foods by drying and fermentation was well known in many ancient cultures and used for different foods such as meat. Drying of meat is the oldest method of meat preservation. Drying is the application of heat to remove the majority of water by evaporation. Drying can be achieved through the use of solar energy, smoking as in smoke-drying, hot-air drying and freeze-drying achieved by sublimation (Fellows, 2000). Meat is nutritious and contains protein of high quality with all the complements of essential and non-essential amino acids needed to build, maintain and repair body tissue and help fight infections and diseases. Mineral iron together with the high quality protein is vital in the formation and maintenance of

red blood cells and prevention of anemia. Meat is one of the best sources of phosphorus which is essential for muscles, fetal development, lactation, nerves and many organs (Marco et al., 2008). However, despite the nutritional content of meat products, they are highly susceptible to spoilage due to actions of microorganisms which causes spoilage and constitutes health problems for man (FAO, 2010; Aremu et al., 2014; 2015). Meat is a highly perishable food item that is readily attacked by bacteria and other microorganisms, insects, endogenous and exogenous enzymes and chemical reactions. These bacteria have optimum growth in low acid medium, an available water supply and a warm temperature. This contamination occurs generally during evisceration, dressing, handling and processing. In Nigeria, the slaughter slabs are filthy with stinking odor, poorly equipped, constructed and maintained; the refuse disposal systems are inadequate, temperature, relative

humidity and sunshine are high and these accelerate microbial, chemical and physical changes of meat exposed for sale in our local markets (Okonkwo, 1984).

Meat products undergo changes during drying and storage that changes their quality however, it is essential to minimize these changes while maximizing process efficiency (Fellows, 2000). Changes in texture, loss of flavor and aroma, changes in color and nutritional value are the main changes that occur in dried foods. Continuous evaporation and weight losses during meat drying causes shrinkage, the consistency changes from soft to hard. Other biochemical reactions that impact organoleptic characteristics to the product also take place. Moreover, meat drying has severe changes on the meat texture caused by aggregation and denaturation, which lead to toughening of muscle tissue and volatile components are lost from meat when heat is applied. The preservative effect is based on the fact that microbial action, chemical and physical processes and enzymatic action on meat depend greatly on the amount of available moisture content which is drastically reduced during drying depending the method employed. Moisture content of the meat is reduced to such a level that the activities of these deteriorative agents are reduced or halted. Drying could be achieved by hot air drying in ovens, sun-drying or use of other mechanical dryers. As a result, most dried foods have lesser flavor than the original material. Okere et al. (2021) reported the effect of oven drying on some quality attributes of meat including sensory properties (like colour, flavor, taste, texture, tenderness, juiciness and overall acceptability) and physical properties (like cooking loss, pH and water holding capacity). This study therefore investigated the degree of influence of oven drying on outstanding quality parameters of meat.

2. Material and Methods

2.1 Experimental Procedure

The study was carried out at the Institute of Agriculture Research and Training, Moor Plantation Apata, Ibadan, Southwest, Oyo State. 10kg of frozen chicken was placed in warm water for about 15 minutes in order to defreeze. After the defreezing, the chicken was cut into pieces and then cooked for about 45 minutes to soften it. The chicken was deboned and the lean meat was grinded minced using mortar and pestle. The minced chicken meat was poured into a big bowl, then 213.97g of butter was added together with 85.67g of red chili pepper, 44.24g of Nut Meg, 120.06g of Green pepper, 85.33g of Ginger, 350g of corn flour, Onion and garlic powder of 1g, Maggi and salt were all added to the minced chicken. Everything was then mixed together in order to achieve uniform

paste mixture. It was then stuffed into the prepared casing/collagen (cow intestines). After stuffing the pasty mixture into the casing it was then break into links of diameter 20-22mm.

2.2 Sample Treatment: The experiment was conducted after storing the samples for 0, 3, 6, and 9 days consecutively. The samples were also dried in the electric oven at varying temperature and time as stated in Table 1. The oven used is a hot air circulation drying machine powered by charcoal with steady hot air flowing in the drying chamber. The hot air circulation dryer is a kind of all-purpose drying equipment, having wide application for the curing and dehydrating of many kinds of materials and products in the food industry, agriculture and sideline production and fishery industries.

Table 1: Oven Drying Duration

Sample treatment	Drying at 70°C	Drying at 85°C
T ₁	40 minutes	-
T ₂	40 minutes	40 minutes
T ₃	40 minutes	50 minutes
T ₄	40 minutes	60 minutes

2.3 Determination of the Proximate Composition

The proximate composition determined include crude protein, crude fat, crude fibre Proximate Product Yield, Lipid oxidation, Microbial loads of the sausage, the test was carried out and monitored as day 0, 3, 6, and 9 consecutively.

2.3.1 Crude Protein: this was determined using micro-Kjeldahl method Leroy et al., (2006) and Famurewa et al. (2021). Two gram of sample was placed in the Kjeldahl flask. Anhydrous sodium sulphate (5g of Kjeldahl catalyst) was added to the flask and concentrated H₂SO₄ (25ml) was added. The flask was heated in the fume chamber until the sample solution became clear. The sample solution was allowed to cool to room temperature, then transferred into a 250ml volumetric flask and made up to volume with distilled water. The distillation unit was cleaned, and the apparatus set up. Five milliliters of 2% boric acid solution with few drops of methyl red indicator was introduced into a distillate collector (100ml conical flask). The conical flask was placed under the condenser. Then 5ml of the sample digest was pipetted into the apparatus, and washed down with distilled water. Five milliliters of 60% sodium

hydroxide solution was added to the digest. The sample was heated until 100ml of distillate was collected in the receiving flask. The content of the receiving flask was titrated with 0.049M H₂SO₄ to a pink coloured end point. A blank with filter paper was subjected to the same procedure. The crude protein was obtained using Equations 1 - 3:

$$\% \text{ Total Nitrogen} = \frac{(\text{titre-black}) \times \text{normality of acid} \times N_2}{\text{Weight of sample}} \quad (1)$$

$$\text{Nitrogen factor} = 6.25 \quad (2)$$

$$\text{Crude protein} = \% \text{ total nitrogen} \times 6.25 \quad (3)$$

2.3.2 Microbial Analysis

The determination of the total aerobic count of the coconut oil was performed by the method outlined in the compendium of methods for the microbiological examination of foods, with some modifications (APHA, 1992; Ndife *et al.* 2019).

2.4 Statistical Analysis

Data collected was analyzed using the general linear model procedure available in SAS. The Duncan's Multiple Range (DMRT) was used to determine the difference among means.

3. Results

3.1 Effect of oven drying on Proximate composition of chicken sausage

Tables 2 and 3 shows proximate composition of the chicken sausage as affected by oven drying. A remarkable increase in crude protein, crude fat, crude fibre and ash was observed when sausage was dried in the hot air oven, the values obtained varies between the treatments which shows that the higher the drying time, the higher the protein content in the sausage. T₂= 18.38^b, T₃= 18.79^c, T₄= 19.00^d. While the moisture is different, the lower the drying time of the sausage the higher the moisture content T₁= 55.40^d, T₂= 55.51^c, T₃= 53.19^b, T₄= 51.85^a. Increase in the drying time significantly (p<0.05) affected the crude protein, crude fat, crude fibre and Ash content of the sausage. This implies that as the drying increases the crude protein,

crude fat, crude fibre increases while the ash content varies.

Crude protein in T₄ (51.85) was significantly higher than those in T₂ (18.38) and T₃ (18.79) but T₃ (18.79) was significantly higher than T₂ (18.38). Also, crude fat in T₄ (20.14) was significantly higher than those in T₃ (20.05) and T₂ (19.91) But T₃ (20.05) was significantly higher than T₂ (19.91). Crude fibre in T₄ (0.30) was significantly higher than those in T₃ (0.25) and T₂ (0.22) but T₃ (0.25) was significantly higher than T₂ (0.22). Ash content in T₄ (2.24) was significantly lower than those in T₂ (2.33) and T₃ (2.31) but T₃ (2.31) was significantly higher than T₂ (2.33).

Storage days

Crude Protein in D0 (18.81) was significantly higher than those in D3 (18.68), D6 (18.46) and D9 (18.26). But D3 (18.68) and D6 (18.46) was significantly higher than D9 (18.26). Crude fat in D0 (20.28) was significantly higher than those in D3 (20.18), D6 (19.88) and D9 (19.70). But D3 (20.18) and D6 (19.88) was significantly higher than D9 (19.70). Crude fibre in D0 (0.32) was significantly higher than those in D3 (0.26), D6 (0.19) and D9 (0.11). But D3 (0.26) and D6 (0.19) was significantly higher than D9 (0.11). Ash content in D0 (2.24) was significantly higher than those in D3 (2.37), D6 (2.28) and D9 (2.21). But D3 (2.37) and D6 (2.28) was significantly higher than D9 (2.21).

3.2 Effect of Oven drying on Microbial Content of the Chicken Sausage

Microbial load was significantly (p<0.05) reduced as the drying time increases in this order T1 (0.40) > T2 (0.25) > T3 (0.22) > T4 (0.12) as shown in Table 3. Thus, T4 (0.12) had the least significant TBC, TCC, TFC and E.Coli. While the highest microbial load was found in T1 for TBC, TCC, TFC, E.Coli and S.A The major difference in total bacterial counts between raw and dried sausage samples confirmed raw sausage is primed to spoilage quicker than dried treated one (Libby1975; Maedy *et al.* 1997).

Table 2: Proximate Composition of the Chicken Sausage

Main effect	Crude protein		Crude fat		Crude fiber		Ash	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
T ₁	18.02 ^a	0.02	19.94 ^b	0.01	0.12 ^a	0.01	2.39 ^a	0.01
T ₂	18.38 ^b	0.02	19.91 ^a	0.01	0.22 ^b	0.01	2.33 ^c	0.01
T ₃	18.79 ^c	0.02	20.05 ^c	0.01	0.25 ^c	0.01	2.31 ^b	0.01
T ₄	19 ^a	0.02	20.14 ^d	0.01	0.30 ^d	0.01	2.24 ^a	0.01
Storage Days								
0	18.81 ^d	0.02	20.28 ^d	0.01	0.32 ^d	0.01	2.42 ^d	0.01
3	18.68 ^c	0.02	20.18 ^c	0.01	0.26 ^c	0.01	2.37 ^c	0.01
6	18.46 ^b	0.02	19.88 ^b	0.01	0.19 ^b	0.01	2.28 ^b	0.01
9	18.26 ^a	0.02	19.70 ^a	0.01	0.11 ^a	0.01	2.21 ^a	0.01
P – Values								
Treatments	0.000		0.000		0.000		0.000	
Storage days	0.00		0.000		0.000		0.000	
Treatment * Storage	0.392		0.000		0.001		0.761	

abcd means in the same column (within a main effect) with different superscript differs significantly ($p < 0.005$)

Table 2: Proximate Composition of the Chicken Sausage

Main effect	Moisture		CHO		Lipid Ox		Cholesterol	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
T ₁	55.40 ^d	0.01	95.58 ^d	0.03	6.92 ^d	0.01	72.33 ^b	0.01
T ₂	55.51 ^c	0.01	95.10 ^c	0.03	6.61 ^c	0.01	69.71 ^a	0.01
T ₃	53.19 ^b	0.01	94.39 ^a	0.03	6.38 ^a	0.01	73.75 ^c	0.01
T ₄	51.85 ^a	0.01	94.39 ^a	0.03	6.38 ^a	0.01	73.75 ^c	0.01
Storage Days								
0	52.03 ^a	0.01	93.88 ^a	0.03	6.51 ^b	0.01	73.08 ^d	0.01
3	52.77 ^b	0.01	94.28 ^b	0.03	7.18 ^c	0.01	73.04 ^c	0.01
6	54.13 ^c	0.01	95.51 ^c	0.03	6.35 ^{ab}	0.01	72.83 ^b	0.01
9	56.02 ^d	0.01	95.94 ^d	0.03	6.32 ^{ab}	0.01	72.80 ^a	0.01

Table 3: Microbial Analysis of the Chicken Sausage

Main effect	TBC		TCC		TFC		E Coli		S. A.	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
T ₁	0.40 ^d	0.00	0.55 ^c	0.01	0.12 ^c	0.00	0.35 ^d	0.00	0.40 ^c	0.00
T ₂	0.25 ^c	0.00	0.28 ^b	0.01	0.10 ^c	0.00	0.22 ^c	0.00	0.25 ^b	0.00
T ₃	0.22 ^b	0.00	0.26 ^{bc}	0.01	0.07 ^a	0.00	0.20 ^b	0.00	0.15 ^a	0.00
T ₄	0.12 ^a	0.00	0.20 ^a	0.01	0.07 ^a	0.00	0.15 ^a	0.00	0.15 ^a	0.00
Storage Days										
0	0.00 ^a	0.00	0.02 ^a	0.01	0.00 ^a	0.00	0.02 ^a	0.00	0.00 ^a	0.00
3	0.10 ^b	0.00	0.17 ^d	0.01	0.00 ^a	0.00	0.15 ^b	0.00	0.20 ^b	0.00
6	0.32 ^c	0.00	0.32 ^c	0.01	0.10 ^b	0.00	0.30 ^c	0.00	0.30 ^c	0.00
9	0.57 ^d	0.00	0.77 ^d	0.01	0.27 ^c	0.00	0.45 ^d	0.00	0.45 ^d	0.00
P – Values										
Treatments	0.000		0.000		0.000		0.000		0.000	
Storage days	0.000		0.000		0.000		0.000		0.000	
Treatment * Storage	0.000		0.000		0.000		0.000		0.000	

abcd means in the same column (within a main effect) with different superscript differs significantly ($p < 0.005$)

4.0 Conclusion

The effect of oven drying on the proximate composition and microbial content of chicken was investigated. The results showed that the oven dried sausage raised the shelf life proximate attributes by increasing the crude protein, crude fat, crude fibre and ash content. Samples dried at 70°C for 40 minutes, 85°C for 50 minutes and 85°C for 60 minutes gave best chicken quality

Acknowledgements:

Authors are grateful to the Management of Federal College of Agriculture, Moor plantation, Apata, Ibadan for giving access to the laboratory and other facilities

Corresponding Author:

Engr Oladimeji, S. T.
Department of Agricultural and Bio-Environmental Engineering
Federal College of Agriculture
Moor Plantation
Apata, Ibadan.

References

- [1]. APHA (1992). Compendium of methods for the microbiological examination of foods. 4th Ed. American Public Health Association, Washington, D.C. U.S.A.; 1992
- [2]. Aremu, A. K., Ademuwagun, A. A. and Ogunlade, C. A. (2014). Effects of Moisture Content and Loading Orientation on Some Mechanical Properties of African Oil Bean Seeds (*Pentaclethra macropylla* Benth).

- African Journal of Agricultural Research* Vol. 9(49): PP 3504-3510. Also available online at <http://www.academicjournals.org/AJAR>
- [3]. Aremu, D. O., Babajide, N. A., Ogunlade, C. A., Oyeniran, T and Kadiri, A. O (2015). Effects of storage media and duration on nutritional qualities of cowpea (*Vigna unguiculata* L. Walp). *IOSR Journal of Agriculture and Veterinary Science (IOSR_JAVS)*, Vol. 8, Issue 2, Version 1: PP 60-65
- [4]. Famurewa, J. A. V., Jaiyeoba, K. F., Ogunlade, C. A. and Ayeni, O. B. (2021). Effect of extraction methods on yield and quality characteristics of coconut (*Cocos nucifera* L) oil. *AgricEngInt: CIGR Journal Open access* at <http://www.cigrjournal.org>, 23 (3): 251 – 260. <https://cigrjournal.org/index.php/Ejournal/article/view/6679/3707>
- [5]. FAO. (2010). Meat processing technology for small – to – medium scale producers. Food and Agricultural Organization of the United Nations, Regional Office for Asia and Pacific; 2007.
- [6]. Fellows, P. J. (2000). Food Processing Technology, Principles and Practice. Woodhead Publishing Ltd, Cambridge. pp: 45-50.
- [7]. Leroy F, Verluyten J, Vuyst LD. (2006). Functional meat starter cultures for improved sausage fermentation. *Inter J Food Micro* 2006; 106: 270-85.
- [8]. Marco A, Navarro JL, Flores M. (2008). The sensory quality of dry fermented sausages as affected by fermentation stage and curing agents. *Eur. Food Res Technol* 2008; 226: 449-58. McBride NT, Hogan SA, Kerry JP. Comparative addition of rosemary extract and additives on sensory and antioxidant properties of retail packaged beef. *Inter J Food Sci Technol* 2007; 42: 1201-7.
- [9]. Ndife, J., Obot, D. and Kuyik Abasiokong (2019). Quality Evaluation of Coconut (*Cocos nucifera* L) Oils Produced by Different Extraction Methods. *Asian Food Science Journal* 8(4): 1-10.
- [10]. Ogunlade, C. A. and Aremu, A. K. (2019). Influence of Processing Conditions on Yield and Quality of Mechanically Expressed African Oil Bean (*Pentaclethra macrophylla* Benth) Kernels: A Response Surface Approach. *Journal of Food Process Engineering*, John Wiley. 42 (2): 1-9. <https://doi.org/10.1111/jfpe.12967> and <https://onlinelibrary.wiley.com/doi/pdf/10.1111/jfpe.12967>
- [11]. Ogunlade, C. A. and Aremu, A. K. (2020). Modeling and optimisation of oil recovery and throughput capacity in mechanically expressing oil from African oil bean (*Pentaclethra macrophylla* Benth) kernels. *Journal of Food Science and Technology*. Springer Science, *J Food Sci Technol* (2020). <https://doi.org/10.1007/s13197-020-04435-0>. <http://link.springer.com/article/10.1007/s13197-020-04435-0>
- [12]. Okere, I. A., Oladimeji, S. T., Azeez, A. A., Onatola, I. T., Tulagha, I. and Jaiyeoba, K. F. (2021). Effect of Oven Drying on Selected Quality Composition of Chicken. *New York Science Journal*, 14 (10): 27 – 30. http://www.sciencepub.net/newyork/nys141021/05_37483nys141021_27_30.pdf
- [13]. Okonkwo, T. M. (1984). Studies on the commercial production, consumption and quality of hot-smoked meat (Banda, Anu-Okpo) in Nigeria. M. Sc Thesis, University of Nigeria, Nsukka.

3/1/2022