EFFECT OF AGING DURATION ON THE QUALITY PARAMETERS OF GRILLED LOCAL CHICKENS

Zakka G. C., Gandi B.R., Musa J. and Kachong Y.K.
Department of Animal Science, Kaduna State University.
Corresponding Authors mail: zakkaxtian@gmail.com.

ABSTRACT
This study evaluated the effect of aging duration on the sensory attributes of grilled local chickens. Sixteen roasters (24 weeks old) of the Fulani ecotype were conventionally slaughtered, dressed and randomly allotted into four treatments with four replicates per treatment in a completely randomized design. Carcass from birds were aged at 4^{O}C for 0, 24, 48 and 72 hours corresponding to the various treatments (T1, T2, T3 and T4 respectively). Meat samples from each treatment were grilled and evaluated for their sensory and physical parameters. Results obtained for sensory evaluation on a 9 point hedonic scale was statistically significant (P<0.05), with T4 having the highest values in terms of tenderness (8.90), juiciness (8.45), aroma (8.55) and overall acceptability (8.75), while T1 had the least mean values. A decline in pH was recorded for T2, T3 and T4 (5.86%, 5.60% and 5.36% respectively). Treatment four had the highest thermal shortening (22.5%) statistically significant (P<0.05), while T1 was the lowest (6.75%). Percent cooking was highest in T1 (31.3%) and T4 recorded the lowest value (12.5%) which was statistically significant (P<0.05). Treatment one was significantly the highest (88.3%) in water holding capacity while T4 was the lowest (52%). From these observations, it was concluded that local chickens aged for 72 hours before grilling possess the best physical and sensory qualities.

Key words: Aging, Grilled, Local, Chickens, Sensory.

INTRODUCTION
In Nigeria, local Chickens are grown for their meat as well as their eggs. These chickens are grown in their natural environments without much interference from farmers. The population of the Nigerian local chickens is estimated to be about 149.4 million (FLD, 2015) with the vast majority being raised by farmers living in rural areas. The population outstrips that of the exotic which accounts for only 11.8%. The local chickens account for about 69% and 12% of poultry meat and total egg production respectively (FLD, 2015).

Grilled chicken is one of the world's most popular grilled dishes, it consists of chicken parts or entire chickens that are barbecued or smoked (Campbell *et al*., 2016). Grilled chicken is often seasoned or coated in a spice rub, barbecue rub, or both then coated with tomato based barbecue sauce and grilled.

Aging is a process of preparing meat for consumption, mainly by breaking down the connective tissue, it involves storing meat without protective packaging at refrigeration temperatures for few hours to five weeks to allow the natural enzymatic and biochemical processes that result in improved tenderness and the development of the unique flavor. The key effect of aging is the concentration and saturation of the natural flavor, as well as the tenderization of the meat texture (Stenstrom *et al*., 2014).

In Nigeria, many people love the flavor of grilled local Chickens compared to the exotic broiler birds, but meat from these birds are often associated with problem of toughness, local poultry meat can therefore benefit from conditioning or aging which is known to improve meat quality especially the textural characteristics.

This study was necessitated by the limited availability of information and research on the aspect of value addition to meat products obtained from our own indigenous breeds of chicken. Addressing factors that affect meat quality from these chickens will enhance formulation of grading standards and increase acceptability of meat produced from local chickens in various niche market segments such as tourist hotels and supermarkets.

The objectives of this study was to determine the effects of varying aging durations on the sensory qualities of grilled local chickens, determine the physical properties of grilled chickens aged at different durations and to determine the effect of aging on nutrient profile of chickens.

MATERIALS AND METHOD

The study was conducted in Department of animal science Kaduna State University (KASU) located at Kafanchan Jama'a Local Government Kaduna state, latitude 9.58° N, longitude 8.29° E and situated at an elevation of 733m above sea level (world atlas, 2018). Sixteen rosters (24 weeks old) from the Fulani ecotype breeds were conventionally slaughtered and randomly allotted into four treatments (T1, T2, T3 and T4). Treatment one was grilled immediately after slaughter, while T2, T3 and T4 were held at 4°C for 24, 48 and 72hours respectively before grilling, after which meat samples from each treatment were collected for sensory evaluation using 20 semi-trained sensory panelists, a 9 point hedonic scale was used with a score of 9 indicating "like extremely", 5 "neither like nor dislike" and 1 "dislike extremely". Physical parameters such as percent cooking loss, water holding capacity and thermal shortening were evaluated alongside proximate compositions of the meat samples.

Proximate analyses was carried out at the Food Science Departmental Laboratory of Kaduna State Polytechnique using AOAC (2011) methods which include protein determination using Kjeldahl, fat extraction via Soxhlet, crude fiber determination using digestion with sulphuric acid, moisture determination by drying the sample for 16-18 hours at 100-102°C in an oven and mineral, by ashing the sample at 550°C for 9 hours in a furnace oven. Percentage cooking loss was determined using the formula; $\%\ cooking\ loss = \frac{initial\ sample\ weight - grilled\ sample\ weight}{initial\ sample\ weight} \times 100$

(Petracci and Baéza, 2009).

Thermal shortening determined according to the procedure described by Mahendraker *et al.*, (1998) which is; $(initial\ length - final\ length) \times 100$. Water holding capacity (WHC) was calculated using the formulae developed by Suzuki *et al.*, (1997) which is; $WHC = \frac{100-(Ar-Am)\times 9.47}{Wm \times Mc} \times 100$. Where Ar = Area of water released from meat (cm^2), Am = Area of meat sample (cm^2), Wm = Weight of meat in mg, Mc = Moisture content of meat % and 9.47 is a constant factor. Data obtained from sensory evaluation and that of physical parameters of chickens were analyzed by one way ANOVA using IBM SPSS statistics software (21) and Tukey HSD was used for mean comparisons, test of significance and standard error.

RESULTS AND DISCUSSION

Proximate composition of grilled local chickens aged at different durations is shown in table 1. There was an increase in moisture content for T2, T3 and T4 (67.5, 67.6 and 67.8%, respectively). Studies conducted by Dashmaa *et al.*, (2016) explained that during aging process, the juices are absorbed back into the meat, this may account for the increase in moisture content. There was a decrease in dry matter content for T2, T3 and T4 (32.5, 32.4 and 32.2% respectively). Studies conducted by Dashmaa *et al*, (2016) revealed that during aging of meat, there is natural breakdown of protein, connective tissues and fat components of the meat by enzymes contained in the meat. A decline in pH was observed for T2, T3 and T4 (5.86, 5.60 and 5.36% respectively). The decline in pH was due to anaerobic metabolism of glucose leading to the production of lactic acid which in turn lowers the meat pH (Mbaga *et al*., 2016).

Table 1: Proximate Composition of Grilled Local Chickens Aged at Different Durations

Parameters	**T1**	**T2**	**T3**	**T4**
Moisture (%)	67.2	67.5	67.6	67.8
Dry matter (%)	32.8	32.5	32.4	32.2
Protein (%)	22.1	22.0	21.8	21.5
Fat (%)	2.14	2.12	2.10	2.00
Ash (%)	0.85	0.83	0.825	0.82
Crude fiber (%)	3.01	2.9	2.84	2.60
Carbohydrate (%)	4.71	4.65	4.835	5.28
pH (%)	5.90	5.86	5.60	5.36

KEY: **T1**: chickens aged for 0hours. **T2**: chickens aged for 24hours.
T3: chickens aged for 48hours **T4**: chickens aged for 72hours.

Physical Composition of Grilled Local Chickens Aged at Different Durations

Mean values for physical properties of grilled local chickens aged at different durations is presented in table 3. The highest value for percent cooking loss was recorded in T1 (31.3%) and the lowest was T4 (12.5%) which was statistically ($P<0.05$) significant. Mushi *et al*. (2009) explained that cooking loss in meat depends on ultimate pH. From table 1, there was a decline in pH for T2, T3 and T4 (5.86%, 5.60% and 5.36% respectively) this may account for the decrease in cooking loss. The highest value for water holding capacity (WHC) was recorded at T1 (88.3%) and the lowest was T4 (52.0%) which was statistically ($P<0.05$) significant. Bendall (1979) explained that pH influences the color and WHC of meat, and in table 2, a decline in pH was observed, this could be the reason for the decrease in WHC.

Table 3: Mean Values for Physical Properties of Grilled Local Chickens Aged at Different Durations

Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
Cooking loss (%)	31.3^{a}	22.5^{b}	17.5^{bc}	12.5^{c}	2.3783
Water holding capacity (%)	88.3^{a}	74.3^{b}	64.8^{c}	52.0^{d}	1.6646
Thermal shortening (%)	6.75^{c}	13.8^{b}	19.0^{ab}	22.5^{a}	1.8085

Means on the same column with different superscripts are significantly ($P<0.05$) different.

SENSORY QUALITIES OF GRILLED LOCAL CHICKENS AGED AT DIFFERENT DURATIONS

Table 4 shows the mean values for the sensory qualities of grilled local chickens aged at different durations. Mean scores for aroma obtained at T2, T3 and T4 (8.10, 8.40 and 8.55 respectively) were statistically the same ($P>0.05$) while T1 had the lowest score (7.45) which was statistically significant ($P<0.05$). When aged meat is being cooked, flavor precursors react with each other to form new molecules or volatile compounds that enrich the aroma further (Kemp *et al*., 2009). Mean values for taste obtained from T1, T2, T3 and T4 (7.95, 8.05, 8.15 and 8.25 respectively were statistically ($P>0.05$) the same. Mean scores for color obtained from T1, T2, T3 and T4 (8.40, 8.05, 7.95 and 7.65 respectively) were statically ($P<0.05$) different, with T1 having the highest score, while T4 had the lowest score, reason being that meat samples appeared darker with successive increase in aging

duration. Mean scores for tenderness obtained from T1, T2, T3 and T4 (7.20, 8.10, 8.45 and 8.90 respectively) were statistically (P<0.05) different with T4 recording the highest tenderness, while T1 was the lowest. Tenderness during aging is brought about by natural breakdown of fat, proteins and connective tissues by enzymes contained in the meat (John *et al*., 2007).The highest mean value for juiciness was recorded in T4 (8.4500) and the lowest was T1 (7.25) which was significantly (P<0.05) different. Mean scores for T2 and T3 (7.65 and 7.85 respectively) were statistically the same (P>0.05). Studies conducted by Dashmaa *et al*, (2016) showed that beef steaks were significantly juicier 21days after aging than 14days, and steaks aged for 14days were statistically juicier than those aged for 7days. Overall acceptability recorded for T1, T2, T3 and T4 (7.90, 8.20, 8.45 and 8.75 respectively) was statistically significant (P<0.05) with T4 having the highest mean value (8.75), and T1 having the lowest score of 7.90. This result is similar to that given by Smith *et al*. (2012), which showed that broiler chickens aged for 8-12hours significantly recorded the best overall acceptability.

Table 4: Mean Scores for Sensory Qualities of Grilled Local Chickens Aged at Different Durations

Parameters	**T1**	**T2**	**T3**	**T4**	**S.E.M**
Aroma	7.45^{b}	8.10^{a}	8.40^{a}	8.55^{a}	0.33
Taste	7.95^{a}	8.05^{a}	8.15^{a}	8.25^{a}	0.30
Color	8.40^{a}	8.05^{b}	7.95^{c}	7.65^{d}	0.28
Tenderness	7.20^{d}	8.10^{c}	8.45^{b}	8.90^{a}	0.34
Juiciness	7.25^{c}	7.65^{b}	7.85^{b}	8.45^{a}	0.33
Overall	7.90^{d}	8.20^{c}	8.45^{b}	8.75^{a}	0.25

Means in the same Colum with different superscript are significantly (P<0.05) different. *Rated on a nine-point hedonic scale, higher value indicates higher preference.

CONCLUSION AND RECOMMENDATION

Results obtained from this study shows that 72hours is the best duration to age local chickens before grilling because it recorded the highest value for tenderness, juiciness, aroma and overall acceptability as well as having no notable change in crude protein, minerals, and carbohydrate contents. Aging of local chickens for 72hours is again commendable because it recorded favorable changes in physical parameters such as thermal shortening, percent cooking loss and water holding capacity although further research could be carried out using longer durations of time and other different processing techniques e.g. boiling.

REFERENCES

AOAC. (2011). Official Methods of Analysis. Association of Official Analytical Chemists, (18th ed.). Washington, DC.

Bendall, J. R. (1979). Relations between meat pH and important biochemical parameters during the postmortem changes in mammalian meat. *J. Meat Sci.*, 3, 143–157.

Campbell, R. E., Hunt, M. C. and Chambers, L. P. (2001). EIV Dry-aging effects on palatability of beef *longissimus* muscle. *J. Food. Sci.*, 66, 196–205.

Dashmaa, D., Vinay, K. T., Soohyun, C., Younghoon, K., and Inho, H. (2016). Dry aging of beef; a review. *J. Ani. Sci. Tech.*, 58, 20-33.

Federal Livestock Department (FLD) (2015). Second National Poultry Survey. Federal Ministry of Agriculture Water Resources and Rural Development Lagos, pp. 10-65.

IBM SPSS Statistics software, V21-EQUiNOX full. Developer(s): IBM Corporation. (2017).

John, J. A., Sendra-Nadal, E., Sanchez-Zapata, E. J. and Viuda-Martos, M. (2007). Poultry flavour: General aspects and applications, in: GUERRERO-LEGARRETA, I. & HUI, Y.H. (Eds)

Handbook of Poultry Science and Technology: Secondary Processing, Vol. 2, pp. 339-357 (New Jersey, John Wiley & Sons).

Kemp, C. M., Sensky, P. L., Bardsley, R. G., Buttery, P. J. and Parr, T. (2010). Tenderness–An enzymatic view. *J. Meat. Sci.*, 84, 24–56.

Mbaga, S.H., Sanka, Y.D., Katule, A.M. and Mushi, D. (2016). Effects of Storage Time on the Quality of Local Chicken Meat. *Tanz. J. Agric. Sci.*, 13(1), *48-54.*

Mahendraker, N. S., Khabade, V. S. and Dani, N. B. (1988). Studies on the effects of fattening on carcass characteristics and quality of meat from Bannu-lamb. *J. Food. Sci. Tech.*, 25, 228-230.

Mushi, T., Rhue, M. R., Okitani, A. and Kato, H. (2009). Components contributing to the improvement of meat taste during storage. Agricultural and Biological Chemistry, 52, 2323-2330.

Petracci, P. O., and Baeza, A. E. (2013). Processing and Preparation of Meat and Formation of Carcinogens. AICR‟S Annual Research Conference on Food, Nutrition, Physical Activity and Cancer, 7(8), 29-38

Smith, R. D., Nicholson, K. L., Nicholson, J. D., Harris, K. B., Miller, R. K., Griffin, D. B. and Savell, J. W. (2008). Dry versus wet aging of beef: Retail cutting yields and consumer palatability evaluations of steaks from US choice and US select short loins. *J. Meat. Sci.*, 79, 6–9.

Stenström, H., Li, X., Hunt, M. C. and Lundström, K. (2014). Consumer preference and effect of correct or misleading information after aging beef *longissimus* muscle using vacuum, dry aging, or a dry aging bag. *J. Meat Sci.*, 96, 661–670.

World atlas (2018). Retrieved from https://academic.oup.com/worldmap/search91/6/1489/1548662 on 08 August 2018