NUTRITIONAL EVALUATION OF FRESH, REFRIGERATED, SUNDRIED AND SMOKED BROILER CHICKEN CARCASSES

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Abstract

This research was conducted to determine the nutritional contents of fresh, refrigerated, sundried and smoked preserved broiler chicken carcasses using a completely randomized design. The broiler chickens were purchased from the Teaching and Research Farm, Binyaminu Usman Polytechnic Hadejia. Sixteen broiler chickens of 7 weeks old were slaughtered, scalded, eviscerated, decapitated, washed and labelled for refrigeration, sun drying and smoke preservation. The fresh sample was analyzed for proximate and mineral compositions, while the other samples were refrigerated at 3±1˚C, sun - heat exposed and smoked, respectively. Refrigerated and sundried samples were preserved for the period of eight days, afterward all samples were analyzed for proximate and mineral compositions. Result showed that the fresh and refrigerated samples were statistically similar ($p>0.05$) in crude protein (CP), ash and ether extract (EE) contents, while the sundried sample recorded a higher significant ($p<0.05$) value when compared to the other samples in terms of CP and dry matter (DM) with statistical similarities in the % EE and ash contents. The smoked sample was significantly ($p<0.05$) different from other samples in the CP, DM and EE, while ash content for fresh and refrigerated samples was statistically similar ($p>0.05$) for calcium (Ca), magnesium (Mg) and phosphorous (P) contents, although zinc (Zn) content varied significantly ($p<0.05$) among all the samples. The study concludes that fresh and refrigerated broiler chicken carcasses showed similarities in their nutritional contents, similarly smoked and sundried samples presented similar observation. Refrigeration method is therefore recommended as it recorded higher nutrient content of broiler chicken carcass.

Keywords*: Chicken carcass, preservation, proximate composition, nutrient content*

Introduction

Poultry meat plays an important role in nutrition as a contributor of high-quality protein and according to FAO (2020), poultry production is gaining popularity in the developing countries, due to its role in bridging the protein malnutrition and economic empowerment of the resource-poor segment of the society. Poultry production is practiced in all levels ranging from subsistence to large scale commercial operations (Kim *et al*., 2020). Poultry meat and eggs are the most consumed animal protein unrestricted by any religion or culture in Nigeria. It was recorded that the poultry industry contributed about 25% to the country's Agricultural Gross Domestic Product (FAO, 2020). Nigeria presently produces above 550,000mt of poultry meat and 700,000mt of eggs per annum. Despite this, Nigeria is far from meeting her domestic demand, when compared with developed countries. This situation has been worsened by animal

product spoilage hence, the necessity to preserve the little available meat by preventing its contamination and spoilage (Emelue *et al*., 2017).

Meat protein also plays important physiological role in that it promotes iron absorption and prevents calcium losses (Li *et al*., 2020). The B-vitamins and mineral contents of meat are important nutritional factors. Consumers are getting less than one fifth animal protein of the required recommendation (Cowlishaw *et al*., 2005), which reflect the extreme shortage in supply of meat for human consumption. Unfortunately, there is a dearth of appropriate techniques of meat preservation that are suitable for our sellers. Some butchers, meat sellers and urban housewives use freezing technique and in most rural areas meat is being preserved by sun drying (Wright, 2007)

Industrialized countries tend to prefer particular varieties and expect quality levels leading to a highly managed system where breed, dietary requirements, and specialized rearing are used to meet these consumer expectations (Li *et al*., 2020). For example, the poultry production industry has grown with consumer demand over the last 50 years through methods like shorter growing periods and slaughter times, while also increasing breast meat yield production by 10% (Emennaa *et al*., 2019). Previous literature and evidence within this study indicates that longer storage times could be tested. For example, Kim *et al*. (2020), reported that thawing loss and cooking loss increased with storage time when testing pork and chicken thigh meat samples and found that -18°C had the lowest water holding capacity (WHC) of all temperatures tested (Kim *et al*., 2020).

This study investigated and compared the effect of preservation of broiler chicken carcasses by smoking, refrigerating, and sun drying methods on the nutritional quality of broiler meat.

Materials and Methods

The study was conducted at the livestock grazing areas of Binyaminu Usman Polytechnic, Hadejia, Jigawa State Nigeria. The area is located on latitude 12º 28^{I} N of the equator and longitude 10º 01 ^{I} E of the Greenwich Meridien. The annual rainfall ranges between 200 and 600 mm with relative humidity of 75 % during the rainy season and a mean annual temperature of 28º C (insert ref). A total of sixteen broiler chickens of 7 weeks were bought from the Poultry Unit of the Teaching and Research Farm and divided in to four groups with four replications each and labelled as H1, H2, H3 and H4 for fresh, refrigerated, smoked and sun dried samples, respectively. Broiler chickens in H2 to H4 were slaughtered, dressed and washed with clean water; H2 sample was refrigerated for 8 days as recommended by Emennaa *et al.* (2019). Samples in H3 and H4 were smoked and solar radiated respectively; on the 7th day all the samples including the H1 were further prepared for proximate and mineral analyses.

Experimental Procedure

A total of sixteen broiler chickens of 7 weeks old were bought from Binyaminu Usman Polytechnic Hadejia, Farm. They were slaughtered, scalded, defeathered, eviscerated, washed and packed separately. The carcass was taken to the refrigerator cooled and stored for 8 days within the ice block, the next one was stored under full sunlight hour for good 8 days and the last one was smoked and stored under generated condition, one of the two were slaughtered and prepared for lab analysis together with the rest of preserved carcasses. The proximate (proteins, fat, dry matter, moisture, ether extract and ash) and mineral (calcium, magnesium, phosphorous

and zinc) analyses were conducted in the animal science laboratory faculty of Agriculture, bayero university Kano.

Results and Discussion

Proximate composition of fresh, refrigerated, sundried and smoked broiler chicken carcasses

Effect of preservation methods on the nutritional content of broiler chicken carcasses is presented in Table 1. The crude protein obtained from the fresh carcass was (25.24 %) and for the refrigerated carcass was 25.39 %, with no significant ($p>0.05$) difference, this is possibly due to fact that refrigeration lower or inactivate the enzymatic activities which prevent deterioration (Beriain *et al*., 2018). The fresh, refrigerated and sundried carcasses were significantly ($p<0.05$) different from the smoked carcass. A significant decrease was observed between the crude protein of sundried sample (22.09% CP) and smoked one (18.59% CP); the crude protein content decreases with storage of cured meat and this was attributed to changes during storage caused by maillard reaction and change pH (Li *et al*., 2020).

The dry matter contents were (74.48 %) for the fresh sample and (79.27 %) for the refrigerated sample which differs significantly ($P<0.05$), this is in line with report of Emelue et al. (2017). The smoked sample recorded the highest value of DM (88.06 %) followed by sundried with a value of 86.54 % which are significantly different ($p<0.05$). This finding is in line with the report of Kim *et al*. (2020) who stated decrease in the moisture increase in salt content and consequently extended shelf life of the product. Ether extract in the fresh sample was 4.71% and 4.75% in the refrigerated sample, 4.53% was recorded as the value of sundried sample, all values were statistically similar ($p>0.05$), which is in line with report of Fargeot (2000). Only the smoked sample with value of 3.97% was significantly different ($p<0.05$), these findings have shown that preservation methods have no effect on ether extract content of meat, this could be due to oxidative deterioration (Gandotra *et al*. 2012). Ash content recorded for the samples were 2.11, 2.29, 2.29 and 2.26% for the fresh, refrigerated, sundried and smoked carcasses, respectively with no significant ($p>0.05$) difference; this is in line with the report of Emelue *et al*. (2017), who stated that the ash content of meat remained insensitive to different preservation techniques.

Table 1: Effect of preservation methods on the proximate composition of broiler chicken carcasses

Treatment	% CP	% DM	% MC	% EE	%ASH
Fresh	25.24^{a}	74.48^{d}	25.52^{a}	4.71^{a}	2.11^{a}
Refrigerated	25.39^{a}	79.27^{c}	20.73^{b}	4.75^{a}	2.29^{a}
Sundried	22.09^{b}	86.54^{b}	13.46^{c}	4.53^{a}	2.29^{a}
Smoked	18.59^{c}	88.06^{a}	11.94^{d}	3.97^{b}	2.26^{a}
P -values	<0.001	<0.001	<0.001	0.005	0.563

$^{a, b, c, d}$ Means with different superscripts along same column differ significantly ($p< 0.05$). MC = Moisture Content, DM = Dry Matter, CP = Crude Protein, EE = Ether Extract

Mineral composition of fresh, refrigerated, sundried and smoked broiler chicken carcasses

Mineral contents of broiler chicken carcasses are presented in Table 2. Calcium (Ca) for the fresh and that of refrigerated and sundried samples were found to be statistically ($p>0.05$) similar, this is in line with report of Sun and Holley (2011). Magnesium, phosphorus and zinc contents recorded in this study were also statistically ($p>0.05$) similar for fresh and refrigerated samples. Similarly, in sundried and smoked samples no difference was observed. This means that despite the subjection of the samples to different preservation methods, no any significant different was recorded. Heat treatment has been found to concentrate the micronutrients like zinc, magnesium, iron, phosphorous in meat; however, some amounts of these micronutrients are lost to thermal leaching (Sun and Holley, 2011).

Table 2. Effect of preservation methods on the mineral content of broiler chicken carcasses

Treatment	Ca (mg/kg)	Mg (mg/kg)	P (mg/kg)	Zn (mg/kg)
Fresh	1.99[a]	0.08[a]	0.20[a]	34.20[a]
Refrigerated	1.98[a]	0.08a	0.20a	34.70[a]
Sundried	0.95[b]	0.05b	0.19a	25.11[b]
Smoked	0.94[b]	0.04[b]	0.18[a]	21.05[c]
P- value	<0.001	0.013	0.400	<0.001

[a, b, c, d] Means with different superscripts along same column differ significantly ($p<0.05$). Ca = Calcium, Mg = Magnesium, P = Phosphorus and Zn = Zinc.

Conclusion and Recommendation

The study concludes that fresh, refrigerated, smoked and sundried broiler chicken carcasses showed similarities in their nutritional contents, irrespective of the preservation method. But refrigeration method can be recommended as it maintains and recorded higher nutrient values.

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