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Comparative Nutritional Value Analysis of Oven Dried and Sun Dried Ginger (*Zingiber officinale*) and their Tenderization Effects on Old Layer Chickens in Pankshin Lga of Plateau State, Nigeria

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Abstract

The purpose of this study was to determine the comparative nutritional value analysis of oven dried and sun dried ginger and their tenderization effects on old layer chickens in Pankshin LGA of Plateau State. Six (6) laying hens of three (3) Months old were randomly distributed into three dietary treatments (Group A, B and C) of 2 laying hens each in a deep litter pen. Group A which was the control group were given normal chikun feed and water daily for three (3) weeks while group B were given chikun feed mixed with oven dried ginger and group C were given chikun feed mixed with sun dried ginger respectively for three (3) weeks as well. Significant differences ($P<0.05$) were observed in the overall body weight of the chickens with the highest weight recorded in the control group (2.12 ± 0.16) compared to the sun dried ginger (2.03 ± 0.23) and the oven dried ginger (1.83 ± 0.41). The nutritional analysis showed that the moisture content of sun-dried ginger (31.30 ± 0.71) was recorded higher significantly ($p<0.05$) compared to the oven-dried ginger (15.92 ± 0.25). Crude protein content of oven-dried ginger (5.88 ± 0.005) ginger was recorded higher significantly ($p<0.05$) compared to the sun-dried ginger (3.95 ± 0.10). Crude fiber content was significantly higher ($P<0.05$) in sun-dried ginger (9.23 ± 0.02) compared to oven-dried ginger (9.03 ± 0.015). Crude fats content of oven-dried ginger (3.62 ± 0.015) was recorded higher significantly ($p<0.05$) compared to the sun-dried ginger (1.87 ± 0.02). Ash content of oven-dried ginger (10.20 ± 0.04) was recorded higher significantly ($p<0.05$) compared to the sun-dried ginger (4.30 ± 1.06). The calcium content of sun-dried ginger (0.75 ± 0.02) was recorded higher significantly ($p<0.05$) compared to the oven-dried ginger (0.70 ± 0.01). In this study, Phosphorus content of sun-dried ginger (0.24 ± 0.01) was recorded higher significantly ($p<0.05$) compared to the oven-dried ginger (0.12 ± 0.10). The result of the tenderization also showed that from the opinion of 19 panelists in this study, 03 panelists evaluated that the chicken meat fed with impregnated oven dried and sun dried Ginger is extremely tender, while 08 of the panelists showed that the chicken meat was very tender. 05 panelists showed that the chicken meat was moderately tender, while 02 of the panelists showed that the chicken meat was slightly tender and 01 of the panelists showed that the chicken meat was neither tender nor tough. Therefore, the result generated from this study showed that ginger powder prepared using sun-dried and oven-dried methods are good source of micronutrients and it contains pharmacological active compounds that could be useful in animal production. It can also be effectively utilized to tenderize chicken meat without adversely affecting other meat quality parameters. Therefore, a technology for utilization of easily and cheaply available ginger can be exploited at the industrial or household level for tenderization of meat.

Keywords: *Zingiber officinale* • Nutritional value • Tenderization • Old layer chicken

Introduction

Ginger (*Zingiber officinale*) is an herbaceous perennial plant of the family Zingiberaceae used as a spice, food, flavouring agent, and medicine [1]. Ginger is widely cultivated all over many countries such as Nigeria, Taiwan, India, Jamaica and Bangladesh because it is assumed to grow best in warm climates.

Ginger and its all useful parts have numerous properties such as; flavoring, carminative, stimulator, digestive aids and antiemetic in stopping nausea, it can be used as an ingredient in many herbals and cosmetics. In Chinese and Indian alternative medicines, ginger is being used as a dietary supplement, as a spice and as well as a flavoring agent for foods and beverages.

Nutritionally, the plant is used in a variety of foods because of its nutritional value and flavoring compounds. The Rhizome is a rich source of Vitamins such as Vitamin B, C and E; it also contains mineral elements Like Calcium, Manganese, Zinc, Iron, Magnesium, Phosphorous, Potassium and Sodium [2]. Most of the food components including macro- and micro-nutrients play important role as a nutraceutical, and provides potential health benefits [3]. Dietary fiber, Polyunsaturated Fatty Acids (PUFA), Proteins, Amino acids, Minerals, Vitamins and other bioactive compounds are considered as beneficial nutrient components of Ginger. According to Andlauer and Fürst, Fresh ginger contains 80.9% moisture, 2.3% protein, 0.9% fat, 1.2% minerals, 2.4% fibre and 12.3% carbohydrates. The minerals present in Ginger are Iron, Calcium and Phosphorous. It also contains vitamins such as Thiamine, Riboflavin, Niacin and Vitamin C. The composition varies with the variety, agronomic conditions, curing methods, drying and storage conditions.

Ginger has many medicinal uses; the fresh or dried rhizome is used in oral or topical preparations for treating a variety of ailments, while

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the essential oil is applied topically as an analgesic. Ginger is a kind of herbal plant that can strengthen the body and treat diseases. Scientists have found evidence to support a wide range of medicinal functions of Gingers. These functions include lowering cholesterol, relieving allergies, and asthma, arthritis, colds, and nausea, and protecting the digestive tract and liver against toxins and parasites [4] while the essential oil is used tropically as an analgesic.

Ginger has been reported to have tenderization effect on meat. Tenderization is a quality of meat gauging, how easily it is chewed or cut. It can be increased by a number of processing techniques of Ginger such as sun-drying, oven-drying, impregnated feed; cooking etc. Meat tenderness is one of the most important eating quality parameters [5]. Tenderness of meat is influenced by breed, age, feeding, suspension of carcass during slaughter, electrical stimulation, chilling rate and aging, mechanical, marination, freezing, thawing and cooking. Tenderness plays a very important role in deciding the quality of meat by consumers [6] and is considered to be a critical component of processed meat. Since it ensured that meat reach an optimum level of tenderness before consumption.

Materials and Methods

Location of the study

The study was conducted in Pankshin Local Government Area of Plateau State, Nigeria with its headquarters in the town of Pankshin. It has an area of 1,524 km and a population of 191,685 at the 2006 census. The geographical co-ordinates of Pankshin are Latitude 9.32790 E and longitude 9,543120 E, and an altitude of 1371 meters elevation above sea level [7]. Pankshin enjoys a more temperate climate than much of the rest of the local government areas in plateau state. Average monthly temperatures range from 20-240 (70°F-79°F) and the annual rainfall is at average of 1150 mm (45.26 inch) of rainfall per year, or 95.8 mm (3.77 inch) per month.

Sample collection and preparation

Fresh Ginger Rhizomes (*Zingiber officinale*) were procured from Monday market located in Pankshin LGA of Plateau State and was transported to Federal College of Education, Pankshin for processing analysis. The fresh Ginger Rhizome was washed with distilled water to remove the adhering dirts. The rinds were peeled off after which they were chopped into smaller pieces using kitchen knife. It was sun dried in hostel 7, Federal College of Education, Pankshin and was also oven-dried in biology department laboratory two (2), Federal College of Education, Pankshin using an electric oven at a temperature of 6°C for 6-9 hours [8]. The oven dried Ginger and the sun dried Ginger were then blended using an electric blender (Model: BLFPPK-201) to form a powder. The grounded powder [9] was sieved in to fine texture. The sieved oven dried Ginger and the sun dried Ginger were stored in air tight container separately and taken to National Vertinary Institute (NVRI) VOM for nutritional analysis.

Experimental animal collection and design

Six (6) laying hens of three (3) Months old were bought from Ecwa Vertinary located in Jos, Plateau State and were transported to Federal College of Education, Pankshin for further analysis. Six (6) laying hens of three (3) Months old were randomly distributed into three dietary treatments (Group A, B and C) of 2 laying hens each in a deep litter pen [10]. Group A which was the control group were given normal chikun feed and water daily for three (3) weeks while group B were given chikun feed mixed with oven dried ginger and group C were given chikun feed mixed with sun dried ginger respectively for three (3) weeks as well. Routine management and all necessary medication were followed. At the end of the experiment, the laying hens were sacrificed, cooked for 45 minutes each, and then given to panel of judges for tenderization analysis.

Chemical analysis

The nutritional composition analyses [11] (Moisture content, protein, Crude fiber, Lipids, Ash, NFE, Phosphorus and Calcium) in the sample were determined using the method described by AOAC. Crude fat was determined using the Soxlet system [12], Crude protein and NFE were determine by Kjeldahl method using Kjeltec TM Model 2300 principle: The Soxlet equipment was used to defeat the sample as in crude fat determination, Moisture content determination by the air oven drying method, the Calcium, Phosphorus and the ash content were determined using different methods [13]. The sensory quality of the developed oven and sun dried Ginger in respect to its tenderization effects was judged by 19 panelists using 9-point category rating scale (Figures 1-4).

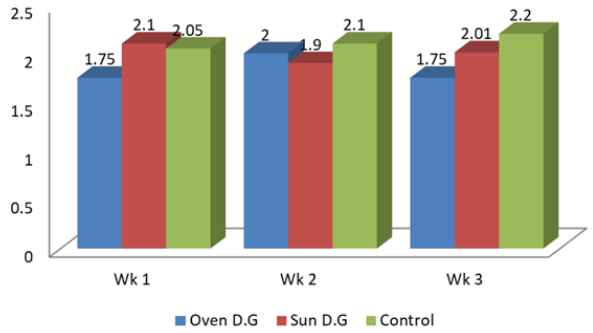

Figure 1. Mean weight of chicken in different weeks.

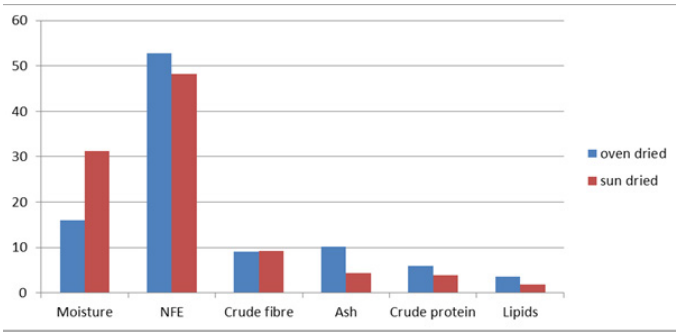

Figure 2. Nutritional composition and tenderization effect of sun dried and oven dried Ginger on the chicken.

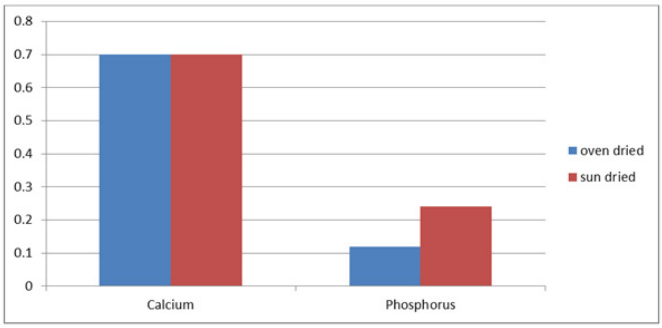

Figure 3. Nutritional composition and tenderization effect of sun dried and oven dried Ginger on the chicken.

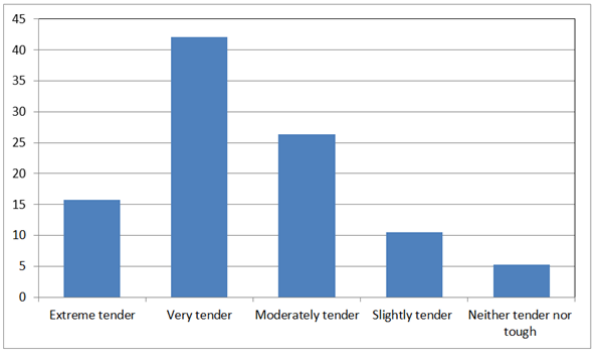

Figure 4. Likert scale of tenderization of ginger feed chicken in percentages.

Statistical analysis

Statistical analysis was carried out using one-way Analysis of Variance (ANOVA). Data were analyzed using SPSS computer software. Data were expressed as the mean + standard error of mean and values at P<0.05 were considered significant.

Results and Discussion

Significant differences (P<0.05) were observed in the overall body weight of the chickens with the highest weight recorded in the control group (2.12 ± 0.16) compared to the sun dried Ginger (2.03 ± 0.23) and the oven dried Ginger (1.83 ± 0.41). This suggests that whereas Ginger inclusion in the diets of laying hens may not affect egg production, it certainly affects live weight. The observed live weight depression effect may be related to the effect of Ginger on fat level [14]. Since fat is major component of fat weight, reduction in fat level will have proportionate effect on overall live weight, also, in order to maintain egg productivity, the hens fed Ginger diets may have been draining from nutrients in body reserves. Nonetheless, egg production across the three dietary treatments was not optimal because of the age of the layers.

The moisture content of foods indicates their freshness and time the foods could be stored without becoming unfit for consumption. Higher moisture content subjects food to an increased microbial contamination and shorter shelf life, and vice versa. In this study, the moisture content of sun-dried Ginger (31.30 ± 0.71) was recorded higher significantly (p<0.05) compared to the oven-dried Ginger (15.92 ± 0.25) [15]. This result is in agreement with Nzikou et al; 2006. Showing that sun-dried Ginger can easily be subjected to spoilage than oven-dried Ginger, hence measures for proper storage need to be adopted. Crude protein content of oven-dried Ginger (5.88 ± 0.005) ginger was recorded higher significantly (p<0.05) compared to the sun-dried Ginger (3.95 ± 0.10). This indicates that oven-dried Ginger is rich sours of protein and oil than sun-dried Ginger and so, it has been utilized as a source of oil and protein to fortify cereal flour production. Crude fiber content was significantly higher (P<0.05) in sun-dried Ginger (9.23 ± 0.02) compared to oven-dried Ginger (9.03 ± 0.015). This is an indicative that the crude fiber of sun-dried Ginger is a valuable nutrient for intestine micro-organisms [16] as agreed with the work of Sathish and Eswar. It also normalize bowel movement, lower cholesterol controls blood sugar levels, prevents choleorectal cancer. Crude fats content of oven-dried Ginger (3.62 ± 0.015) was recorded higher significantly (p<0.05) compared to the sun-dried Ginger (1.87 ± 0.02). This indicates that the oven-dried Ginger could be a better source of lipid than the sun-dried Ginger tested, the oil could be extracted for use as an essential oil [17]. Ash content of oven-dried Ginger (10.20 ± 0.04) was recorded higher significantly (p<0.05) compared to the sun-dried Ginger (4.30 ± 1.06). This is an indication that oven-dried Ginger contains more minerals content required for proper growth and development than the sun-dried Ginger. This result disagrees with the work of Adelakum et al. All the mineral elements quantified in this study are very essential in human and animal nutrition. For example, calcium plays a greater role in the normal pulse rate, transmission of nerve impulses and strong bones. In this study, the calcium content of sun-dried Ginger (0.75 ± 0.02) was recorded higher significantly (p<0.05) compared to the oven-dried Ginger (0.70 ± 0.01). This indicates that calcium in sun-dried Ginger plays a good role in the maintaining of acid alkaline balance in the body [18]. Aremu et al. opines that potassium is one of the most abundant minerals in Nigerian agricultural products. In this study, Phosphorus content of sun-dried Ginger (0.24 ± 0.01) was recorded higher significantly (p<0.05) compared to the oven-dried Ginger (0.12 ± 0.10). The increase of potassium obtained in this study agrees with the findings of Afzal et al. and explains the roles of Ginger Rhizome powder in reducing high blood pressure.

From the opinion of 19 panelists in this study, 03 panelists evaluated that the chicken meat fed with impregnated oven dried and sun dried Ginger is extremely tender, while 08 of the panelists showed that the chicken meat was very tender. 05 panelists showed that the chicken meat was moderately tender, while 02 of the panelists showed that the chicken meat was slightly tender and 01 of the panelists showed that the chicken meat was neither tender nor tough [19]. The observed increases in the percentage of panelists who ate cooked chicken meat treated with oven-dried ginger and sun-dried ginger powder, agree with Xiong, and Badr, which states that Ginger has excellent water binding capacity and is able to improve the tenderness of the cooked meats. Therefore, samples of cooked chicken meat treated with oven-dried ginger and sun-dried Ginger powder were rated superior and most preferred by the panelists and appears to be the optimum level to achieve the best tenderization effect, which can be attributed to the desirable Ginger flavor and can be effectively utilized at household or industrial level and they can be used as better alternatives to papain for tenderization of tough meat (Tables 1-3).

Table 1. Mean and Standard error of chicken weight.

Treatment	Week 1	Week 2	Week 3	Overall
Oven dried ginger	1.8 ± 0.4	2 ± 0.7	1.75 ± 0.35	1.83 ± 0.41
Sun dried ginger	2.10 ± 0.40	1.91 ± 0.10	2.0 ± 0.14	2.03 ± 0.23
Control	2.10 ± 0.10	2.11 ± 0.10	2.20 ± 0.28	2.12 ± 0.16
P-value	0.565	0.433	0.356	0.245
LOS	Ns	ns	Ns	Ns

Note: M ± S.E, NS: Not Significant; LOS: Level of Significance

Table 2. Nutritional composition and tenderization effect of sun dried and oven dried Ginger on the chicken.

Parameters	Control	Oven dried	Sun dried	p-value	LOS
Moisture	-	15.92 ± 0.25	31.30 ± 0.71	0.001	NS
Crude protein	-	5.88 ± 0.005	3.95 ± 0.10	0.002	NS
Crude fibre	-	9.03 ± 0.015	9.23 ± 0.02	0.001	NS
Lipids	-	3.62 ± 0.015	1.87 ± 0.02	0.003	NS
Ash	-	10.20 ± 0.04	4.30 ± 1.06	0.154	*
NFE	-	52.77 ± 0.62	48.30 ± 0.02	0.007	*
Calcium	-	0.70 ± 0.01	0.75 ± 0.02	0.001	NS
Phosphorus	-	0.12 ± 0.10	0.24 ± 0.01	0.014	¬*

Note: NS: Not Significant; LOS: Level of Significance* = significant at 0.05

Table 3. Likert scale of tenderization of ginger feed chicken in percentages.

Tenderization parameters	Percentage (100%)
Extremely tender	15.78
Very tender	42.11
Moderately tender	26.32
Slightly tender	10.53
Neither tender nor tough	5.26

Conclusion

In conclusion, the result generated from this study showed that ginger powder prepared using sun-dried and oven-dried methods are good source of micronutrients and it contains pharmacological active compounds that could be useful in animal production. It can also be effectively utilized to tenderize chicken meat without adversely affecting other meat quality parameters. Therefore, a technology for utilization of easily and cheaply available ginger can be exploited at the industrial or household level for tenderization of meat.

Conflict of Interest

Nil

Funding and Sponsorship

Nil

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