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UV-VIS DETERMINATION OF TOTAL CHOLESTEROL IN VARIOUS TROPICAL POULTRY MEAT PARTS

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ABSTRACT: *The cholesterol contents of the different parts of tropical Gallus species were analyzed using UV-Vis spectrophotometer and results shows that in all the three species of Gallus studied, Gallus sonnratii's intestine had the highest cholesterol content of 226.96 mg/100 g compared to the Gallus gallus and Gallus domesticus intestine with lower values of 215.65 mg/100 g and 177.39 mg/100 g respectively. Gallus gallus liver had the highest cholesterol content of 218.26 mg/100 g. However, Gallus sonnratii had the highest cholesterol content of 163.48 mg/100 g. In general, raw poultry meat has approximately 27 to 90 mg cholesterol/100 g and cooked poultry meat contains around 59 to 154 mg/100. A significant factor affecting cholesterol content of poultry is the type of retail cut because of the difference between dark and white chicken meat and the presence of skin in many retail cuts. Most importantly too, the extent of cholesterol in any meat part is indicative of the nature of the dietary.*

KEYWORDS: Cholesterol, Uv-Vis spectroscopy, Gallus sp, lipoprotein, anti-oxidant.

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INTRODUCTION

Cholesterol, also known as cholesterin belong to the class of organic compounds known as cholesterols and derivatives. They are compounds containing a 3-hydroxylated cholestane core and are considered to be a sterol lipid molecule. Cholesterol as an essential component of all cell membranes helps to maintain structural integrity and fluidity of cell membranes. It also allows animal cell to change shape easily without cell wall wreckage. Cholesterol, a soft waxy fat-soluble steroid made by animal liver and also supplied in diet through animal products such as meats, chicken and fish is a precursor of steroidal hormones and bile acids, Madu and Yakubu, (2018). Cholesterol is a very essential lipid in human cell membranes and is needed to insulate the nerves, produce cell membranes and certain hormones. As a lipid, it is hydrophobic or water-insoluble; it is bonded with a protein so that it can be transported in the blood. Cholesterol is important to life as a primary component of cell membranes and a substrate for the synthesis of steroid hormones such as Progesterone and Estrogen, bile acids and vitamin D. Cholesterol is a fat-like substance, found in the blood stream and also in bodily organs and nerve fibers. Most cholesterol in the body is made by the liver from a wide variety of foods, but especially from saturated fats, such as those found in animal products.

The determination of cholesterol level in different animal protein extracts from meats sold in some parts of Imo State Nigeria have been studied, Edward, Nwafor, Poara, Iroka and Irechukwu, (2023). In the work, five different animal meat samples studied included cow, pig, deer, goat and rabbit. The UV-Vis and GC analysis show that beef (cow meat) had the highest cholesterol value of 17.73 mg/L while pork (pig meat) had the least value 8.08 mg/L. Deer showed the highest percentage of saturated fat 69.99 %. However, pork had the highest value of percentage unsaturated fatty acids 31.01 % while beef had the least value 14.55 %.

It is believed that some processing techniques have impact on cholesterol level of some foods. The effect of cooking procedures on cholesterol and fat contents of some selected meat products have been studied to ascertain the extent to which heat treatment affect cholesterol composition in meat, Keklik, Bozkurt and Tekin, (2018). After frying, the cholesterol content of lamb ($p<0.5$), tail fat ($p>0.5$) and beef fried with or without olive oil ($p<0.5$) all showed a significant increase. Regardless of the meat product or cooking procedure, the cholesterol and fat contents on dry basis exhibited a significant decrease after cooking ($p<0.5$).

Many studies has shown the correlation between a high blood cholesterol level and a high risk of the development of heart disease like arteriosclerosis, Piironen, Toivo and Lampi (2002); Johnston, Korolenko, Pirro and Sahebkar, (2017).

The AOAC adopted the first cholesterol analysis procedure for foods in 1976 (AOAC Official Method 976.26). A modification using direct saponification was made in 1994 and later adapted to the AOAC official method 994.10. This progress was a significant change because it eliminated the lipid extraction step, and therefore, reduced analysis time and solvent use.

Madu, *et al.,* (2018) extracted and quantified cholesterol in selected tropical cow meat parts using colorimetric method. In their study, it was discovered that cholesterol is unevenly distributed in cow meat parts with the intestine having the highest value. Analysis of cholesterol has also been achieved using high performance liquid chromatography, Almeida, Perassolo, Camargo, Bragagnolo and Gross, (2006). The resulting chromatograms were

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processed at 20 nm. Cholesterol identification was performed by co-chromatography and by comparing sample retention times with standard retention times. Quantification for each sample was achieved by internal standardization after saponification.

The USDA Natl. Nutrient database for standard reference (SR) reports cholesterol content of various beef, pork and chicken products and updates the information periodically, USDA, (2011). The SR provides public information on nutritional composition and such information can be used for the mandatory nutrition labeling. Cholesterol data are usually accompanied by fat content, fatty acid composition, and type of meats (species).

The official Gas Chromatography (GC) method used for cholesterol determination in foods is as recommended by the association of Official Analytical Chemists (AOAC) 994.10. Many analysts consider this method to be lengthy and labour intensive as a result of large amount of chemicals needed, the complexity of the method, and the several preparatory steps needed before GC analysis. For these reasons, many authors have developed their own methods for cholesterol determination in meat and other food matrices since the publication of AOAC 995.10. However, the majority of methods developed for meats and other foods rely on external calibration rather than internal standard for quantification purposes. For example, no publications to date have used relative response factors (RRFs) to validate GC cholesterol methods, although the use of RRFs has some advantages over traditional methods relying on calibration curves. The response factors of compounds in GC can vary from one data to another and also from one instrument to another.

Experimental

The materials used in this study were *Gallus gallus* (layers) skin, *Gallus gallus* (layers) heart, *Gallus gallus* (layers) intestine, *Gallus gallus* (layers) liver, *Gallus gallus* (layers) kidney, *Gallus sonnratii* (broilers) skin, *Gallus sonnratii* heart, *Gallus sonnratii* intestine, *Gallus sonnratii* liver, *Gallus sonnratii* kidney, *Gallus domesticus*(local chicken) skin, *Gallus domesticus* heart, *Gallus domesticus* intestine, *Gallus domesticus* liver, *Gallus domesticus* kidney, filter paper, thimble, muslin cloth, cotton wool and stainless trays. The reagents used were analytical grade of n-hexane, potassium hydroxide, methanol, isopropanol and Hydrochloric acid HCl.

Live *Gallus gallus*, *Gallus sonnratii* and *Gallus domesticus* were purchased from the abattoir market in Agege, Lagos State, Nigeria. The samples were identified by a zoologist based on traditional system, ethno-botanical survey and scientific justification. All the three species of Gallus were killed, de-feathered with hot water and dismembered to get the skin, heart, intestine, liver and kidney. These five parts of each of the three Gallus species was washed, cut into pieces to reduce the sizes and dried using electric oven. The dried chicken sample was pulverized into powder for easy extraction of oil. The lipid content of the Gallus species skin was extracted by soxhlet extraction according to the method described by Leila, (2015). Five grams of each of the finely ground dried samples was packed in a thimble extracted with 200 mL of n-hexane with three replications over an extraction period of 8.0 hrs. The n-hexane residue in the extracted oils will be evaporated using a rotary evaporator (Heidolph, Germany) at a temperature of 65 °C. The evaporated sample was kept in an oven at 45 °C for 1.0 hr for the confirmation to totally disappear moisture and n-hexane. After each extraction, the extraction yield was calculated by the following formula-

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$$\text{Oil Yield (\%)} = \frac{\text{Amount of lipid extracted}}{\text{Weight of the sample (5 g)}} \times 100$$

2.0 g of each sample was placed in a round bottomed flask and 10 mL of methanolic potassium hydroxide solution (1M) was added. The solution was heated under reflux for 25 min, cooled and transferred to a 25 mL volumetric flask. The round-bottomed flask was rinsed three times with small quantities of isopropanol and added to the volumetric flask. 1.0 mL of HCl (8M) was added and the flask was filled to the line with isopropanol and placed in an ice bath for 10 min. The turbid solution was quickly filtered through Whatman No 1 filter paper.

The samples and one blank each was analyzed with an enzymatic kit (Cat. 10 139 050 035; Boehringer Mannheim/R Biopharm, Darmstadt, Germany) in accordance with the manufacturer's instructions and read at 405 nm. The total cholesterol content was expressed in g cholesterol/100 g.

RESULTS AND DISCUSSION

The lipid content of Gallus species was reported in Table1with all meat parts of *Gallus sonnratii* having the highest oil content (3.70 %, 1.65 %, 0.51 %, 0.72 % and 2.90 %) as compared to parts of *Gallus domesticus* and *Gallus gallus*. This may be caused by the type of feed they consume as a result of the difference in their species. Lipids essentially play a vital role in the structural and biological, function of the cells and to transport fat soluble vitamin in the body. Histogram A and B (Fig.1) shows the range of values of the lipid and cholesterol content of the various *Gallus* species.

Table 1: Lipid Content of Gallus Species

	Gallus domesticus	*Gallus sonnratii*	*Gallus gallus*
Skin (%)	3.20±0.05	3.70±0.05	3.45.±0.05
Liver (%)	1.50±0.08	1.65±0.08	1.60±0.05
Kidney (%)	0.40±0.05	0.51±0.05	-
Heart (%)	0.60±0.05	0.72±0.05	0.60±0.05
Intestine (%)	2.70±0.05	2.90±0.08	2.79±0.08

Values are ± standard deviation of triplicate determinations

Table 2: Cholesterol Content of Gallus Species

	Gallus sonnratii	*Gallus gallus*	*Gallus domesticus*
Skin (mg/100g)	163.48±0.87	128.70±0.87	81.31±1.31
Liver (mg/100g)	188.70±0.87	218.26±.87	153.91±0.87
Kidney (mg/100g)	160.87±0.87	123.42±.87	87.83±0.87
Heart (mg/100g)	117.39±0.87	72.17±0.87	84.35±0.87
Intestine(mg/100g)	226.96±0.87	215.65±0.87	177.39±0.87

Values are ± standard deviation of duplicate determinations

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Table 3: *Total Cholesterol*

Code	Local fowl Sample	Cholesterol (mg/100g)	Code	Broiler Sample	Cholesterol (mg/100g)	Code	Layer Sample	Cholesterol (mg/100g)
G1A1	Skin	80.00	G2A1	Skin	164.35	G3A1	Skin	129.57
G1A2	Skin	82.61	G2A2	Skin	162.61	G3A2	Skin	127.83
G1B1	Liver	154.78	G2B1	Liver	189.57	G3B1	Liver	219.13
G1B2	Liver	153.04	G2B2	Liver	187.83	G3B2	Liver	217.39
G1C1	Kidney	88.70	G2C1	Kidney	161.74	G3C1	Heart	73.04
G1C2	Kidney	86.96	G2C2	Kidney	160.00	G3C2	Heart	71.30
G1D1	Heart	85.22	G2D1	Heart	118.26	G3D1	Intestine	216.52
G1D2	Heart	83.48	G2D2	Heart	116.52	G3D2	Intestine	214.78
G1E1	Intestine	178.26	G2E1	Intestine	227.83	G3E1	Kidney	80.05
G1E2	Intestine	176.52	G2E2	Intestine	226.09	G3E2	Kidney	82.14

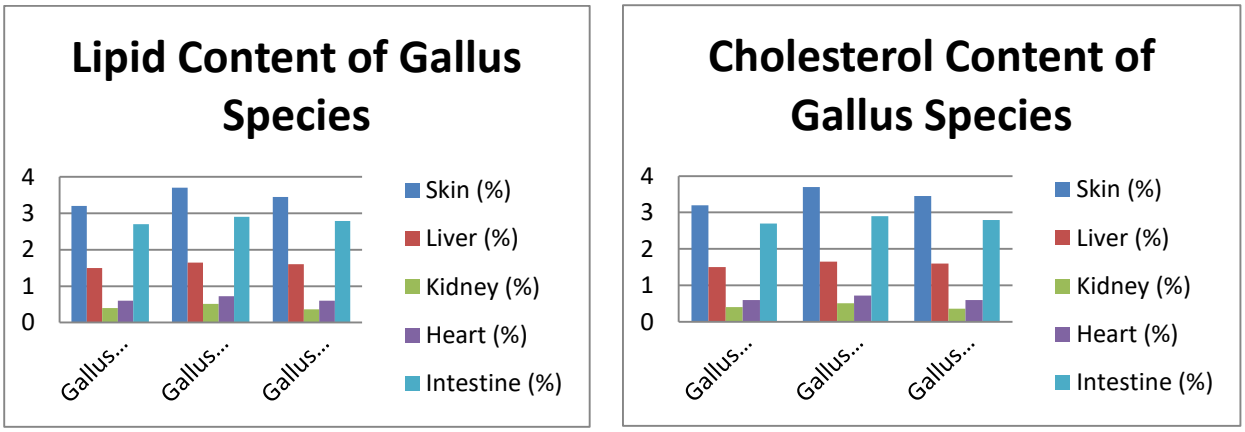

Fig. 1 *Histogram showing the lipid (A) and cholesterol (B) contents of various Gallus species*

The cholesterol content of the different parts of Gallus species were shown in Table 2. In all the three species of Gallus in this study, *Gallus sonnratii*'s intestine had the highest cholesterol content of 226.96 mg/100 g compared to the *Gallus gallus* and *Gallus domesticus* intestine that has lower values of 215.65 mg/100 g and 177.39 mg/100 g respectively. This is contrary to the report of Valsta, Tapanainen and Mannisto, (2005); Honikel, (2009) that says cholesterol content of raw, cooked meat and poultry products ranges from 40 to 90 mg/100 g. Although recent data has reported upper concentrations of up to 150 mg/100 g for cooked chicken dark meat USDA, (2011). Among the liver of all the species, *Gallus gallus* liver had the highest cholesterol content of 218.26mg/100g. Bone marrow and organs, such as liver, kidney, or brain contain a much greater content, up to several hundred milligrams per 100 g, Williams, (2007). Processed meat products contain from less than 50 mg/100 g to more than 150 mg/100 g, depending on their formulation Valsta *et al*., (2005); Honikel, (2009). Also, out of the skin of the three species, Gallus sonnratii had the highest cholesterol content of 163.48mg/100g.This is higher than 131 mg/100 g reported by Lilia *et al*., (2015).

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Dietary treatments such as feed rations also have been studied extensively in an effort to improve lipid quality and decrease cholesterol content in poultry meats Ponte, Mendes, Quaresma, Aguiar, Lemos, Ferreira, Soares, Alfaia, Prates and Fontes, (2004). Cholesterol contents of processed meat products greatly vary from 23 to 144 mg/100 g Bragagnolo, (2009), primarily as a result of variation in ingredients, formulation, type of meats or muscles used, cooking or heating processes applied, storage, and oxidation of cholesterol. Cooked or processed meat products usually have greater cholesterol content than raw meat because of moisture loss with cholesterol being retained in the tissues, Baggio and Bragagnolo, (2006), despite the fact that some of cholesterol is also lost during cooking. The migration of cholesterol from fat tissues to muscle tissues was used as an explanation for greater cholesterol content of cooked meats Swiize, Harris, Savell and Cross, (1992).

CONCLUSION

The cholesterol content obtained in this study shows that intestine and skin are very high in cholesterol compared to other parts of the Gallus species. This is not peculiar to birds alone but a general observed occurrence in all animal because of the storage of adipic acid (fatty acid) more in the intestine than any other part. This justifies the practice of removing the skin and intestine in order to reduce fat consumption and the search for alternatives in reducing the subcutaneous fat in poultry is higher than those reported in other birds' meat. In order to take advantage of the type of fatty acids in the skin and intestine of chicken and considering that abdominal and subcutaneous fat are regarded as the main sources of waste in the slaughterhouse, these lipids can be used as raw materials for biodiesel.

This study revealed that the cholesterol contents of all the parts of Gallus species are relatively low except for the intestine and skin thereby much more recommended than beef or other animal meat.

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