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Quality evaluation and value addition, of chicken dabunama products, from broilers, fed abattoir waste in their diet as alternative protein

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Danbunama products, value addition, raw chicken meat, alternative protein, microbial loads and shelf life.

Abstract

Value addition has gained increasing attention as a means of naturally controlling wastage in meat industry, to facilitate reasonable consumption and production, SGDs goal 12. Dabunama products from chicken fed abattoir waste, could assist in increasing protein intake, convert waste to reasonable products, and reduce cost of feed production. 300-day old Ross broiler chicks were randomly distributed to 5 treatments percentage inclusion, of abattoir waste. 60 birds, with 3 replicates of 20 birds each, at 0%, 5%, 10%, 15% and 20% respectively. Completely randomized design was employed to evaluate, proximate and mineral composition, cholesterol content, of raw chicken and their respective danbunama products using Analysis Association Analytical Chemists AOAC, palatability status using 9-points hedonic scale and microbial loads. Results show that raw chicken meat has (20.72 - 26.48 %) protein, while danbunama had (32.96 - 46.32 %). Ether extract of raw muscle and dandunama products increases as inclusion of abattoir waste increases. Phosphorus from mineral composition was not significantly different in raw chicken meat. T2 performed better with mineral composition compared to other treatments evaluated. Microbial status, T2 had lowest value significantly ($p<0.05$) for both the raw chicken at 5 % and for danbunama products but observed to increase as inclusion increases. There were no ($p>0.05$) difference in value gotten for overall acceptability of both boiled broiler chicken and danbunama chicken products.

Chicken danbunama, had higher proximate composition with lower values: in moisture content, mineral content, microbial loads, palatability scores compared to raw chicken and cooked chicken meat.

Nomenclature and units

%	Percentage
g	Grams
cfu/g	Colony forming units per gram
Mg/100g	milligrams per 100grams
g/100g	Grams per 100 grams
Kg	Kilogram

1.0 Introduction

Waste management is the process on incorporating waste unto useful production to meet up with human needs. Under the 17 SGD goals, it also agrees with the 12 SGD goals to ensure sustainable consumption and production patterns. Since poultry feed is taking over 75 % of the total cost of production now, and with the present economic situation where dollar and petroleum cost keeps increasing in Nigeria, there is a need for alternate feeds ingredient to help reduce the total cost and yet to ensure sustainable consumption and production of poultry birds, at reasonable prices. Waste management can have different definition, but in this study, it is a way of recycle or reusing unwanted material or waste into useful products for economics production.

Abattoir waste are, unwanted meat materials or waste gotten from slaughter of animals in the abattoirs, they include horn, hoof, skin, feathers, blood, bone, fats, offal's, undigested feeds, rumen content, intestine, hairs, and other meat particles with those found on top or under the abattoir tables, or on the slab in the abattoir house.These wastes gotten from the abattoirs can be converted into meal and incorporate it into meal and which may be substituted or alternate with soy bean meal, because it has proven to be of higher protein percentage source. Onunkwo *et al*., (2018), observed that bovine blood and rumen content contains 9.34 % moisture content, 35.35 % protein content, 3.60 % ether extract, 15.57 % crude fiber, and ash 0.98 %, and NFE of 25.06 %, Also, Sakaba *et al*., (2017) reported that the nutrients in rumen digester are 5.83 % moisture content, crude protein 15.52 %, lipid 5.17 %, fiber 48.73 %, ash 11.00 %, and NFE 19.98 %, with the above submission it could be deduced that abattoir waste has higher percentage of nutrient, which could alternate other expensive ingredients in poultry feed to reduce total cost of production to poultry farmers.

Now a days, consumers are tired of consuming chicken meat all the time, as it is one of the major cholesterol free meats, even after frying, cooking or processing, they get easily fed-up with it, except with the introduction of value addition, to improve the eating qualities and the shelf life, in birds like cured layer, quail, and even turkey. Value addition has shown several ways of improving meat product acceptability, protein intake, eating ability and shelf life, e.g in called layer, cockerels, quails etc, as different meat products; *Kundi, Suya, Kilishi, danbunama* are easy produced from beef and other ruminant animals but rarely produced from poultry meat in Nigeria. This study focuses on the use of abattoir waste to lower broiler feed cost and valve addition of chicken meat, into *dabunama* products.

2.0 Materials and Methods

In this section, the materials and methods for this research are presented.

2.1 Experimental production procedure

A total of one hundred and fifty (150) day old Ross breed chicks were used for this study which lasted for 8 weeks. The birds were sourced from a good reputable farm in Osun State, Nigeria. The experimental birds were raised in an intensive system of management in a deep litter system in two phases (The starter phase and the finisher phase). The starter phase which is also the brooding phase lasted for 4 weeks and the birds were fed compounded broiler starter feed while the finisher phases was fed compounded broiler finisher with varied levels or percentages of abattoir waste inclusion to the birds. This phase lasted for another four weeks to make a total of 8 weeks experimental period.

2.2 Sample collection and preparation

The sourced bones were sun dried until the moisture content is totally drained and were shattered steamed at 100 °C for more than 30 minutes in an autoclave, which were later milled and crushed into smaller particles using a milling machine into powder form. Same was done to cattle horns and hooves after sun drying; they were steam cooked for seven hours at 100 - 112 °C in an autoclave. Both mixtures were then grinded into powdering form.

Rumen content was retrieved from an abattoir, gathered and emptied into a clean bag, squeezed out locally, to reduce moisture content and its bulkiness. And lay on a clean nylon sheet, sundried in an aerated environment till uniform dryness was observed. It was flipped often or turned during drying to aid the drying process. Using a milling machine, the dried rumen content was converted into a fine ground rumen content meal.

Blood was collected during slaughtering of cattle at the abattoir and was transferred to a drum and coagulated for 45 minutes on a burner at 100 °C. It was sieved after coagulation to drain any excess water. The coagulated blood was sun dried on a clean aluminum sheet in a well-aerated environment, and turned for even dryness. Using milling machinery, the dried blood was crushed into a fine ground blood meal powder. Separately milled abattoir waste was sent to a laboratory for chemical analysis to identify its proximate composition, The combination was combined in a 1:1 ratio and utilized at various levels (0%, 5%, 10%, 15% and 20%) to compound feed, used for broiler finisher feed.

2.3 Experimental Treatments

150 birds were purchased and randomly divided into five (5) treatments and three (3) replicates in which 10 birds per replicate and 30 birds per treatment. The treatment includes;

Treatment 1: Compounded feed
Treatment 2: Compounded feed with abattoir waste at 5%
Treatment 3: Compounded feed with abattoir waste at 10%
Treatment 4: Compounded feed with abattoir waste at 15%
Treatment 5: Compounded feed with abattoir waste at 20%
At the end of the 8th weeks, broiler meat was sourced from broilers fed varying levels of abattoir waste to prepare *Danbunama.*

Table 1: Experimental diet fed to broilers (Finisher stage)

Ingredients	0% (T1)	5% (T2)	10% (T3)	15% (T4)	20% (T5)
Maize	64.00	64.00	64.00	64.00	64.00
Soya bean meal	28.00	26.60	25.20	23.80	22.40
Abattoir waste meal	0.00	1.40	2.66	4.20	5.60
Wheat offal	4.00	4.00	4.00	4.00	4.00
Rice bran	3.20	3.20	3.20	3.20	3.20
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15	0.15

Proximate Composition of the Abattoir waste meal are, Crude Protein 17.88%, Ash 53.03%, Either Extract 5.44 %, Crude Fibre 6.33%, Moisture Content 7.25%, Nigeria Free 10.11%.

Table 2: Vaccination and Medication programme for broiler chicken Table 3

AGE OF THE BIRDS	TYPES	MEDICATION AND VECCINATION
DAY 1	Vaccination	Marek (Hatchery)
1 WEEK	Vaccination	1st Gumboro vaccine
2 WEEKS	Vaccination	1ST NDV(Lasota vaccine)
3 WEEKS	Vaccination	2nd (Gumboro vaccine)
DAY 1-3	Medication	Anti-stress, glucose
DAY 4-6	Medication	Anti-biotic in water
DAY 8-10	Medication	Live water
DAY 10-13	Medication	Anti-Coccidial in water
DAY 15-17	Medication	Live water
DAY 18-20	Medication	Vitamins
DAY 22-24	Medication	Live water
DAY 25-27	Medication	Anti-biotic in water
DAY 29-33	Medication	Anti-coccidial in water
DAY 34-35	Medication	Live water
DAY 36-37	Medication	Iodine in water
DAY 37-40	Medication	Live water

2.4 Experimental bird management

The poultry pen, its surrounding areas and all equipment's were thoroughly washed, cleaned and disinfected. Wood shaving was sourced and was spread evenly to a depth of 3-10cm, leveled and compacted in the brooding house. All equipment's were assembled in appropriate configuration. The pen was pre heated, immediately after arrival of the chicks, the chick boxes were carefully offloaded and chicks were distributed evenly throughout in the pen.

Chicks were tipped quickly, gently and evenly, and the empty boxes were removed from the house. Solution of glucose and vitamins was served to the chicks as anti-stress. A one to two hourly check was done mandated during the brooding stage. Vaccination and medication programme was strictly adhered to good production condition.

2.5 Production of Value Addition to broilers meat/ *Danbunama* products

Cooking

Raw meat (breast and thigh muscle) was cut into pieces of 50 g each and the meats were trimmed off of all visible dirt's, fats, and washed with cool distilled water, mixed with spices and ingredients (Maggi, salt curry, ginger and thyme), boiled for about 90 minutes or till it becomes soft, in ratio, 200 ml of distill water to I kg of chicken meat. The meat samples were cooked to an internal temperature of 72 ºC, for 20 minutes. The meat samples were removed and allowed to equilibrate to room temperature and weighed.

Shredding

The cooked meat sample was shredded separately by pounding with a local mortar and pestle. These were weighed and added little by little at a time as pounding progressed for uniform mixing of the recipe. The pounding was intense and consistent until the meat strands disengaged.

Frying
The shredded meats from each chicken meat according to abattoir waste inclusion were separately deep fried in soybean oil which was pre-heated to 180 ºC. The meat samples were fried until a golden brown colour was obtained, for about 15 – 20 minutes.

Draining of Oil
The products were poured into a colander after frying and pressure was applied to remove excess oil and to prevent the final product from sticking together. The dried spongy products from each percentage inclusion were poured into separately marked transparent containers, allowed to cool and separate into strands.

Table 3: Recipes used in *danbunama* / shredding chicken meat

Ingredients	Scientific/Botanical names	Quantity(g)
Red Peppser	*Piper nigrum L.*	35.00
Maggi	*Maggi*	30.00
African Nut Meg	*Monodoramyristica (Gaertn.) Dunal*	2.50
Ginger	*ZingiberofficinaleRosc.*	4.00
Garlic	*Allium sativum L.*	3.00
Cloves	*Syzygiumaromaticum (L.) Merr. et L.M. Perry*	2.50
Curry powder	*Murrayakoenigii L.*	3.50
Thyme leaves	*Thymus vulgaris L.*	2.50
Salt	*Sodium Chloride*	5.00
Onions	*Allium cepa L. var. cepa*	12.00
Total		100.0

Source: *Omojola et al*., (2014)

2.6 Data collection
After preparation of the *Danbunama,* raw chicken meat and its products were packed and taken to the laboratory for proximate composition, mineral composition, microbial loads, and palatability status.

2.6.1 Proximate Composition
Proximate analysis was carried out on the raw chicken meat and *Danbunama* products according to the method described by (Omojola *et al*., 2014).

2.6.2 Microbiological Evaluation
Total bacterial Count (TBC) and Total Fungal Count were determined. All analyses were done following the procedures described AOAC (2000).

2.6.3 Palatability status
The *Danbunama* products were subjected to palatability evaluation which were evaluated using; its juiciness, color, flavor, tenderness, texture and overall acceptability. A total number of 10 trained panelists were used. The panelists were provided with taste neutralizer such as unsalted cracker biscuits and nine-point hedonic scales for rating.

2.7 Yield of processed *Danbunama*
The yield of processed *danbunama* was calculated using the method,

$$\text{Product Yield (\%)} = \frac{\text{Weight of meat floss}}{\text{Weight of raw meat sample}} \times 100$$

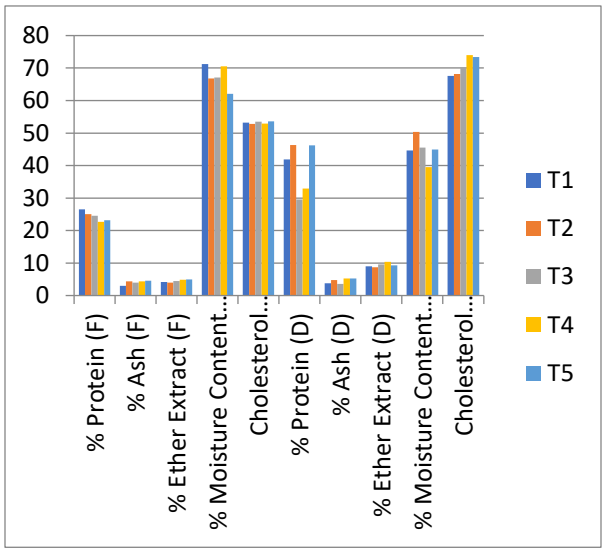
2.8 Experimental Design and Statistical Analysis
All data collected was subjected to analysis of variance (ANOVA) with the procedure of SAS (2000). Statistically significant observed mean was compared using Turkey test of the same package at 5% level of probability

3.0 Results and Discussion
In this section, we present our analyses, which are shown below;
Figure 1 shows an increased in the proximate composition value obtained from the raw chicken meat to *Danbunama* products. The values of protein, moisture content and ether extract gotten in the figure 1 are significantly greater than the one reported by Owosibo *et al*., (2017), who work on "Growth, carcass and sensory traits of broiler chickens fed graded levels of extruded sesame seed meal". The table above reveals that during processing of *Dabunama* products, there were increase in nutrients e.g protein, ash and either extract, then the moisture content which had a lower value for all the treatments evaluated, but with higher values ($p<0.05$) for raw chicken meat. It was also observed that the treatment with 5 % (T1) had the highest protein content which decreases in T3 and T4 respectively, these observations were also observed for both in raw and *Danbunama* chicken meat. The raw chicken meat protein values 22.72% -26.48% are higher than 22.48% - 22.70% for protein reported by (Okunbanjo *et al*., 2003). It could be concluded that the nutrient values were influenced by the abattoir waste inclusion but T2 performed better. The moisture percentage fell between 62.05 – 71.1 8% which were lower than 75.37 – 75.62 % by (Souza *et al*., 2011), for proximate composition of broilers meat and meat quality of broiler meat reared under different production system.

T2 appeared to be better with higher protein and ash content and lower ether extract percentage. The moisture content decreases with increased in inclusion of abattoir waste for the *Danbunama* products. T2 was also observed to perform better than other inclusion with the highest protein and ash contents and lowest ether extract

percentage. The report collaborates with Omojola *et al*., (2014), on development and quality evaluation of *Danbunama* (meat Floss) a Nigerian shredded meat products with (64.16 -74.98 %) moisture content and (21.23 -22.89 %) of protein respectively.

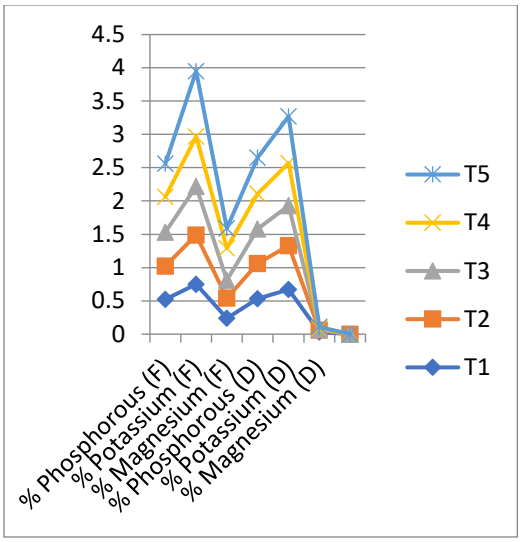
Cholesterol content increases significantly ($p<0.05$) with the production of danbunama according to (Kyakma *et al*., 2022 and Sanwo *et al.,* 2020) who worked on the quality and stability of meat obtained from broiler fed tonic root (Mondia) as supplement. The values increase as the inclusion increases, but there is no significant different ($p>0.05$) in raw chicken meat as inclusion increases as observed in the table below.



(F) Fresh broiler meat and (D) Dabunama product
T1: *Compounded feed,* ***T2:*** *Compounded feed with abattoir waste at 5%,* ***T3:*** *Compounded feed with abattoir waste at 10%,*
T4: *Compounded feed with abattoir waste at 15%,*
T5: *Compounded feed with abattoir waste at 20%.*
Figure 1
Proximate composition and cholesterol content of fresh broiler meat with *Danbunama* products produced from broilers fed abattoir waste inclusion in their diet.

Mineral composition of fresh broiler meat with *Danbunama* is shown in figure 2. Phosphorus helps in the formation of bones and teeth, Potassium in the body, help to maintain normal levels of fluid inside the cells, while magnesium helps to maintain normal nerve and muscle function.

As the abattoir waste increases, the mineral content also increases, especially for Potassium (K) for both the fresh chicken meat and *Danbunama* products. It could be deducted that there were loses of minerals during the processing into *Danbunama* as showed in table 6. However, Phosphorus was not affected with abattoir waste inclusion, in figure 2 above, however, T2 performed better.
Umar and Mohammed, (2019) obtained a different value or had a higher mineral content, especially for Mg and P (16.62 and 32.22%) respectively. This deducted that during production of *Danbunama*, mineral escape during processing and this agrees with the work of (Omojola *et al*., 2014).



(F) Fresh broiler meat and (D) Dabunama product
T1: Compounded feed, T2: Compounded feed with abattoir waste at 5%, T3: Compounded feed with abattoir waste at 10%, T4: Compounded feed with abattoir waste at 15%, T5: Compounded feed with abattoir waste at 20%.
Figure 2: Mineral Composition of fresh broiler meat with *Danbunama* products produced from Broilers fed Abattoir waste inclusion in their diet.

Figure 3 shows TBC (Total bacteria count) and TFC (Total fungi count), The total viable count is the quantitative sanitary standard to identify the process conditions and contamination degree of meat. TBC-Total bacteria count is a quantitative estimation of the number of, micro-organisms present in a sample, this measurement is represented by the number of colony-forming bacterial units per gram in the sample. Total fungi count is a quantitative estimate of the number of fungi present in a sample. The microbial analysis of raw broiler meat and *Danbunama* products produced from broilers fed abattoir waste as alternative in their diets, are shown above. It was observed that abattoir waste inclusion has effect on the TFC for *Danbunama*, since fungi usually affect substrate with low moisture content, TBC for raw chicken meat of *Danbunama* respectively. The Table also

show a decrease in T2 and T3 (5% and 10% of abattoir waste inclusion) and the microbes increases at T4 –T5. But the products had lower microbial loads values to its raw counterpart (Bala, 2014). It was also observed that from 5% of T2 inclusion, the microbial values decrease as the inclusion increases there are increase in the microbial value despite the method of processing used. These observations collaborate with the report of Balarabe *et al*., (2021) with values ranges from 2.00 - 28.00 cf/g x 10^{-4} on the microbial qualities of *Danbunama* processed from broiler fed graded level of leaf meat.

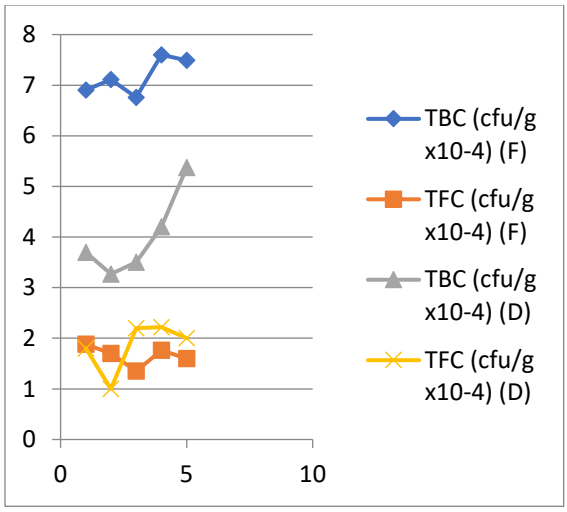


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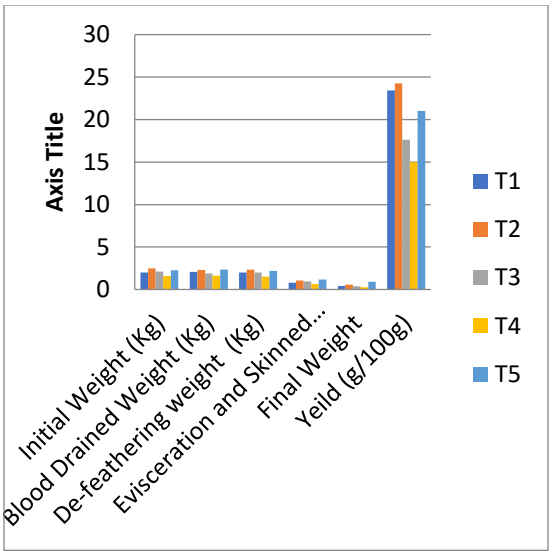
Figure 3: Microbial Analysis of fresh broiler meat with *Danbunama* products produced from Broilers fed Abattoir waste inclusion in their diet.

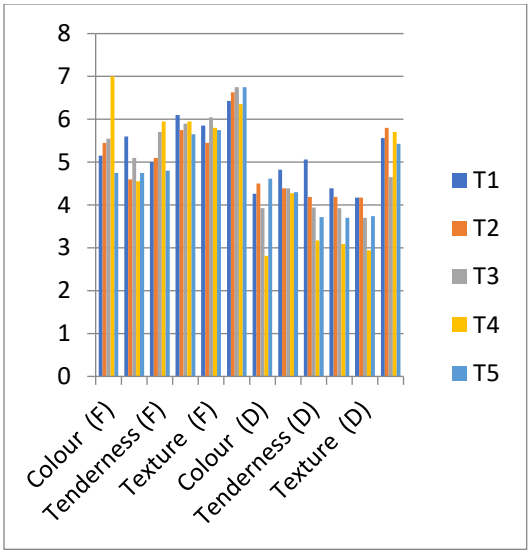
In Figure 4, the yield of processed *Danbunama* was calculated by weight of meat floss divided by the weight of raw meat sample and multiplied by 100. T2 of 5 % inclusion had the highest yield of 24.27 % ($p<0.05$) than T1 (23.44 %), T3 (17.63%), T4 (13.00%) and T5 (21.02 %). This might be due to the fact that T2 had the highest initial weight, blood drained weight, de-feathering weight, and final weight than other treatments evaluated. The product yields did not agree with the report of (Omojola *et al*., 2014), who recorded 70.07 g/100g – 74.05 g/100g for product yield on development and quality evaluation of *Danbunama*, a Nigerian Shredded meat product.



(F) Fresh broiler meat and (D) Dabunama product
T1: Compounded feed, T2: Compounded feed with abattoir waste at 5%, T3: Compounded feed with abattoir waste at 10%, T4: Compounded feed with abattoir waste at 15%, T5: Compounded feed with abattoir waste at 20%.

Figure 4: Yield of processed *Danbunama* produced from broiler fed abattoir waste in their diet.

Figure 5 shows the palatability result of boiled chicken meat and *danbunama products*. The figure shows the texture, colour, flavour, juiciness, tenderness and overall acceptability. The results shows that the abattoir waste had no serious effect in flavor and juiceiness of cooked broiler meat, since the highest significant value ($p<0.05$) was observed in the control treatment (T1). But it had influences on the colour and tenderness of the boiled chicken meat. However, there were no significant different ($p<0.05$) in the overall acceptability of boiled chicken meat. For *Danbunama* products, as the abattoir inclusion increases, the palatability scores by the panelists decreases. As T1 and T2 (for control and 5% inclusion) had the highest palatability scores compared to other treatments. This observation is in agreement with the report of (Ogunsola and Omojola, 2008) on the development and qualitative evaluation of *Danbunama*.



(F) Fresh broiler meat and (D) Dabunama products T1: Compounded feed, T2: Compounded feed with abattoir waste at 5%, T3: Compounded feed with abattoir waste at 10%, T4: Compounded feed with abattoir waste at 15%, T5: Compounded feed with abattoir waste at 20%.

Figure 5: Palatability results of boiled broiler meat with *Danbunama* products produced from Broilers fed Abattoir waste inclusion in their diet.

4.0 Conclusion

It could be concluded that abattoir waste is a good alternative to Soya bean meal especially at 5% (T2). *Danbunama* products at T2 (5% of inclusion) performed better than other treatments, as it has higher or increase proximate composition, (except moisture content), increase in cholesterol values, and decrease in mineral composition, microbial loads and palatability scores.

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Declaration of conflict of interest

The authors have collectively contributed to the conceptualization design, and execution of this journal. They have worked on drafting and critically revising the article to include significant intellectual content. This manuscript has not been previously submitting or reviewed by any other journal or publishing platform. Additionally, the authors do not have any affiliation with any organization that has a direct or indirect financial stake in the subject matter discussed in this manuscript,

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