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Effect of Processed Cowpea-based Diets (V. unguiculata) on Meat and Sensory Characteristics of Broilers

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ABSTRACT *Original research paper*

Nowadays meat consumers are nowmindful of health, meaning that they buy meat that has a balanced nutritional profile, free from adulteration, and is not contaminated by microorganisms. The objectives of this study were to determine the effect of processing cowpeas on meat and sensory characteristics of broilers. A total of 210-day-old broiler chicks were randomly allocated into seven different feeding groups in a completely randomised design. Each dietary treatment was replicated three times with ten birds in each replicate. The control group contained maize-soybean meal (MS). The cowpea-based groups were: maize-soybean-dehulled boiled cowpea meal (MSDBC), maize- soybean-dehulled roasted cowpea meal (MSDRC), maize-soybean-dehulled cowpea meal (MSDC), maize-soybean-boiled cowpea meal (MSBC), maize-soybean-roasted cowpea meal (MSRC) and maize-soybean-untreated cowpea meal (MSUC). A total of fifteen birds (five per replicate) were randomly chosen and killed at the 42-day mark of the experiment. Meat samples were selected from the breasts to analyse meat quality and sensory characteristics. Forty trained panellists were randomly selected to conduct the organoleptic quality test of broiler meat. Meat from MS diet had the highest protein content of 22.5%, while meat from MSDBC treatment had the lowest (18.6%). Meat from raw cowpea-based diet had the highest fat content (1.3%) while meat from MSDBC had the lowest fat (0.9%) and other treatments were not different (1.2%). Meat from MSDBC, MSDRC, and MSRC had similar crude fiber content (0.8%), whereas meat from MSBC and MSUC had the highest (1.0%) compared to the control diet (0.9%). The amount of crude fiber in meat from the MSDC group was similar to that of the control. Meat form MSBC had the highest water holding capacity of 74.1%, MSUC had the lowest (61.5%) and other treatments were similar. Meat from MSBC had the highest pH of 6.6. Meat from MSUC had the lowest pH of 6.0, while pH from the remaining dietary groups was not different. Meat from broilers fed diets containing raw cowpeas had the lowest colour and texture scores, while the rest of treatments were similar in the two parameters. There were no differences in the aroma scores of all treatments.Meat from MSDBC, MSDC and MSBC had the highest taste scores, while MSUC had the lowest ($P<0.05$) and the remaining treatments were similar. Tenderness scores of meat were *highest in MS, MSDBC and MSBC groups and lowest in the MSUC treatment. Tenderness of meat from the remaining treatments was not different in this parameter. In conclusion, processed cowpeas can be added to broiler diets up to 15% inclusion levels without compromising the quality and sensory attributes of broiler meat.*

1. Introduction

Therehas been a larger demand for chicken meat due to factors such as the recent increase in the global population, urbanization, shifting consumer preferences, rising per capita income, and its affordability relative to other meat varieties. (Beatriz Alvarado Soares and de Oliveira Silva, 2022). Broiler meat is also not affected by religious and cultural beliefs (Petracci*et al*., 2015). Broiler meat is highly digestible (contains less collagen) and is very nutritious (Ahmad *et al*., 2018). It has low levels of cholesterol and fats but is rich in proteins (Al-Baadani*et al*., 2023). Al-Baadani*et al*. (2023) found that chicken meat is composed of 22.9 % crude protein (CP), 1.9% fats, and 113 kilocalories (kcal) of energy when compared to 20.9% CP, 3.2% fats, and 115 kcal of energy in beef and 21.9% CP, 4.9% fats and 134% kcal of energy in pork (Ahmad *et al*., 2018). Nowadays meat consumers are nowmindful of health, meaning that they buy meat that has a balanced nutritional profile, free from adulteration, and is not contaminated by microorganisms (Beatriz Alvarado Soares and de Oliveira Silva, 2022). The meat should be of high quality for it to be acceptable to the consumers.

According to Bogosavljevic-Boskovic*et al*. (2010), the characteristics of meat that affect its price and acceptability by consumers are referred to as meat quality.Meat quality can be classified into two groups: (i) conformance quality and (ii) functional quality. The desirable qualities of a product, such as yield, color, texture, flavor, water-holding capacity, and meat taste, are referred to as functional quality. Conformance quality is mainly concerned with creating a product that precisely satisfies the needs of the customer e.g. producing chickens with a certain weight as per consumers' request. Both types of quality are very crucial to meat producers and consumers because no consumer will accept broiler chickens having the exact dressing-out percentage but with a poor flavor, texture, and color (Bogosavljevic-Boskovic*et al*., 2010; Nusairat *et al*., 2022).

According to Northcutt (1997) and Nusairat*et al*. (2022), there are three levels of meat quality namely wholesomeness, functional, and eating quality. The term "wholesomeness" describes the nutritional, chemical, and microbiological characteristics of meat. Meat's texture, flavor, juiciness, taste, and tenderness are all considered aspects of its eating quality.

The term "functional quality" describes the meat's color, pH, water-holding capacity, yield, and carcass composition. Al-Baadani*et al*. (2023) reviewed the influence of genetic and non-genetic factors on meat quality. Genetic determinants include genotype; non-genetic factors include nutrition, feeding strategy, and rearing system (Nusairat*et al*., 2022). Bogosavljevic-Boskovic*et al*. (2010) claimed that broiler nutrition is the most important non-genetic factor that significantly influences certain meat quality traits. The same authors claimed that the chemical makeup of muscle tissue can be somewhat influenced by feed consumption and diet composition. The choice of raw materials for feed formulation, their chemical composition, the varying protein and energy values of the formulated rations, the extent of nutrient utilization, and the various interactive or associative effects (synergistic or antagonistic) of feed components are some of the factors that affect the quality of broiler meat (Bogosavljevic-Boskovic *et al*., 2010).

The use of organic acids and other feed additives, such as antibiotics, has increased broiler growth rates, decreased the incidence of sickness, and improved the grade of meat produced by broiler chickens. However, because health hazards (such as cancer and coronary heart disease) are connected with the antibiotics' residual effects in meat, the use of antibiotics in chickens is banned in all EU member states (Castanon, 2007). Probiotics, prebiotics, and exogenous digestive enzymes are increasingly being used in place of antibiotics in modern broiler production to improve meat quality, growth rate, and nutrient digestibility (Allouі*et al*., 2013). Probiotic dosage rates and modes of action, however, are still unknown (Jha*et al*., 2020). Moreover, probiotic supplementation in human diets may carry certain health hazards, according to current research on probiotics in humans (Jha*et al*., 2020).

Soybeans, a conventional source of protein used to prepare poultry feeds, is scarce in Zimbabwe and the shortage of this commodity is causing a proportional increase in the price of poultry feeds. The shortage of soybeans has raised awareness for stakeholders in the poultry industry to search for alternative plant sources of protein that can partially substitute soybeans in poultry feed manufacture. Grain legumes such as faba beans (*Viciafaba*), chickpeas (*Cicer arietinum*), pigeon pea (*Cajanascajan*) and velvet bean (*Mucunapruriens*) have been evaluated in several studies to analyse their suitability in replacing soybeans in broiler feeds. However, all the above-mentioned grain legumes are not widely distributed in Zimbabwe (Odeny, 2007) and are not sufficient to be used as a supplement to soybeans in broiler feed formulation. It is necessary to investigate whether cowpeas, which are inexpensive, readily accessible, resistant to drought, and able to adapt to Zimbabwe's semi-arid climate, may take the place of soybeans in the production of chicken feed. Since consumers of meat are now health-conscious, adding cowpeas to broiler diets shouldn't have an impact on the sensory qualities and quality features of the meat (Mir *et al*., 2017). They do not prefer meat that has high levels of fat and cholesterol (Wideman*et al*., 2016). Consumers like meat which is tender and light in colour. Meat with a high content of saturated fatty acids and cholesterol predisposes human beings to coronary heart diseases and obesity (Ponte *et al*., 2004). On the other hand, meat processors are mainly concerned about water holding capacity and pH of broiler meat since they determine the yield and shelf life of meat (Mir, *et al*., 2017)

A lot of studies (Kur *et al*., 2014; Akanji*et al*., 2016) were carried out to investigate the effect of partial replacement of soybeans with cowpeas in broiler diets on production parameters and carcass characteristics but there is dearth of information on the influence of cowpea-based diets on sensory attributes and meat quality parameters of broiler meat. Therefore, research is needed to investigate if cowpeas can be incorporated into broiler diets without negatively affecting sensory characteristics and quality of broiler meat.

1.1 Materials and Methods

Study Site

Two hundred and ten day-old broiler chicks were purchased from Irvine's Day Old Chicks Pvt Ltd and were raised in fowl runs owned by Cold Storage Company in Kadoma District of Mashonaland West Province. The sensory evaluation of broiler meat was conducted at Chinhoyi University of Technology Food Science Laboratory, located in Mashonaland West Province, Zimbabwe. It is on a Latitude of 17° 20' 59" South and a Longitude of 30° 12' 31".The area has a minimum and maximum temperature of 15.07°C and 27.94°C, respectively. The area has an elevation of 1140m above sea level.

1.1.1 Cowpea Grain and Preparation

The cowpea grains (CBC5 variety) utilized in this experiment were bought in a Kadoma neighbourhood market. To get rid of bad grains, the cowpea grains were sorted. While some of the sorted cowpea grains were left untreated, others were roasted in a metal box roaster for 15 minutes at 120°C. Cowpea grains were mixed with an equal amount of sand and then roasted. The sand was used to evenly distribute the heat and ensure even roasting of cowpea grains. The roasted cowpea grains were, afterwards, separated from the cowpeas-sand mixture using a 2mm sieve. Another sample of cowpea grains was boiled at 120°C for 15 minutes, others were soaked in sodium chloride solution for 12 hours, physically dehulled by hand, and air dried for 5 days. One sample was dehulled and roasted at 120°C for 15 minutes. Another sample was dehulled and boiled at 120°C for 15 minutes. The last sample consisted of dehulled cowpea grains which were boiled at 120°C for 15 minutes. The cowpeas in the six groups were ground so they could fit through a 1.5 mm sieve.

1.1.2 Experimental Design

Two hundred and ten one-day-old unsexed Cobb 500 broiler chicks were randomly allocated into seven dietary treatments using a completely randomised design. Each dietary treatment was replicated three times with 30 broilers per treatment and 10 birds per replicate. Breast meat samples weighing 50g were collected from 15 broiler carcasses per each treatment and were used to measure the nutritional composition, pH and water holding capacity of meat. A sample of fifteen broiler carcasses per treatment (five per replicate) were used to measure the colour, taste, aroma, texture and tenderness of broiler meat.

1.1.3 Animal Management and Data Collection

Irvine's Day-Old Chicks (Pvt) Limited supplied 210-day-old, unsexed broiler chicks of the Cobb 500 breed. The chicks were put in a deep litter housing unit with open sides. The broiler house was cleaned, disinfected, and left to rest for a period of two weeks. The floor was covered with wheat straw that was dry and dust-free. Two weeks were spent brooding the chicks. On days 12 and 16, the birds were vaccinated against infectious bursal disease (IBD) using the Gumboro D78 vaccine. On day 21, they underwent a second dose of the ND Lasota vaccine, which protects against Newcastle disease. Starting on day one and continuing through day fourteen, and day fifteen through day forty-two, the chicks were fed broiler starter and finisher mashes. The experiment was terminated six weeks following the placement of the birds.Upon completion of the experiment, measurements were made of the broiler meat's water holding capacity, pH, nutritional composition, and sensory attributes (42 days post-hatch).Fifteen birds from each food group (five per replicate) were randomly chosen on day 42 of the experiment, killed, defeathered, eviscerated, and refrigerated at -20°C for a period of two days. On the third day, Breast meat samples weighing 50g were selected from each feeding group and were sent to the University of Zimbabwe in Harare, where tests were done on the meat's pH, water-holding capacity, and nutritional makeup. Fifteen birds per dietary group were brought to Chinhoyi University of Technology, where students with training in food science, animal production and technology performed the sensory evaluation.

1.2 Water Holding Capacity of Broiler Meat

The water holding capacity (WHC) of the fresh breast meat samples was determined using the method described and authorized by Hussain *et al*. (2016).Each dietary treatment's 8g of meat samples were put in a centrifuge tube along with 12ml of 0.6M NaCl solution. After centrifuging the tube for

15 minutes at 4ºC and 10,000 rpm, the following computation was used to quantify the supernatant after it was decanted;

WHC (%) = before centrifuge weight – After centrifuge weight *100

Before Centrifuge weight

1.3 pH of Broiler Meat

Samples of broiler meat were analyzed using the protocol that Hussain *et al.* (2016) advised. Two birds per replicate provided 10g of breast meat, which was then crushed in a blender and homogenized for one minute with 100ml of distilled water. The pH was determined using a digital pH test meter.

1.4 Meat Sensory Characteristics

Fifteen broiler carcasses were used for each dietary treatment. Samples of breast meat were taken out, sliced into 3 cm by 3 cm pieces, homogenized, and then cooked for 30 minutes. A hedonic scale ranging from 1 to 5 was used by forty trained students from Chinhoyi University of Technology to undertake the sensory evaluation of the boiled meat samples. Table 5.1 lists the characteristics that were evaluated: color, aroma, texture, tenderness, and taste.

1.5 Statistical analyses

For the data analysis, the General Linear Model Procedure (Proc PRINCOMP) in the Statistical Analysis System (SAS) ver. 9.3 (SAS Institute Inc., 2010) was used. Significant differences between the means were determined using the adjusted Tukey's method for mean comparisons, with differences considered significant at the $p<0.05$ level.

The following was used to model the data;

$Y_{ijk} = \mu + R_i + T_j + Rep_i \times T_j + e_{ijk}$

Where;

Y_{ijk} = Response variable (Prox Comp, WHC, pH, colour, tenderness, texture, aroma, taste)

μ = The overall mean,

R_i= Effect of the i^{th} Replicate

T_j= Effect of the j^{th}treatment

$Rep_i \times T_j$= Effect of replication by treatment interaction

e_{ij} = The experimental random error.

Table 1.1 Broiler Meat Assessment Score Guide

Score	Color	Texture	Aroma	Taste	Tenderness	General Acceptability
1	Brown	E. rough	V. dislike	V. dislike	V. N. soft	3 – 5
2	Brownish	Rough	D. not like	D. N. like	N. soft	3 – 5
3	M. White	R. rough	Q. like	Q like	S. enough	3 - 5
4	White	Smooth	L	Like	Soft	3 – 5
5	V. White	E Smooth	R. like	R. like	V. soft	3 – 5

Whereas V. smooth means extremely smooth, R. rough means rather rough, V. dislike means very dislike, D. N. like means do not like, V. N. soft means very not soft, N. soft means not soft, and V. soft means very soft. And where M. white means medium white, V. white means very white, E. rough means extremely rough, R. rough means rather rough, and E. smooth means extremely smooth.

1.6 Results

1.6.1 The Proximate Composition of Broiler Meat

The nutritional composition values of meat from broilers fed with diets containing differently processed cowpeas are presented in Table 5.2 below. The crude protein and fat of meat ranged from 18.6% to 22.5% and 0.9% to 1.3%, respectively. Dehulled-boiled cowpea-based diets produced meat with the lowest crude protein of 18.6% and the control diet produced broilers with meat containing 22.5% CP. The meat of broilers that were fed with dehulled-boiled cowpea-based diets had the lowest fat content (0.9%) and the meat of broilers from the MSUC and control diet had the highest fat content (1.3) %. The fiber content in meat varied from 0.8% to 1.0%. MSRC, MSDRC and MSDBC produced meat with the least fiber and MSUC and MSBC had the highest. Meat from MSDBC and MSDRC had the least ash content and ash content of meat from the remaining groups were similar. Replication × Treatment had no effect on proximate composition of meat.

1.6.2 Moisture Content, Water Holding Capacity and pH of Meat

The results of moisture content, water holding capacity and pH of broiler meat from broilers fed cowpea-based diets are indicated in Table 5.3 below. The highest moisture content (77.8%) was found in the meat of broilers fed diets containing dehulled-roasted cowpeas (MSDRC), while the meat from MSUC, MSBC, MSDC and MS had the lowest moisture content. Meat from the remaining dietary groups had similar amounts of moisture content. Meat from broilers given raw cowpea-based diets had the lowest water-holding capacity (61.5%), while meat from broilers fed dehulled-roasted cowpea-based diets had the best water-holding capacity (74.1%). The meat from broiler chickens fed diets based on raw cowpeas had the lowest pH (6.0), whereas the greatest pH (6.6) was found in the boiled cowpeas treatment group. Meat from MSRC had an average pH of 6.4. The pH of meat from the remaining treatments did not differ. Replication × Treatment had no effect on moisture content, WHC and pH of broiler meat.

Table 1.2 Proximate Composition of Broiler Meat

	Nutrient Composition (%)			
	Crude Protein	**Crude Fat**	**Crude Fiber**	**Ash**
MS	22.5 ± 0.07^{a}	1.3 ± 0.03^{a}	0.9 ± 0.01^{b}	1.2 ± 0.03^{b}
MSUC	22.1 ± 0.07^{b}	1.3 ± 0.03^{a}	1.0 ± 0.01^{a}	1.3 ± 0.03^{ab}
MSBC	21.9 ± 0.07^{b}	1.2 ± 0.03^{b}	1.0 ± 0.01^{a}	1.3 ± 0.03^{ab}
MSDC	19.4 ± 0.07^{d}	1.2 ± 0.03^{b}	0.9 ± 0.01^{b}	1.2 ± 0.03^{b}
MSRC	19.1 ± 0.07^{d}	1.2 ± 0.03^{b}	0.8 ± 0.01^{c}	1.4 ± 0.03^{a}
MSDRC	19.1 ± 0.07^{d}	0.9 ± 0.03^{c}	0.8 ± 0.01^{c}	1.1 ± 0.03^{c}
MSDBC	18.6 ± 0.07^{c}	0.9 ±0.03^{c}	0.8 ± 0.01^{c}	0.9 ± 0.03^{d}

$^{a-d}$**Means** with different superscripts within the same column denotes that they are significantly different (P<0.05).
MS = Maize-Soybean diet (control), **MSUC** = Maize-Soybean-Untreated Cowpea diet, **MSBC** = Maize-Soybean-Boiled Cowpea diet, **MSDC** = Maize-Soybean-Dehulled Cowpea diet, **MSRC** = Maize-Soybean-Roasted Cowpea diet, **MSDRC** = Maize-Soybean-Dehulled-Roasted Cowpea diet, **MSDBC** = Maize-Soybean-Dehulled-Boiled Cowpea diets.

Table 1.3 Moisture Content, Water Holding Capacity and pH of Broiler Meat

Treatment	Moisture (%)	Water Holding Capacity (%)	pH
MS	75.0 ± 0.16^{d}	66.5 ± 0.01^{b}	6.3 ± 0.54^{b}
MSDBC	76.3 ± 0.16^{c}	67.1 ± 0.01^{b}	6.4 ± 0.54^{b}
MSDRC	77.8 ± 0.16^{a}	70.4 ± 0.01^{b}	6.4 ± 0.54^{b}
MSDC	75.0 ± 0.16^{d}	66.7± 0.01^{b}	6.3 ± 0.54^{b}
MSBC	75.0 ± 0.16^{d}	74.1 ± 0.01^{a}	6.6 ± 0.54^{a}
MSRC	76.9 ± 0.16^{b}	71.0 ± 0.01^{b}	6.4 ± 0.54^{b}
MSUC	74.6 ± 0.16^{d}	61.5 ± 0.01^{c}	6.0 ± 0.54^{c}

$^{a-d}$**Means** with different superscripts within the same column denotes that they are significantly different (P<0.05).
MS = Maize-Soybean diet (control), **MSUC** = Maize-Soybean-Untreated Cowpea diet, **MSBC** = Maize-Soybean-Boiled Cowpea diet, **MSDC** = Maize-Soybean-Dehulled Cowpea diet, **MSRC** = Maize-Soybean-Roasted Cowpea diet, **MSDRC** = Maize-Soybean-Dehulled-Roasted Cowpea diet, **MSDBC** = Maize-Soybean-Dehulled-Boiled Cowpea diets.

1.6.3 Sensory Characteristics of Broiler Meat

The sensory evaluation results of meat from broilers fed diets containing differently processed cowpeas are shown in Table 5.4.Meat from broilers fed diets containing raw cowpeas had the lowest colour and texture scores, while the rest of treatments were similar in the two parameters. There were no differences in the aroma scores of all treatments. The meat from broilers fed diets containing raw cowpeas had the lowest taste score of 3, and the highest taste scores (5.0) came from broilers fed diets containing dehulled, boiled, and dehulled-boiled cowpeas. The meat from broilers fed with the MSUC diet had the lowest tenderness score of 2.0. The meat from broilers fed the MS, MSBC and MSDBC diets had the highest tenderness scores of 4.0, while the meat from broilers fed MSDC, MSDRC and MSRC had average tenderness scores of 3.0. Replication × Treatment had no effect on sensory characteristics.

Table 1.4 Organoleptic Quality Characteristics of Meat from Broilers Fed Cowpea-Based Diets

	Colour	Texture	Aroma	Taste	Tenderness
MS	4.0±0.13^{a}	4.0±0.32^{b}	4.0±0.06^{a}	4.0±0.20^{b}	4.0±0.27^{a}
MSDBC	4.0±0.13^{a}	4.0±0.32^{b}	4.0±0.06^{a}	5.0±0.21^{a}	4.0±0.27^{a}
MSDRC	4.0±0.13^{a}	4.0±0.32^{b}	4.0±0.06^{a}	4.0±0.20^{b}	3.0±0.26^{b}
MSDC	4.0±0.13^{a}	4.0±0.32^{b}	4.0±0.06^{a}	5.0±0.21^{a}	3.0±0.26^{b}
MSBC	4.0±0.13^{a}	4.0±0.32^{b}	4.0±0.06^{a}	5.0±0.21^{a}	4.0±0.27^{a}
MSRC	4.0±0.13^{a}	4.0±0.32^{b}	4.0±0.06^{a}	4.0±0.20^{b}	3.0±0.26^{b}
MSUC	2.0±0.11^{b}	5.0±0.32^{a}	4.0±0.06^{a}	3.0±0.19^{c}	2.0±0.25^{c}

$^{a\text{-}c}$**Means** with different superscripts within the same column denotes that they are significantly different (P<0.05).
Where; **MS** stands for basal diet, **MSDBC** stands for dehulled-boiled cowpeas, **MSDRC** stands for dehulled-roasted cowpeas, **MSDC** stands for dehulled cowpeas, **MSBC** stands for boiled cowpeas, **MSRC** stands for roasted cowpeas, **MSUC** stands for raw cowpeas.

1.7 Discussion

1.7.1 Proximate Composition of Breast Meat

In this study, it has been observed that feeding broiler diets including processed cowpea meal reduced the crude protein content of breast meat. The results were in line with the findings of several authors (Bogosavljevic-Boskovic, 2010; de Oliveira *et al*., 2016; Biesek*et al*., 2020) who reported that the crude protein content of broiler meat ranges from 15.8 to 23.5% depending on diet composition and sex of the experimental birds among other factors. The crude fat content and crude fiber content of broiler meat were different among the dietary treatments. The same results were observed by Souza *et al*. (2011). The findings of this study are in tandem with the results obtained from researches conducted using other types of grain legumes (Janocha*et al*., 2022). The same writers observed the crude protein, ether extract (EE), and ash content of broiler meat ranges from 15 to 25% CP, 1.5 to 5.3% EE, and 1.00 to 1.26% Ash.

1.7.2 The Moisture Content of Broiler Meat

In this study, feeding broilers with feed containing roasted, dehulled-roasted and dehulled-boiled cowpeas increased the moisture content of broiler meat. These findings are supported by Kucukyilmaz*et al*. (2012) who reported that the moisture content of broiler meat is influenced by feed composition. However, the moisture content of breast meat observed across all the dietary treatments in this current study was in line with the acceptable moisture content of broiler meat which ranges from 65 to 80% (Qiao*et al*., 2001; Rokonuzzaman, 2018; Kyakma*et al*., 2022). High moisture content in broiler meat is not recommended because it provides a conducive breeding environment for spoilage microorganisms that reduce the shelf life of meat (Mir *et al*., 2017).

1.7.3 The pH of Broiler Meat

A decrease in the pH of breast meat from broilers fed the MSUC diet was observed. Fernandes*et al*. (2016) claimed that oxygen becomes deficient when an animal is slaughtered and the glycogen in meat is anaerobically converted to lactic acid that lowers the pH of meat during rigor mortis. The pH of meat from broilers fed the MSBC diet was higher and it might have been caused by a lower concentration of glycogen in the pectoralis major muscle that consequently ended up releasing low amounts of lactic acid during glycolysis (Mir *et al*., 2017). The pH is very important in meat science because it influences the colour, tenderness, water holding capacity and overall, the shelf life of meat (Jankowiak*et al*., 2021). The same authors claimed that water holding capacity below 5.7 reduces the WHC (increases drip loss) and negatively affects the yield and juiciness of meat. The yield determines the profit and juiciness is preferred by those who are into the business of meat processing (high WHC increases the juiciness of minced meat). High drip loss in packaged meat products results in discolouration of meat, predisposes it to spoilage and pathogenic microorganisms and loss of essential nutrients (Kaic*et al*., 2020).The pH results obtained in this feeding trial are consistent with studies by Janocha*et al*. (2020) which showed that feeding broiler chicks diets containing *Pisumsativa* meal resulted in pH meat falling within a range of 6.21 to 6.29 and by Dinesh *et al*. (2013) who found that breast meat had a pH range of 5.7 to 6.6.Tavanielloe*t al* (2022) also confirmed that the pH of broiler meat fell within acceptable levels of 5.7 to 6.8 when broilers were fed diets containing soybeans (control) and *Pisumsativum*.

1.7.4 The Water Holding Capacity of Broiler Meat

The observed increased water holding capacity from the MSBC treatment can be attributed to an elevated pH of broiler meat since information from the previous literature state that the proteins of meat with a high pH have more negative charges that have a greater propensity to bind water, and this is evident when the pH of meat is higher than the isoelectric point (Saelin*et al.*, 2017). The lowest water holding capacity results obtained from the MSUC group can be attributed to the low pH of meat from this dietary group (Table 5.3) Kai*cet al*. (2020) emphasised that the WHC is generally decreased when the positive and negative charges of proteins in meat are equaled (isoelectric point) due to glycolysis. In proximity to the isoelectric point, meat loses its ability to bind water (Kralik*et al*., 2018). The current trial's WHC results for meat from broilers fed diets including processed cowpeas support the findings of Agbetuyi*et al*. (2024), who found that the meat's WHC values ranged from 75 to 86%. Garcia *et al*. (2010) recorded lower WHC values ranging from 64 to 69%. Lower WHC readings in meat are typically the result of pre-slaughter variables like stress, which lowers the meat's ph. Meat from diets containing processed cowpea had good water-holding capacity (WHC), an important factor for consumer perception of meat quality, weight loss during cooking, and sensory attributes when consumed (Nusairat*et al*., 2022). The yield of meat is negatively impacted by drip loss, leading to reduced profits from the sale of broiler meat (Agbetuyi*et al*., 2024). Additionally, purge loss can influence the colour, juiciness, tenderness, and taste of the meat (Saelin*et a*l., 2017).

1.7.5 Sensory Analysis

It has been observed that the colour, texture and taste of broiler meat areinfluenced by the incorporation of cowpeas in broiler diets. The poor colour score of meat from broilers fed the MSUC diet can be due partly to the presence of carotenoids and xanthophylls in untreated cowpeas (Mir *et al*., 2017). The inferior taste of meat from broilers fed with diets containing raw cowpeas might have emanated from the bitter taste of anti-nutrients that are contained in raw cowpeas (Akanji*et al*., 2016). The best colour, taste, texture and tenderness scores obtained from the remaining treatments might be credited to the high pH and water holding capacity values that were associated with these feeding groups. WHC and pH are responsible for good sensory attributes of meat when they are high and the vice-versa is also true (Li *et al*., 2021). The good color, taste, texture, tenderness, and aroma scores obtained from the meat of broilers fed with diets containing processed cowpeas are very important to meat consumers since consumer acceptance of meat is determined by its freshness, which is determined by its colour, and repeat purchases are prompted by the eating quality (taste, texture, aroma, and tenderness) of meat (Nusairat*et al*., 2022).

1.8 Conclusions

Cowpeas that have been either dehulled, roasted, boiled, dehulled-roasted, or dehulled-boiled can be substituted for soybeans in broiler diets at inclusion levels no more than 15% without affecting the meat's pH, ability to hold water, or sensory qualities.

1.9 References

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