QUALITY ATTRIBUTES OF MEAT FROM BROILER CHICKENS FED DIETS CONTAINING THREE OIL TYPES AND VARYING LEVELS OF CALCIUM

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ABSTRACT

This study was aimed at assessing the effects of dietary oil types and varying calcium inclusion levels on meat attributes of broiler chickens (BC). One-day old Arbor Acres BC (n=630) were randomly allotted to diets containing three dietary oils at 2.00% level of inclusion shea butter (SB), coconut (CO) and palm kernel oil (PKO)) and three levels (%) of dietary calcium (0.75, 1.00, 1.25%) in a 3 x 3 factorial arrangement and completely randomized design. Each treatment was replicated seven times and a replicate had ten chicks. Meats from BC fed PKO was higher (P<0.05) in arachidonic, linolenic, oleic acid, while those on SB had higher (p<0.05) linoleic (1.44%) and palmitoleic acids compared with other treatments. At 24 hours post mortem, meat pH of BC fed CO (5.91) was higher (P<0.05) than SB (5.35) and PKO (5.50). At 24 hours post mortem, the pH of meat from BC fed 0.75% DC (5.51) was significantly lower (P<0.05) than those from 1.00% (5.65) and 1.25% (5.61). Effect of interaction of different oil types and dietary calcium was significant (P<0.05) on meat pH at 0 and 24 hours. Dietary inclusion of PKO and increasing dietary calcium up to 1.25% improved BC meat attributes.

Keywords: Broiler chicken, Physico-chemical characteristics, Colour, Dietary calcium and Meat pH.

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INTRODUCTION

Consumers are becoming increasingly concerned about the nutritional and health aspects of food (Yeung and Morris, 2001). The use of vegetable oils and animal fats in broiler diets has been beneficial for poultry production as they often present higher than expected biological value, increasing dietary metabolizable energy. This results in higher growth rates and better feed efficiency (Leeson and Summers, 2001). Supplementation of broiler diets with small quantities of fats and oils has also been shown to stimulate growth and palatability of the chicken meat (Miller and Robisch, 1999; Leeson *et al*., 2001).

The modern-day poultry industries as well as consumers of chicken meat are concerned with the excessive fat deposition in chicken meat (Choct *et al*., 2000; Fouad and El-Senousey, 2014). In response to the concern of health-conscious consumers, researches are now aimed at reducing excessive fat deposition in broiler chicken meat without affecting growth performance through dietary means. Newman *et al.,* (2002) fed diets containing 8% level of sunflower oil, fish oil or beef tallow to broiler chickens and observed a positive relationship in the composition of the fatty acid present in diets and the breast, thigh and skin fatty acid composition of broiler chicken meat. According to Rodriguez *et al*. (2002), palm kernel oil or mixtures of palm oil, fatty acids distilled from the palm and calcium soap are sources of vegetable oils with a fatty acid profile capable of replacing animal fats without negative impact on meat quality.

Leeson and Summers, (2001) earlier surmised that diets digestibility is an important nutritional factor associated with fat sources. This factor is dependent on fatty acid saturation degree, carbon number in the chain, free fatty acid concentration, position of the glycerol molecule, as well as the interaction between saturated and unsaturated fatty acids. Studies (Atteh and Leeson, 1983; 1984) have shown that high calcium concentrations may decrease the digestibility of nutrients, especially fat, in broilers. Female broilers were fed diets containing two different forms of canola oil, and they showed better growth rate compared to females fed diets containing tallow and acidulated soybean oil soap stock (Thacker and Campbell, 1994). This observation confirms the advantage of using vegetal oils and a source of mineral instead of tallow and acidulated soybean oil soap stock as energy sources for birds. Andreotti *et al.,* (2001) observed similar performance, carcass yield and cut yields of broilers when broiler chickens were fed poultry fat, canola, sunflower, corn, soybean or lard.

Most studies were focused on effect of different oil types on meat (Crespo and Esteve-Garcia, 2002). Scanty reports have been on the effects of dietary calcium on meat characteristics (Tamim *et al*., 2004). Information on effects of varying dietary calcium and oil types in broiler rearing were often limited to digestibility (Smith *et al*., 2003), performance of chickens (Bao *et al*., 2007) blood profiles (Samman, 2008) However, there have been dearth of information on the effects of different dietary oil and varying calcium levels on characteristics of broiler meat which the present research was aimed.

MATERIALS AND METHODS

Experimental Sites: The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. The university is located in Ibadan in the tropical rain forest zone of Nigeria within latitude 26 N and longitude 3 º 54 E, with a mean altitude of 277 meters above sea level.

Experimental birds: One-day old Arbor Acre broiler chicks (n=630) were procured from a reputable commercial hatchery. The chicks were randomly allocated to nine dietary treatments of seven replicates with ten birds per replicate. Feed and water were given *ad libitum*. Standard health routines were strictly adhered to.

Experimental diets: Three different sources of oil; coconut oil, shea butter oil and palm kernel oil with graded levels of calcium at 0.75 %, 1.00 % and 1.25 % was used to formulate the nine isocaloric and isonitrogenous diets. Diet 1, 2 and 3 contained coconut oil at 0.75, 1.00 and 1.25% inclusion level of calcium, respectively. Shea butter oil was included in diet 4, 5 and 6 with corresponding calcium level of 0.75, 1.00 and 1.25% while diets 7, 8 and 9 contained palm kernel oil at 0.75, 1.00 and 1.25% inclusion levels of calcium, respectively.

On day 42, two birds per replicate were slaughtered through cervical dislocation, and the breast meat part harvested for the determination of the meat attributes described below.

Lipid oxidation: Lipid oxidation was determined as 2-Thiobarbituric acid reactive substances (TBARS) values of meat.

Table 1: Composition of experimental broiler starter diets fed to broiler chickens (%)

Ingredients (%)	Coconut oil			Shea butter oil			Palm kernel oil		
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Maize	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Soybean cake	34.80	34.80	34.80	34.80	34.80	34.80	34.80	34.80	34.80
Wheat offal	8.36	8.36	8.36	8.36	8.36	8.36	8.36	8.36	8.36
DL-Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Oyster shell	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Oil	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03
Dicalcium Phosphate	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Total	100	100	100	100	100	100	100	100	100

1kg of Premix contains: Vitamin A 10,000,000IU; Vitamin D3-2,000,000IU; Vitamin E-20,000IU; Vitamin K-2,250mg; Thiamine B1-1,750mg; Riboflavin B2-5,000mg; Pyridoxine B6-2,750mg; Niacin-27,500MG; Pantothenic acid-7,500mg; Biotin-50mg; Choline chloride-400g; Antioxidant-125g; Magnesium-80g; Zinc-50mg; Iron-20g; Copper-5g, Iodine-1.2g; Selenium-200mg; Cobalt-200mg.

Table 2: Composition of the experimental broiler finisher diets fed to broiler chickens (%)

Ingredients (%)	Coconut oil			Shea butter oil			Palm kernel oil		
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Maize	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00
Soybean cake	30.90	30.90	30.90	30.90	30.90	30.90	30.90	30.90	30.90
Wheat offal	11.34	11.34	11.34	11.34	11.34	11.34	11.34	11.34	11.34
DL-Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oil	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03
Dicalcium Phosphate	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100	100

kg of Premix contains: Vitamin A 10,000,000IU; Vitamin D3-2,000,000IU; Vitamin E-20,000IU; Vitamin K-2,250mg; Thiamine B1-1,750mg; Riboflavin B2-5,000mg; Pyridoxine B6-2,750mg; Niacin-27,500MG; Pantothenic acid-7,500mg; Biotin-50mg; Choline chloride-400g; Antioxidant-125g; Magnesium-80g; Zinc-50mg; Iron-20g; Copper-5g, Iodine-1.2g; Selenium-200mg; Cobalt-200mg

TBARS were assayed when fresh and at 24 hours of storage according to the method of (Sarker and Yang, 2011). 1g of the breast meat was put in aa test tube containing

5mL glacial Acetic Acid and shaken for one hour using a mechanical shaker, then filtered. The filtrate was centrifuged and 1mL thiobarbituric acid was added and heated for 60mins at 95^0c. it was cooled at room temperature and rad at an absorbance of 532nm using a UV-visible Spectrophotometer model PharmaSpec 1700 (Shimadzu, Japan).

Meat pH: Meat pH values were estimated with a pH meter (Model 340, Mettler-Toledo, Switzerland). Exactly 1 g of breast meat was cut into small pieces and homogenized with 9 mL distilled water for 1 min in an Ultra-Turrax (Model No. T25, Janken and Kunkel, Germany).

Fatty acid profile: Fatty acid profile of the meat was determined according to (AOAC, 2000). The composition of the fatty acids is determined by the separation of the methyl esters of the fatty acid using gas chromatography. Fatty acids were separated using a gas chromatograph (Hewlett Packard 6890 Series GC System). Chromatograms were compared with Sigma standards, and fatty acid content was expressed as percentage in relation to the total amount of fatty acids determined.

Surface colour: Surface colour values (International Commission on Illumination L*, a*, and b* values representing lightness, redness, and yellowness) of the meat samples were measured using a colorimeter (CR-5, Minolta Camera Co., Japan). The colorimeter was calibrated using a standard black and white plate before analysis. The mean of three measurements taken from the breast muscles were recorded for each sample.

Cooking loss: Cooking loss was measured on the fillet of the breast meat samples by cooking the samples in a conventional oven on aluminum trays at 180^0C until inner core temperature of 80 °C was attained. The fillets were then allowed to equilibrate to room temperature, reweighed, and cook loss was determined as percentage of weight loss.

Water holding capacity: The meat water holding capacity was determined according to the procedure of Suzuki *et al*. (1991). Meat sample of 0.05g was placed between two plexiglass sheets and pressed for 20 minutes by a 1kg weight.

$$\%\text{free water} = \frac{(\text{Total Surface area- meat film area})\ mm^2}{\text{Total moisture (mg) in meat sample}} \times 100$$

%WHC = 100-Free water

Statistical Analysis: Data were subjected to descriptive statistics, regression and analysis of variance using SAS (2003) and Means were separated using Duncan's Multiple Range Test of the same software at $\alpha_{0.05}$

RESULTS

Fatty acid composition: The effect of feeding different oil types and calcium levels on fatty acid composition of broiler chickens' significantly higher (P<0.05) arachidonic, lauric, linoleic, margaric, myristic, oleic, meat is shown in Table 3. The dietary oil types had significant effect (P<0.05) on the fatty acid profile of the meat samples. The breast meat of chickens on shea butter oil had palmitic and stearic acid than the values obtained from diet containing coconut oil but significantly lower (P<0.05) than corresponding breast muscles of those on dietary palm kernel oil. However, the highest linoleic and palmitoleic were recorded in breast muscles of birds fed dietary shea butter while the least value was recorded in diets containing palm kernel oil (P<0.05). Dietary level of calcium had significant effect (P<0.05) on the fatty acid profile of broilers meat. Breast muscles of chickens on diets containing 1.25% level of calcium was highest in arachidonic compared with diets containing 0.75% calcium level. The same trend was observed for lauric, linoleic, margaric, oleic, palmitic and stearic acid.

Table 3: Effect of feeding different oil types and calcium levels on fatty acid composition of broiler chickens' meat

FAP	Oil Type				Level of Calcium (%)				
	Coconut	Shea butter	Palm kernel	P value	0.75	1.00	1.25	P value	SEM
Arachidonic	0.32^{c}	0.35^{b}	0.53^{a}	0.032	0.31^{c}	0.43^{b}	0.45^{a}	0.001**	0.0007
Lauric	1.19^{c}	1.23^{b}	1.38^{a}	0.001	1.19^{c}	1.25^{b}	1.36^{a}	0.001**	0.0007
Linoleic	1.39^{b}	1.44^{a}	1.30^{c}	0.002	1.40^{a}	1.32^{b}	1.41^{a}	0.032*	0.0010
Linolenic	2.26^{c}	2.34^{b}	3.19^{a}	0.041	2.29^{c}	2.68^{b}	2.82^{a}	0.002**	0.0010
Margaric	0.10^{c}	0.16^{b}	0.18^{a}	0.002	0.14^{b}	0.13^{b}	0.16^{a}	0.044*	0.0006
Myristic	0.33^{c}	0.41^{b}	0.44^{a}	0.001	0.36^{b}	0.38^{b}	0.44^{a}	0.033*	0.0001
Oleic	13.49^{c}	13.81^{b}	17.02^{a}	0.001	13.54^{c}	14.91^{b}	15.87^{a}	0.012*	0.0011
Palmitic	9.47^{c}	9.66^{b}	12.27^{a}	0.002	9.51^{c}	10.60^{b}	11.29^{a}	0.002**	0.0026
Palmitoleic	0.30^{b}	0.36^{a}	0.20^{c}	0.001	0.32^{a}	0.27^{b}	0.28^{b}	0.003**	0.0006
Stearic	29.40^{c}	29.74^{b}	42.05^{a}	0.001	29.43^{c}	35.33^{b}	36.42^{a}	0.002**	0.0026

$^{a-c}$Means with different superscripts along the same row are significantly different (p<0.05), FAD- fatty acid profile. SEM = Standard Error of Mean. ns = not significant; * = P < 0.05 (significant at 0.05 or 5%); ** = (significant at 0.01 or 1%)

The effects of feeding different oil types and graded levels of calcium on pH value and thiobarbituric acid reactive substances (TBARS) of broilers meat are shown in Table 4. The varying sources of oil had significant influence (p<0.05) on pH0 (few hours after slaughter). There was a decrease in pH value in this trend; coconut oil >shea butter oil >palm kernel oil with corresponding values of 6.04, 5.87 and 5.71. All values were significantly different (p<0.05). However, the varying level of calcium had no significant effect (p>0.05) on pH0 (few hours after slaughter) but had significant effect (p<0.05) on pH24 (twenty-four hours after slaughter).

Table 4: Effects of feeding different oil types and graded levels of calcium on pH and thiobabituric acid reactive substances (TBARS) of broilers meat

	Ph		TBARS	
	0	24	0	48 (hours
Oil type				
Coconut	6.04^{a}	5.91^{a}	0.29^{c}	0.34^{c}
Shea butter	5.87^{b}	5.50^{b}	0.37^{b}	0.59^{b}
Palm kernel	5.71^{c}	5.35^{c}	0.41^{a}	0.80^{a}
P value	0.0001**	0.0001**	0.0001**	0.0001**
Calcium (%)				
0.75	5.84^{a}	5.51^{b}	0.37^{a}	0.61^{a}
1.00	5.90^{a}	5.65^{a}	0.35^{a}	0.53^{b}
1.25	5.89^{a}	5.61^{a}	0.36^{a}	0.60^{a}
P value	0.309^{ns}	0.002**	0.707^{ns}	0.0005**
SEM	0.0028	0.0025	0.0012	0.0013

$^{a-c}$Means with different superscripts along the same column are significantly different (p<0.05). SEM – Standard Error of Mean, TBARS- Thiobarbituric Acid Reactive Substances.

Table 5: Effects of Feeding Different Oil types and Graded levels of Calcium on the Physical Properties of Broilers Meat

	WHC (%)	Cooking loss (%)	l (lightness)	a (redness)	b (yellowness)
Oil type					
Coconut	89.79^{a}	17.98^{c}	45.35^{c}	8.31^{a}	5.45^{b}
Shea butter	71.58^{b}	23.29^{b}	49.51^{b}	7.38^{b}	5.80^{b}
Palm kernel	60.13^{c}	29.32^{a}	52.31^{a}	6.02^{c}	6.70^{a}
Level of Calcium (%)					
0.75	67.66^{b}	24.80^{a}	50.59^{a}	6.74^{b}	6.18^{a}
1.00	75.94^{a}	23.25^{b}	48.57^{a}	7.30^{a}	6.00^{a}
1.25	77.94^{a}	22.55^{b}	48.01^{a}	7.67^{a}	5.77^{a}
P value	0.0001**	0.0001**	0.155^{ns}	0.013*	0.379^{ns}
SEM	0.1166	0.0257	0.0924	0.0199	0.0201

$^{a-c}$Means with different superscripts along the same column are significantly different (p<0.05). SEM – Standard Error of Mean, WHC - Water holding capacity, l - lightness, a - redness, b – yellowness
ns = not significant; * = P < 0.05 (significant at 0.05 or 5%); ** = (significant at 0.01 or 1%)

The effects of different dietary oil and levels of calcium on physical attributes of broiler chicken meat are shown in Table 5. The water holding capacity of the meat samples differed significantly (p<0.05) by varying dietary oil types. The water holding capacity decreased significantly (p<0.05) in the order; coconut oil < shea butter oil < palm kernel oil with corresponding values of 89.79, 71.58 and 60.13, respectively. Levels of dietary calcium had significant effect ($p<0.05$) on the water holding capacity as well as other parameters in the physical attributes of the cooked meat.

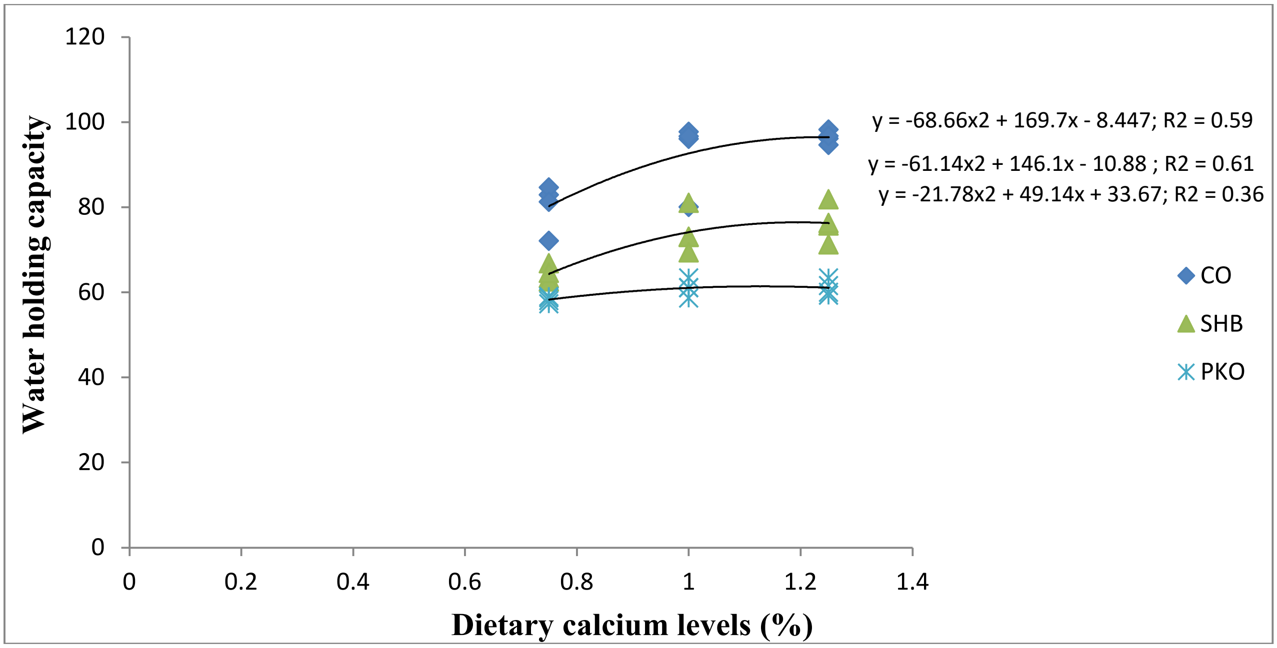

Figure 1: Relationship between dietary calcium levels and water holding capacity of broiler chickens' meat

$y = -68.66x^2 + 169.7x - 8.447;$

$R^2 = 0.59$ …………………….. (1)

1.25% dietary calcium was optimum for enhancing water holding capacity of broiler chickens on coconut oil.

$y = -61.14x^2 + 146.1x - 10.88;$

$R^2 = 0.61$................................ (2)

1.01% DC was optimum in enhancing WHC of broiler chicken on shea butter.

$y = -21.78x^2 + 49.14x + 33.67;$

$R^2 = 0.36$…………………….. (3)

However, 1.08% Dietary Calcium was optimum in enhancing water holding capacity of meat of BC on PKO.

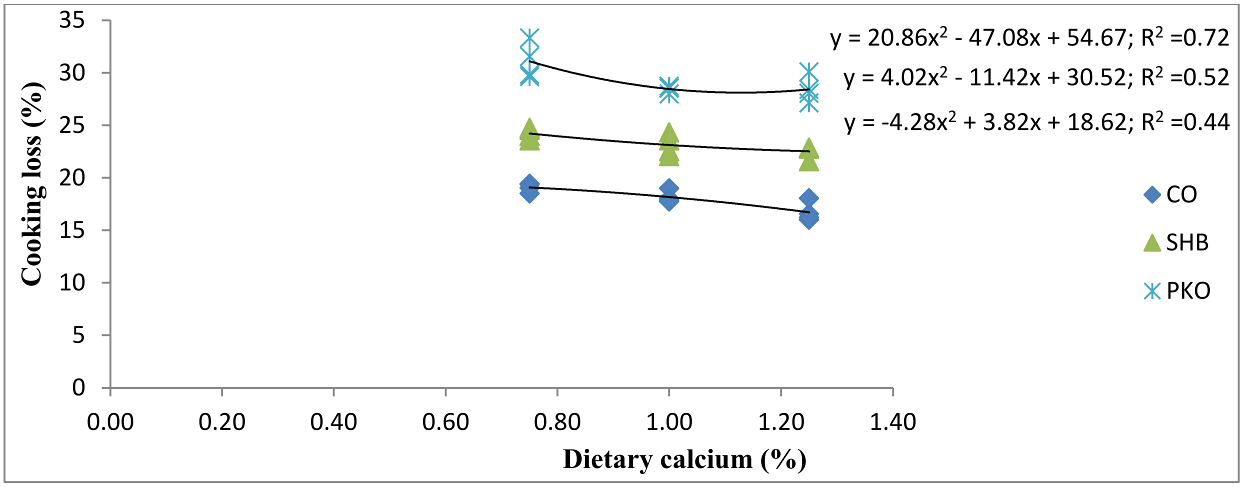

Figure 2: Relationship between dietary calcium levels and cooking loss of broiler chickens' meat

$y = 20.86x^2 - 47.08x + 54.67;$

$R^2 = 0.72$……………………. (4)

1.1% Dietary calcium was optimum for cooking loss observed in meat of broiler chickens on palm kernel oil. The R^2 value (0.72) indicated that the observed difference was 52% dependent on varying level of dietary calcium

$y = 4.02x^2 - 11.42x + 30.52;$

$R^2 = 0.52$………………….... (5)

Optimum cooking loss was observed at 1.15% Dietary Calcium in meat of birds on SHB. The R^2 value (0.52) indicated that the observed differences were 52.0% dependent on varying levels of dietary calcium

$y = -4.28x^2 + 3.82x + 18.62;$

$R^2 = 0.44$…………………… (6)

A linear relationship was observed in cooking loss of meat of broiler chickens on Coconut oil. Increasing dietary calcium significantly lowered cooking loss of broiler meat.

Effects of feeding different oil types and levels of dietary calcium on sensory indices of broilers chicken meat is shown in Table 6. Dietary oil type had significant effect ($p<0.05$) on colour of meat. Value (6.57) recorded at dietary inclusion of coconut oil was significantly higher ($p<0.05$) than 5.37 recorded for meat of broilers on shea butter oil but significantly lower ($p<0.05$) than 8.00 recorded for meat of broilers on palm kernel oil. Flavour and texture was not significantly affected ($p>0.05$) by the dietary oil type, while the meat tenderness due to dietary oil type showed a significant difference ($p<0.05$).

Table 6: Effects of feeding different oil types and graded levels of calcium on the sensory traits of broilers' meat

	Colour	Flavour	Texture	Tenderness	Juiceness	Overall Acceptability
Oil type						
Coconut	6.57[b]	5.57[a]	5.73[a]	6.63[a]	6.03[a]	6.70[a]
Shea butter	5.37[c]	5.87[a]	5.00[a]	5.37[b]	5.40[b]	5.00[b]
Palmkernel	8.00[a]	6.17[a]	5.13[a]	5.67[b]	6.57[a]	6.20[a]
P value	0.0001**	0.4529 [ns]	0.2862 [ns]	0.0009**	0.0118*	0.0001**
Levels of Calcium (%)						
0.75	6.20[b]	5.67[a]	5.07[a]	5.77[a]	5.83[a]	5.67[a]
1.00	6.50[b]	6.03[a]	5.43[a]	6.23[a]	6.17[a]	5.90[a]
1.25	7.23[a]	5.90[a]	5.37[a]	5.67[a]	6.00[a]	6.33[a]
P value	0.0009	0.7371	0.7287	0.2111	0.6839	0.2251
SEM	0.0293	0.0510	0.0527	0.0365	0.0410	0.0418

[abc]Means with different superscripts along the same column are significantly different (P<0.05).
SEM – Standard Error of Mean

DISCUSSION

The effect of varying dietary calcium and different oil sources on fatty acid profile of broiler meat showed that meat from chicks on PKO diets had higher concentrations of arachidonic, lauric, linolenic, margaric, myristic, oleic, palmitic, and stearic acid, than those on other dietary oil sources. Earlier studies have been carried out to manipulate fatty acid profile of broiler muscle tissues in order to increase n-3 PUFA content and decrease n - 6: n - 3 ratio (Zdunczyk *et al*., 2011; Hauget *et al*., 2011; Rahimi *et al*., 2011; Nyquist *et al*., 2013). Maroufyan *et al*. (2013) and Abdulla *et al*. (2015) have shown that supplementation of poultry diet with unsaturated fats increased the proportion of unsaturated fatty acids in breast and thigh meat and, therefore, affects the nutritional composition of further processed products.

Earlier investigations by (Snaz *et al*., 2000; Pesti *et al*., 2002; Shen and Du, 2005) indicated that diet composition affects the fatty acid composition of every fatty depot. The authors observed that the content in polyunsaturated fatty acid (PUFA) was significantly affected by the type of diet, with an increase of PUFA in meat of chicken fed diets containing flax seeds. However, total fat content in tissues were reduced by increasing the dietary PUFA level (Cortinas *et al*., 2004; Shen *et al*., 2005).

Meat pH was influenced by varying levels of dietary calcium and dietary oil sources. The observed increased acidity of meat could be beneficial in increasing the shelf life of meat of broiler chickens on palm kernel oil. Egbert and Cornforth, (1986) stated that breast muscle was more susceptible than the thigh and leg muscles in variations to colour because it comprised a high proportion of the carcass, and its inherent light colour makes any changes in colour more apparent. Different dietary oil sources influenced overall acceptability of BC fillets as observed in this study. Palm kernel oil improved the colour, flavour, texture, juiciness, and overall acceptability of meat of broiler chickens, compared to shea butter. Levels of dietary calcium did not influence the overall acceptabiity of meat obtained from broiler chickens. Vita *et al.* (2013) found that increased intramuscular fat caused improvement of the organoleptic qualities or "eating quality of meat", which can be named as the dietetic quality and that the fat-free meat had a neutral taste, therefore tasteless. Similarly, Lessire (2001) also demonstrated that body has a positive impact in improving organoleptic characteristics of chicken meat. Ayed *et al.*, (2015) reported that meat colour was the most important factor when consumers assess meat quality since they relate colour to freshness of the meat which is a factor in consumer's preference.

Water holding capacity (WHC) and cooking loss (CL) of broiler chickens' meat were affected by dietary oil sources and levels of dietary calcium. This result shows that the palm kernel oil did not actually improve the physical properties of meat. However, lightness and yellowness were significantly improved compared to other dietary oil sources. Increasing levels of dietary calcium improved WHC, but decreased cooking loss significantly, while increasing the affinity for redness among others. Lametsch *et al.* (2003) reported that meat tenderization is mainly due to ultrastructural changes that weaken the integrity of the myofibers in the muscle tissue caused by postmortem proteolytic activity. Reports have indicated that postmortem degradation of muscle proteins not only affects meat tenderness (Huff-Lonergan, 2010), but also determines the amount of cooking loss during ageing and cooking. This effect could be attributed to its high content of polyunsaturated fatty acids. It can be also be concluded that the addition of fat to diets, improves the masticability and elasticity of chicken's meat. This can be the lipoproteins formed after ingestion of dietary fat.

This result of TBARS and pH at 24 and 48 hours shows that higher dietary calcium increased pH and TBARS concentration of meat. Studies have showed that dietary oil source affected TBARS in breast meat (Kanner, 1994; Ruiz *et al.*, 2001; Crespo and Garcia, 2002; Cortinas *et al.*, 2004). Also, the oxidative damages increased with storage time (Cortinas *et al.*, 2004; Barroeta, 2007; Roux *et al.*, 2011). Oxidative changes which occurred during the storage of chicken meat may therefore be minimised by altering dietary fat source.

CONCLUSIONS AND RECOMMENDATION

- Different dietary oil sources influenced overall acceptability of BC meat as observed in this study. Palm kernel oil improved the colour, flavour, texture, juiciness, and overall acceptability of broiler chicken's meat than shea butter.
- Dietary levels of calcium had no effect on organoleptic properties of broiler chickens' meat.
- The water holding capacity of meat from broiler chickens on coconut oil-based diets was higher than in those on palm kernel oil.
- The cooking loss of meat from broiler chickens on palm kernel oil-based diets was higher compared to other oil sources.
- Palm kernel oil at 2% with calcium level of 1.25% was recommended in the diets for improved meat quality of broiler chickens.

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