FATTY ACID PROFILES AND SENSORY CHARACTERISTICS OF MEAT FROM BROILERS SUPPLEMENTED WITH FEVER TEA *(LIPPIA JAVANICA)* LEAF POWDER

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Abstract – The effect of replacement of conventional growth promotant with *Lippia javanica* on fatty acid profiles and sensory attributes was assessed in broilers. Four dietary treatments were formulated as follows: 1) a negative control made up of the commercial broiler diet without prophylactic antibiotics (Albac and Aviax) (Negcontrol); 2) a positive control made up of the commercial broiler diet with prophylactic antibiotics (Poscontrol)]; 3) commercial broiler diet without prophylactic antibiotics but supplemented with 5 g of *L. javanica* per kg of feed (Ljav5) and 4) commercial broiler diet without prophylactic antibiotics but supplemented with 12 g of *L. javanica* per kg of feed (Ljav12) in given to the broilers. *Lippia javanaica* positively influenced the fatty acid composition of broiler meat particularly with regards to total PUFA, total n-3 FAs and PUFA: SFA ratio. *Lippia javanica* also significantly improved meat quality attributes as reflected by the high ratings given to meat from *Lippia* fed broilers. *Lippia javanica* can therefore be effectively used as a growth promotant in broiler chicken with significant benefits to human health.

***Key words: lippia javanica*, fatty acid profiles, sensory attributes.**

I. INTRODUCTION

The use of antibiotics as growth promotants in poultry production is becoming topical among the increasingly health conscious consumers. Although they have been used successfully in poultry, continuous use of antibiotics in poultry feeds can induce bacterial resistance, increasing the associated health risks in humans. Natural alternatives are currently receiving increased attention as replacements for antibiotics (Ghalamkari *et al.,* 2012). A natural alternative that has been popularised in many communities across Southern Africa is fever tea (*Lippia javanica*). It contains secondary plant metabolites, particularly terpenoids that have been reported to possess analgesic, anti-inflammatory and antipyretic activities (Abena *et al.,* 2003). Information is available on the use of phytogenic plants, with similar effects as *L. javanica*, as alternatives for growth promotants in broilers and laying hens. For example, *Mentha pulegium L.* in broiler diets has been observed to improve performance and carcass quality (Gholamkari *et al.*, 2012), while neem (*Azadirachta indica*) was observed to favorably influence the immune response of broilers without any adverse effects on growth and carcass quality (Landy *et al.,* 2011). Despite the potential of *L. javanica* as an alternative to growth promotants in broilers, information is not available on its influences on meat quality and fatty acid profiles in broilers. This study was designed to assess the effect of different levels of *L. javanica* leaf powder on fatty acid profiles and sensory characteristics of broilers.

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II. MATERIALS AND METHODS

The study was conducted at the University of The study was carried at North-West University (NWU) experimental farm. One hundred and eighty (180) day old broiler chicks (Cobb 500) were randomly divided into four treatment groups; each treatment group was further divided into three replications of 15 chickens per pen in a completely randomized design. The chicks were housed in a total of 12 pens. Each pen was equipped with water and feeding troughs while sunflower seed hulls were used as bedding. Infra-red light was provided continuously from day 1 till day 21.

Four dietary treatments were formulated as follows: 1) a negative control made up of the commercial broiler diet without prophylactic antibiotics (Albac and Aviax) (Negcontrol); 2) a positive control made up of the commercial broiler diet with prophylactic antibiotics

(Poscontrol)]; 3) commercial broiler diet without prophylactic antibiotics but supplemented with 5 g of *L. javanica* per kg of feed (Ljav5) and 4) commercial broiler diet without prophylactic antibiotics but supplemented with 12 g of *L. javanica* per kg of feed (Ljav12). Chickens were reared under a 3-phase feeding. The diets were formulated according to the nutrient requirements of broilers at to meet or exceed the nutrient requirements for broilers (NRC, 1997) at different growth phases. Feed and water were offered *ad libitum*

At the end of the experiment the broilers were slaughtered and breasts (5 per treatment) were sampled for fatty acid analysis. Total lipid from feed material was extracted with a Soxhlet extraction according to AOAC (2003) procedures for the determination of fats. Total lipid from muscle samples was quantitatively extracted, according to the method of Folch *et al*., (1957), using chloroform and methanol in a ratio of 2:1. The total extractable fat was determined gravimetrically from the extracted fat and expressed as percent fat (w/w) per 100 g tissue. Fatty acids were trans-esterified to form methyl esters using 0.5 M NaOH in methanol and 14 % boron trifluoride in methanol (Park and Goins, 1994). Fatty Acid Methyl Esters (FAMEs) from subcutaneous fat, feed and muscle were quantified using a Varian 430 flame ionization GC, with a fused silica capillary column, Chrompack CPSIL 88 (100 m length, 0.25 mm ID, 0.2 μm film thicknesses). Fatty acid methyl ester samples were then identified using gas chromatography by comparing the retention times of FAME peaks from samples with those of standards obtained from Supelco (Supelco 37 Component Fame Mix 47885-U, Sigma-Aldrich Aston Manor, Pretoria, South Africa). Individual fatty acids were expressed as a proportion of total fatty acids present in the sample. The following fatty acid combinations were calculated: omega-3 (n-3) fatty acids, omega-6 (n-6) fatty acids, total saturated fatty acids (SFA), total monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), PUFA/SFA ratio (P/S) and n-6/n-3 ratio, atherogenicity index.

Meat samples from the different treatments were also obtained for sensory analysis. Meat pieces enclosed in polythene bags were boiled for 40 minutes at 70^{o}C. The boiled meat from each treatment was evaluated separately using a panel of untrained consumers. Sensory panellists awarded scores using a 8 point descriptive scale to evaluate aroma intensity (1=extremely bland to 8=extremely intense), initial impression of juiciness (1=extremely dry to 8=extremely juicy), first bite (1=extremely tough to 8=extremely tender), sustained impression of juiciness (1=extremely dry to 8=extremely juicy), muscle fibre and overall tenderness (1=extremely tough to 8=extremely tender), amount of connective tissue (1=extremely abundant to 8=none), overall flavour intensity (1=extremely bland to 8=extremely intensive), and atypical flavour intensity (1=none to 8=extremely intense).

Data on fatty acid profiles and sensory evaluation were subjected to analysis of variance procedures using the general linear model procedure (PROC GLM) of SAS (2008). Data on sensory evaluation was log transformed [Log (x +1)] to achieve normality. The sensory results were then reported as back transformed means. Separation of means was done using the probability of difference (PDIFF) option of SAS (2008)

III. RESULTS AND DISCUSSION

The effect of diet on proximate composition of the subcutaneous adipose tissue of broilers is presented in Table 1. Diet significantly (P<0.05) affected subcutaneous fat % (SCF %). Birds on the poscontrol had the highest SCF% while those on the Ljav12 diet had the lowest SCF%. The results on the composition of individual fatty acids (FAs) in the breast muscle of the broilers are presented in Table 2. Across treatments, oleic (30.9–33.9%), followed by palmitic (23.9–25.2%) and linoleic acid (15.8 –16.6 %) were the main FAs found in the breast muscle of the broilers. Similar observations were made in broilers fed *Camelina sativa* oil by Jaskiewicz *et al.* (2014). Diet had significant effect on heptadecenoic (C17:1c10, eicosatrienoic [C20:3c8, 11, 14 (n-6)], docosadienoic

[C22:2c13, 16(n-6)] and docosapentaenoic [C22:5c7, 10,13,16,19 (n-3)] acids.

Table 1. Proximate composition (%) of breast muscle from broilers as affected by diet

Parameter	Dietary Treatment[2]			
	Negcontrol	Poscontrol	Ljav5	Ljav12
SCF	1.64[b]	1.88 [c]	1.59[b]	1.47[a]
FFDM	22.3	22.1	23.5	22.3
Moisture	76.1	76.1	75.3	76.3

[1]Parameter: SCF = Subcutaneous fat; FFDM = Fat free dry matter.

Table 2. Fatty acid composition of breast muscle from broilers fed different diets

Fatty acids (%)	Dietary treatments1			
	Negcontrol	Poscontrol	Ljav5	Ljav12
C14:0	0.3	0.32	0.33	0.3
C14:1c9	0.05	0.08	0.07	0.05
C15:0	0.1	0	0.01	0
C16:0	24.3	23.9	25.2	24.0
C16:1c9	5.15	5.74	5.28	4.97
C17:0	0.04	0.04	0.05	0.03
C17:1c10	0.51[c]	0.39[b]	0.27[a]	0.49[c]
C18:0	8.8	7.9	8.59	9.09
C18:1t9	0.01	0.04	0.02	0.03
C18:1c9	30.9	33.9	31.9	31.2
C18:1c7	5.05	5.23	5.16	5.1
C18:2c9,12 (n6)	16.6	15.8	15.8	16.2
C20:0	0.14	0.09	0.1	0.13
C18:3c6,9,12 (n3)	0.11	0.1	0.12	0.09
C20:1c11	0.3	0.29	0.31	0.31
C18:3c9,12,15 (n3)	0.46	0.53	0.52	0.44
C20:2c11,14 (n6)	0.31	0.2	0.27	0.33
C22:0	0.01	0	0.01	0.01
C20:3c8,11,14 (n6)	1.06[b]	0.78[a]	0.91[a]	1.09[b]
C20:4c5,8,11,14 (n6)	4.89	3.71	4.11	4.96
C22:2c13,16 (n6)	0.02[b]	0.1[c]	0.02[b]	0.01[a]
C20:5c5,8,11,14,17 (n3)	0.39	0.23	0.36	0.39
C22:5c7,10,13,16,19(n3	0.33[b]	0.42[a]	0.44[b]	0.47[b]
C22:6c4,7,10,13,16,19(n3)	0.21	0.18	0.23	0.24

[a,b,c]Means in the same row with different superscript are significantly different (P<0.05).

The proportions of docosadienoic, another n-6 FA, were highest ($P < 0.05$) in the poscontrol group and lowest in the Ljav5 and negcontrol groups. Most of the n-3 FAs were not affected by diets except for the docosapentaenoic which was found to be higher ($P < 0.05$) in the Ljav5 treatment group and lowest in the negcontrol. The effects of diet on total saturated fatty acids (SFA), mono-unsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), omega-6 (n-6) fatty acids, omega-3 (n-3) fatty acids, PUFA: SFA and n-6: n-3 ratios of broiler breasts are presented in Table 3. The broilers in the Negcontrol group and Poscontrol had a significantly ($P<0.05$) higher total SFA compared to the Lippia fed broilers. On the contrary, the broilers in the lippia-containing treatment groups had higher ($P<0.05$) total PUFA, total n-3 FAs and PUFA: SFA ratio and also had significantly lower n-6:n-3 ratios compared to the other two treatment groups. The lower total SFA, higher total PUFA and total n-3 fatty acids may have potential beneficial effects on human nutrition as reported elsewhere (Aldai *et al*. 2007; Alfaia *et al.* 2007; Marume *et al.*, 2012). No differences were however, observed with regards to total MUFA and total n – 6 FAs

Table 3.Total fatty acids and ratios as affected by diet

Fatty acids	Dietary treatments			
	Negcontrol	Poscontrol	Ljav5	Ljav12
Total SFA	33.5[ab]	34.3[a]	32.3[b]	33.5[ab]
Total MUFA	42.1	45.7	42.9	42.3
Total PUFA	22.3[a]	22.1[a]	24.7[b]	24.2[b]
Total n-6	22.8	20.6	21.1	22.6
Total n-3	1.59[a]	1.37[a]	1.65[b]	1.64[b]
PUFA:SFA	0.66[a]	0.68[a]	0.73[b]	0.72[b]
n-6: n-3	14.3[b]	15.36[b]	12.9[a]	13.9[a]

[a,b,c]Means in the same row with different superscript are significantly different (P<0.05).

The effects of diet on various sensory attributes of broiler meat are shown on Tables 4.The results showed that diet significantly affected sensory scores of the meat ($P<0.05$). Of particular interest were the high scores for muscle fibre and overall tenderness and amount of connective tissue given to the Ljav5 and Ljav12 treatment groups, which indicated that the meat was tenderer with less connective tissue in it. Tenderness and juiciness are complex attributes that are often affected by diet and intramuscular fat composition of meat (Calkins and Hodgen 2007). It appears, therefore, *L. javanica* was able to increase and modify the intramuscular fat thereby increasing the marbling of the meat. Ideally, meat quality levels should combine the capacity to retain high nutritional value and to excel in functional roles such as tenderness and juiciness of the cooked product among other roles (Calkins and Hodgen 2007; Muchenje *et al.* 2008).

Table 3. Effect of diet on sensory characteristics of broiler meat

Sensory attributes	**Dietary treatments**			
	Negcontrol	Poscontrol	Ljav5	L.jav12
Aroma intensity	4.06	4.24	4.20	4.13
First bite	4.12^{a}	4.38^{a}	4.60^{b}	4.27^{a}
juiciness	3.65^{a}	4.27^{b}	4.25^{b}	4.25^{b}
Overall tenderness	4.40^{a}	4.52^{a}	4.82^{b}	4.84^{b}
Amount of connective tissue	4.63^{a}	5.12^{b}	5.11^{b}	5.32^{b}
Flavour intensity	4.89^{a}	5.26^{ab}	4.70^{a}	4.87^{a}

[a,b,c]Means in the same row with different superscript are significantly different (P<0.05).

IV. CONCLUSION

Inclusion of *L. javanica* in broiler diets in place of conventional antibiotics significantly improved the fatty acid profile and general sensory perceptions of broiler meat. Therefore, Lippia javanica could effectively reduce the need for use of conventional growth promotants to improve the growth and meat quality of broilers for the benefit of consumer health.

ACKNOWLEDGEMENTS

The authors are indebted to the NWU Food Securty Niche Area for their financial support.

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