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Resaerch Application Summary

Effect of low tannin sorghum on sensory characteristics of layer eggs and broiler meat

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Abstract

The sensory characterization of food and food products is necessary to measure its consumer acceptance as it rates the preference of consumer with regards to the intervention made. low tannin sorghum is important as a feed but its acceptability should also be measured with regards to how consumers perceive the meat and eggs of chicken fed on this as a feed. chicken meat from chicken fed on low tannin sorghum (LTS) showed almost similar preference to those fed on maize and some showed higher acceptability than those fed on pure maize. The layer hens fed on 100% LTS performed just as well as those fed on pure maize most sensory attributes. Low tannin sorghum-based feed can therefore be used to replace maize as the key source of energy in the feed without causing unfavourable sensory quality to the meat and eggs.

Key words: chicken, sorghum, tannin

Résumé

La caractérisation sensorielle des aliments et des produits alimentaires est nécessaire pour mesurer leur acceptation par les consommateurs car elle évalue la préférence des consommateurs par rapport à l'intervention effectuée. Le sorgho à faible tanin est important comme aliment, mais son acceptabilité doit également être mesurée en fonction de la façon dont les consommateurs perçoivent la viande et les œufs de poulet nourris avec ce produit comme aliment. la viande de poulet provenant du poulet nourri au sorgho à faible tanin (LTS) a montré une préférence presque similaire à celles nourries au maïs et certaines ont montré une acceptabilité plus élevée que celles nourries au maïs pur. Les poules pondeuses nourries à 100% de LTS ont aussi bien performé que celles nourries au maïs pur avec la plupart des attributs sensoriels. Les aliments à base de sorgho à faible teneur en tanins peuvent donc être utilisés pour remplacer le maïs en tant que principale source d'énergie dans les aliments sans causer une qualité sensorielle défavorable à la viande et aux œufs.

Mots clés: poulet, sorgho, tanin

Introduction

Over the years farmers have been involved in production of poultry both for subsistence and

commercial purposes (Narrod *et al.*, 2012). Africa's poultry production has been projected to double for the next period and this has tasked the farmers to streamline production processes to ensure profitability and meet the demand. Some farmers are therefore moving to intensive production of chicken and chicken products. In intensive commercial production there is need of using dietary inputs that lead not only to nutritious products but also to foods that are considered delicious and appealing to the consumer. Replacement of maize with low tannin sweet sorghum (LTS) is a strategy that has been found to reduce production cost and provide the nutrients just as well as poultry fed on pure maize as the key source of energy (Ochieng *et al.,* 2018). However, the effect of this feeding intervention on the sensory attributes of the meat has not been fully studied and communicated. To ensure that endorsement of Low Tannin sorghum as a feed, it is not only important for the farmer and feed producer to know the perception of sensory attributes of the products, but consumers should also have the knowledge that the products from chicken fed on LTS are nutritious and delicious for consumption since they are involved at the end of the supply chain.

In the chicken meat and egg industry, chicken variety, feed, and production system have been denoted as the key sources of sensory variation in meat products (Qiao *et al.,* 2002; Bogosavljevic-boskovic *et al.,* 2010; Amenou *et al.,* 2013). Feed has been found to be the key source of variation in the sensory attributes of meat products. It was observed that feeds rich in polyunsaturated fatty acids and fish oils were said to have a fishy taste and this type of feedback is important since at times research is done to improve the nutritional status of the meat using a feed but due to the metabolism of the feed the meat may be observed to have less sensory appeal but be nutritionally richer. Different additions to the feed produce different sensory attributes. It is, therefore, necessary to analyse the sensory attributes of a given food product to know how the consumers perceive the feed effect in the meat and eggs produced.

Study design

Layer chicken were fed on feed as illustrated by Ochieng *et al.* (2018). The illustration of the feeding procedure was as shown in Figure 1.

Evaluation of Sensory attributes of meat. Meat for sensory analysis was prepared as illustrated by AMSA (1978). The meat was prepared, by one person. Portioned pieces of meat were boiled in water using an ordinary kitchen stove. Samples were then removed from the tins and cut into mouth size pieces and placed into coded plates. The sensory panel consisting of 40 people aged between 20 and 35 years, was allowed to sample from each plate and write their feedback on the sensory questionnaires offered. The 9-point hedonic scale (1 = dislike extremely; 9 = like extremely) was used to evaluate appearance, flavour, juiciness, texture, aftertaste and overall acceptability of the meat.

Evaluation of sensory attributes of eggs. In all the experiments eggs laid in one day were tested and stored at 4 °C for 15 days before sensory evaluation. The eggs was evaluated as hard boiled as illustrated by Leeson (1995) where eggs were all boiled and kept warm in a water bath at 35°C. The eggs were then peeled and the yolks presented for sensory analysis to the consumer panel of 40 people aged between 20 to 35. No salt or food additive was used.

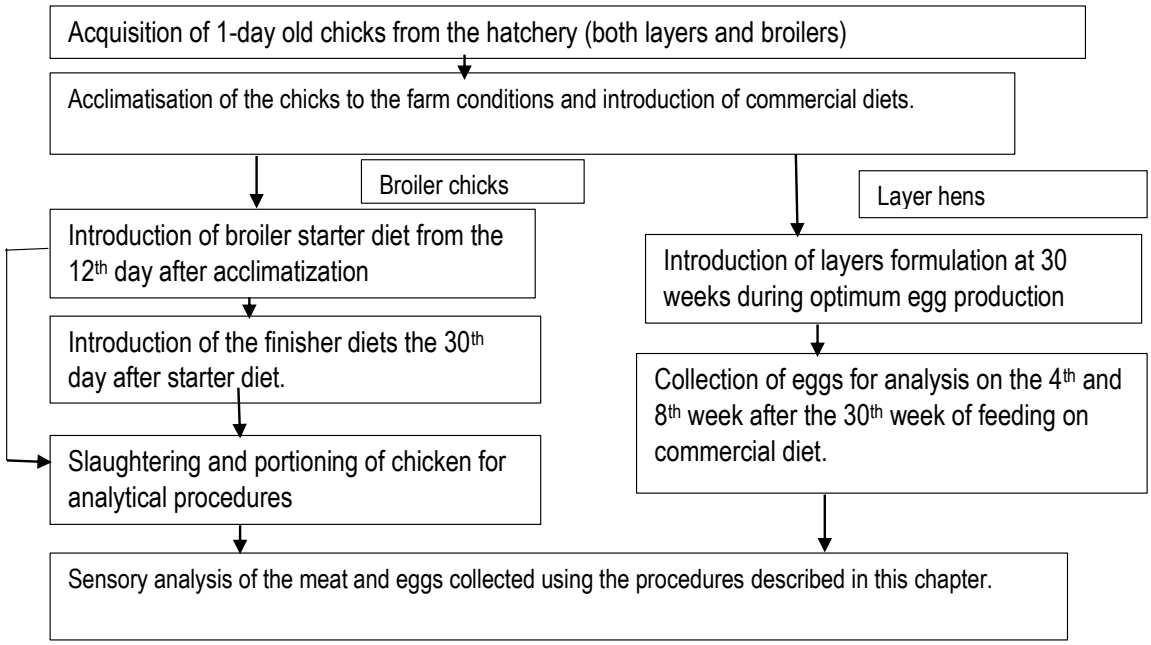

Figure 1. Flow diagram of the study design

The evaluation was based on a 9-point hedonic scale (1 = dislike extremely; 9 = like extremely) for appearance, flavour, texture, after taste and overall acceptability using questionnaire.

Statistical analysis. The quantitative data were analysed using STATA/IC 12.0 statistical software in which the evaluation of residual homogeneity was checked using the Shapiro-Wilk test ($p<0.05$). Further, due to inherent limitations of ANOVA in describing difference in progression of variables over time, the analysis of covariance (ANCOVA) which combines features of both ANOVA and regression was also applied to test effects of diet. One-way ANOVA was performed where diet outcomes at a specific point in feeding time needed to be compared. Means were separated using Bonferroni adjustment at 95% confidence level.

Results and discussion

Meat sensory quality. Diet type had a significant effect on the appearance ($P<0.0001$), flavour ($P<0.0001$), juiciness ($P=0.002$), texture ($P=0.046$), after taste ($P<0.0001$), and overall acceptability ($P<0.0001$), of the chicken fed on the starter diet and prepared by boiling. However, for the finisher diet only the aftertaste ($P=0.001$), was significantly affected by the variation of the level of LTS in the feed. Diet type had no significant effect on all the sensory attributes of the boiled chicken meat fed on the finisher diet. Meat of chicken fed on the starter and finisher feed were not significantly affected by the variation of the level of LTS in the diets. Due to the clear separation provided by the boiled meat samples it was observed that chicken meat from diet 2 (80% M20% LTS) was the most preferred for both the starter and finisher diets. All the scores were in the positive side of the hedonic scale hence this could be used to endorse the formulations irrespective of the amount of LTS in the feed.

Table 1. Broiler feed formulation

Ingredients (kg)	Dietary Treatments											
	1S	2S	3S	4S	5S	6S	1F	2F	3F	4F	5F	6F
Maize	550	440	330	220	110	0	606.7	485.36	364.02	242.68	121.34	0
Low Tannin Sorghum (LTS)	0	110	220	330	440	550	0	121.34	242.68	364.02	485.36	606.7
Soybean meal	370	370	370	370	370	370	340	340	300	340	300	340
Vitamin premix	36	36	36	36	36	36	3	3	2.86	3	2.86	3
Methionine	0.9	1	1.15	1.25	1.37	1.5	0.933	1.071	0.9	1.07	1.43	1.33
Salt	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	3	3	3
Limestone	18	18	18	18	18	18	20	20	21.43	20	21.43	20

Calculated nutrient value of broiler feed

Nutrient	Starter feed	Finisher feed
Energy	2900 Kcal	3000 Kcal
Crude protein (%)	20	18
Crude fibre (%)	4	0.39
Calcium (%)	1	1
Phosphorus (%)	0.42	0.4
Lysine (%)	1.05	0.9
Methionine (%)	0.42	0.4

S-Starter diet
F- Finisher diet

Vitamin premix(kg^{-1}): Vitamin A (I.U) 6250000,Vitamin D3 (I.U) 1000000,Vitamin E (I.U) 15000,Vitamin K3 (Mg) 1000, Vitamin B1 (Mg) 500,Vitamin B2 (Mg) 2500, Vitamin B6 (Mg) 2500, Vitamin B12 (Mg) 10, Pantothenic acid (Mg) 600, Nicotinic acid (Mg) 15000, Folic acid (Mg) 500, Biotin (Mg) 35, Choline chloride (Mg) 150000, Iron (Mg) 20000, Copper (Mg) 2500, Zinc (Mg) 25000, Manganese (Mg) 15000, Iodine (Mg) 600, Cobalt (Mg) 400, BHT (Anti-oxidant, Mg) 125000.

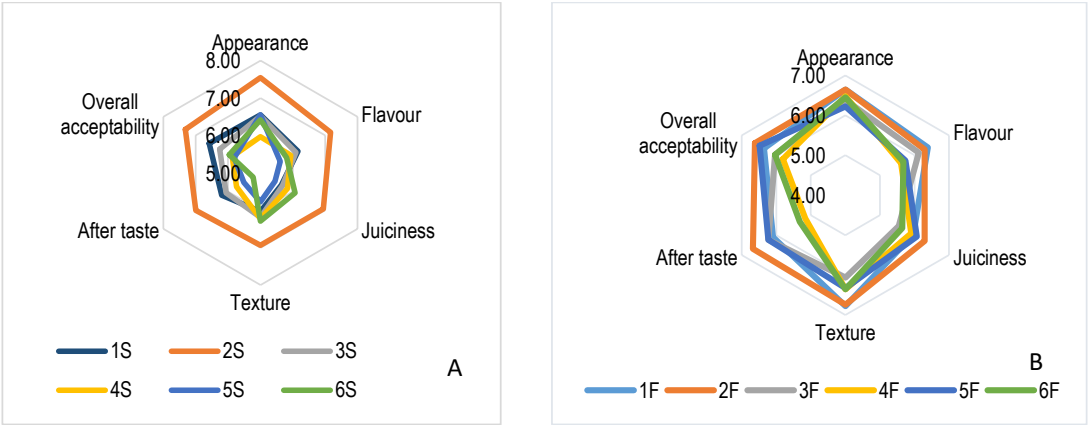

Figure 1: Sensory attributes of boiled meat from chicken fed on A: starter feed B: finisher feed.

Figure 2 gives information on the sensory scores of the chicken meat based on the hedonic score of all the attributes. It was observed that the younger birds gave more consistent results than the older birds. It was also observed that the boiled meat gave a better separation and the sample and the highest score could be easily identified. Diets 2S and 2F had the highest sensory score for all the six attributes for boiled meat samples while treatment 1S and 1F which were the control and treatment 6S and 6F which were the sample with 100% sorghum had non-consistent scores. The older birds, after the finisher diets were also observed to have inconsistent scores while younger birds after the starter gave more consistent and dependable results.

Diet 2 consisting of 80%Maize20%LTS gave the most preferred meat samples in all the six sensory attributes tested for the starter diet. It was followed closely by 1S (100%M) which interchanged with diet 6S on texture and juiciness. The starter meat samples had a generally higher score than the finisher diet showing that older chicken had a less desirable sensory attributes than the younger birds. The finisher diet scale started at 7.3 score while the starter diet started at a 7.5 score. With diet 2 having the highest scores. Based on flavour diets 6 and 5 had the least scores for the starter while the finisher diets 6.5 and 4 tied at the last position. This implied that the addition of high amounts of low Tannin Sorghum had a detrimental effect on the flavour of samples as the sensory panellist recorded the least preference for these. The after taste of diets 6 and 5 were also least preferred for both the starter and finisher diet hence it can be concluded that based on the flavour and olfactory attributes, Low Tannin Sorghum had a negative impact on the meat hence very high concentration of LTS should be avoided for higher preference of the meat samples. Younger animals have been known to produce juicier meats and more tender meats (Mohammad *et al.,* 2002) hence this explains the ability of the younger birds to produce better separation of the attributes.

Egg sensory quality. Figure 3 shows the results of sensory score of unsalted egg yolk. There was no significant difference caused by diet on the appearance (P=0.438), flavour (P=0.791), texture (P=0.740), after taste (P=0.147) and overall acceptability (P=0.194) for the starter feed. The finisher feed also recorded no significant effect of diet on the appearance (P=0.485), flavour (P=0.773), texture (P=0.979), after taste (P=0.270) and overall acceptability (P=0.364) of the yolks.

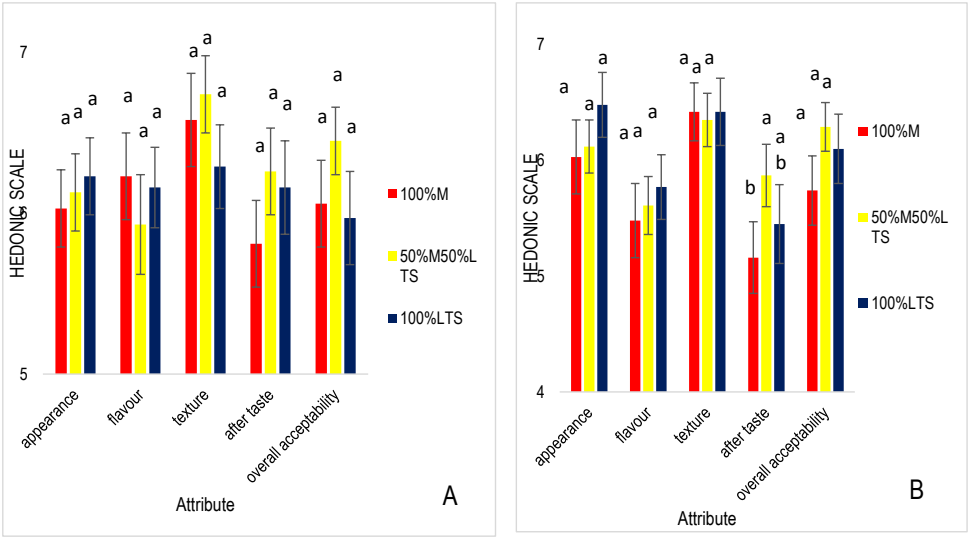

Figure 3: Sensory attribute of boiled unsalted egg yolks. A: eggs collected after 4 weeks; B: eggs collected after 8 weeks.

The sensory scores of the eggs were between 5 and 6.5 for both 4 weeks and 8 weeks of trial diet on a 9-point hedonic scale. From the 4th week trial, samples with 50%M50%LTS showed higher scores with regards to overall acceptability, after taste and texture. The 100%M diet had the highest score in relation to flavour and the least scores of after taste and appearance.This suggests that low tanin sorghurm negatively impacted on flavour but caused a preferred aftertaste. On the other hand maize had an insignificant or no aftertaste for 4week trial period. For the samples from 8 weeks of trial, 50%M50%LTS had the highest scores with regards to overall acceptability and aftertaste. Their texture scores were similar for all the three diets while for appearance 100%LTS had the highest value.

Eggs from younger birds gave a better separation than that from older birds. The 100%LTS at 4 weeks scored 6.1 against 6.27 in the case of 100%M while at 8 weeks the flavour scores diminished to 5.67 and 5.43, respectively. The texture of the eggs was the same since the eggs were hard-boiled. The 100%LTS gave a score of six which was second to the 50%M50%LTS formulation.

In relation to the sensory results recorded in Figure 3 50%M50%LTS had the most acceptability score irrespective of the time after feeding. This suggests that in relation to sensory scores, a mixture of maize and low tannin sorghum will be acceptable to the consumer market. Sorghum can however produce a flat taste in relation to flavour but has a preferred aftertaste.

Based on the results obtained in the two experimental feeding trials, it was observed that low tanin sorghum had little impact on the sensory attributes of the meat and eggs except for the after taste. This finding contradicts earlier findings by Moreki *et al.,* (2012) who observed that meat from guinea fowls fed on sorghum had comparatively lower sensory score than from that fed on maize. Further the LTS on its own and with the boiling had a

negative influence on the flavour of the meat samples. The variation of amounts by mixing both maize and LTS had a neutralizing effect on the negative impact. Based on the meat sensory score, the most appealing level of replacement of maize in the chicken diet in 20% as it was observed to be preferred even better than the control which was 100%M. The eggs also showed a similar trend with the sample with 50% replacement of maize giving the most preferred sensory attributes irrespective of the period of feeding trial.

Conclusion

Low Tannin Sweet sorghum grains can be used to replace maize in chicken feed with minimal effect on most of the attributes except the after taste of the meat. For egg production Low Tannin Sorghum can be used to fully replace maize in the feed with little to no effect on the sensory attributes of the eggs.

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