EVALUATION OF VARIOUS DETOXIFICATION METHODS OF MORINGA OLEIFERA SEEDS IN BROILERS NUTRITION

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Abstract

Poultry production plays a key role in socio-economic development in developing countries. However, poultry production sector are facing a myrid of problems, one of which is the high cost of feed production. Protein sources (soya bean, meal, fish mealetc) which is one of he essential components in ration formulation in this sector are usually scarce and expensive. Researchers are therefore looking for cheap, available and safe alternative sources of protein. One of these alternative protein sources is seed meal of tropical crop, moringaoleifera. Raw Moringaoleifera seed meal was variously processed by water washing, boiling, autoclaving, microwave blanching and a combination of the detoxicant methods and fed at 15% in diets to broiler chicks at hatch in a single factor design (CRD) experiment over a month feeding trial. All the detoxicant methods improved dietary performance of the birds and treating Moringaoleifera seed meal (MOSM) made the stuff in diets innocuous as evidenced by results on relative organ weights (heart, liver), some measured biochemical parameters including protein fractions, detoxicant enzymes (ALP x ALT) which were comparable in values with those obtained on the control diet ($P>0.05$). It was concluded that the detoxicant methods used hold great potential and should be followed with dietary supplementation of additional reduced nutrients (protein, vitamins) and other detoxifying agents.

Introduction

In countries of the world with developed economies, major feed sources for poultry and other food animals are fish meal, meat meal etc. In developing countries like Nigeria, the main sources of proteins in commercial poultry production are the conventional oil and non-oil soya beans, groundnuts, cotton seed, common beans and peas, rapeseeds, lupin. Currently, the use of the seeds cake is attended with serious problems such as scarcity, cost besides their extensive use by other livestock, industries and humans, hence the persistent scarcity and consequent high prices of these conventional proteins and energy feeds in developing countries (D'mello et al. 2017).

The problems have created the necessity to look inward for cheap, available and less competitive alternatives to provide protein and other nutrients for farm animals. The introduction of new or relatively lesser-known/novel seed bearing plants capable of growing in poor soils like Moringaoleiferahas been suggested to be a viable alternative source of protein, vitamins and minerals for poultry feeding (Gadzirayi et al. 2012). In this context, one of the alternative cheap source of protein that can be used in poultry nutrition are the leaves of tropical legumes such as moringaoleifera. (Makkar and Becker, 1997, Melesse et al. 2013). Moringaoleifera which belong to the family Moringaceae is highly valued plant, distributed in the tropical and subtropical areas

around the world (Price 2007, Khalafalla et al. 2010, Mbikay, 2012), making it multipurpose tree, being a good source of protein, B-carotene, vitamins, A, B, C and E, riboflavin, nicotinic acid, folic acid, pyridoxine, amino acids, minerals and various phenolics compounds (Yang et al. Jung 2014). Reports have also described the plant to be anti-inflammatory, antioxidant, antimicrobial and antitumor activity. Moringa has powerful antibiotic and fungicidal effects (Fashey et al. 2001). As well, Moringa has the potential to improve nutrition and support immune functions of poultry and animal.

Oil seeds have the advantage over other seeds because the oil with a high nutritional and economic value can be extracted or the full-fat seeds used in animal feeding to supply the needed protein and energy among other nutrients (Vitamins, minerals) thereby reducing costs. The use of numerous seeds meal as protein sources however, is limited to the presence of toxic factors, anti-nutrients or metabolic inhibitors. These chemical compounds are present in seeds because seeds usually contain a large amount of stored materials such as starch, storage-proteins, oil and minerals required for seed growth and early plant growth.

Some anti-nutritional factors and toxins commonly found in seeds are protease inhibitors, amylase inhibitors, haemagglutinins, goitrogens, cyanogens, vicineand phytic acids, tannis, alkaloids, flatulence factors, hypoglycines. The presence of these poisonous substances in plant food/feedstuff limits their utilization especially in simple-stomached animals diets.

Moringaoleifera seed cake contains valuable nutrients but implicated in anti-nutrients, toxins and metabolic inhibitors which have been implicated in limiting high level inclusion in diet especially for monogastric animals. Efficient and cheap method of detoxifying the seed cake may provide alternative protein source for livestock in place of the competitive conventional protein sources used in Nigeria.

Materials and Methods;

Processing of Test Materials (Moringaoleifera seed cake, MOSC)

Moringaoleifera seeds obtained from Ekiti, Oyo and Kwara states of Nigeira. The undercorticated seeds was subjected to oil extraction using the moringa cold pressing machine which is worked by electricity to express oil from seeds and is assembled with facilities including collectors for oil and seed cake or seed meal. Cake obtained was properly dried and worked into meal before been divided into five equal parts of 15kg. Each 15kg meal was subjected to one of the five different treatment of:

i. Water-washing or soaking for 48hours
ii. Thermal treatment
iii. Autoclaving at a temperature of 120^0c and pressure of $0.15Hg/NM^2$
iv. Microwave blanching for 30 seconds and
v. Multi treatments – kaolin supplementation.

Diets, Animals and Feeding Trial

Six diets having equal energy and protein contents on average to meet the requirement of broiler chicks (NRC 1994) were formulated made of a conventional diet and five test diets, 2, 3, 4, 5 and 6 included with a fixed level of 15% MOSC treated variously as described by (i) to (v).

Ninety six day-old broiler chicks of a commercial breeds were used for the experiment. They were housed in an electrically heated battery brooder cage partitioned into units to allow replication. Chicks were randomly distributed to the six dietary treatments, control diets inclusive, in a single factor design experimental model. A treatment was replicated twice ie A and B, and each replicate was shared with eight (8) chicks.

Diets were fed twice daily. Both feed and drinking water were generously supplied during the feeding trial that lasted for about four (4) weeks. In the course of the trial, data were collected on dietary performance indices of feed consumption, body weight gain, growth rate, efficiency of feed utilization, survival rate etc.

Serum protein, albumin and globulin were analyzed using the sigma kits according to Feteris (1965) while serum enzymes were determined by the colometric method (Sigma Diagnostic, 1985).

Data generated were processed and subjected to analysis of variance (ANOVA) for a one-way classification design model using SAS statistical package (SAS, 2003).

Result and Discussion;

Results: Table 1 presents the proximate (chemical) composition of raw and processed Moringaoleifera seed meal (MOSM) subjected to treatments by water – washing (soaking), thermal treatment (boiling), autoclaving, micronization and the combined (multi) treatments. Microwave blanching increased the protein content of the treated seed meal and treatment by autoclaving did not reduced by far, the protein content from the virgin state (26.25% of raw compared with 25.15% crude protein of the autoclaved). Effects of treatments especially on nutrient protein content of the seed meal showed that protein was reduced from 26% in the raw seed meal to 3, 6, 5% in the water-washed, thermal and multi-treatments respectively while there was no observable effects of treatments on the dry matter contents of seed meal receiving the different treatments.

Data on the dietary treated MOSM on performance characteristics of broilers at termination of the experiment are shown on Table 2. Feed intake on boiled (thermal) MOSM was superior to other dietary treatments relative to the control diet ($P<0.05$). No significant differences were recorded on body weight gain on all the treatment group ($P>0.05$) but growth rate appeared to be the highest on broiler receiving multi-treated MOSM in diet ($P<0.05$). Efficiency of feed utilization (feed conversion ratio) was low on diet 3 and 6 containing thermal and multi-treated MOSM diets compared with the rest of the experimental diet in connection with the anti-nutrients in the treated test feed stuff in diets.

Processed MOSM in diets (Table 3) did not influence the weights of the hearts and livers ($p>0.05$) and, while differences occurred in average weights of organs like the lungs and gizzards, these differences were not wide apart from the values of the control group birds ($p<0.05$).

The biochemical determinant in broilers following consumption of the dietary treated MOSM are given on Table 4. Feeding the differently processed MOSM in diets did not influence total protein and serum globulin level ($p>0.05$), neither did the feeding change the activities of Alkaline phosphate (ALP) and Alanine aminotransferase (ALT) ($P>0.05$). However, treatment reduced the activity of Aspartate aminotrasferace (AST) in comparism with that of broilers offered the conventional diet ($P<0.05$).

Profiling electrolytes in the experimental birds fed the various treated MOSM in diets (Table 5) indicated that broilers were well nourished with both the macro and micro-minerals and where differences in mean values occurred, they were either higher than or slightly less than values on the reference diets.

TABLE 1: NUTRITIONAL/CHEMICAL COMPOSITION OF UNTREATED AND TREATED M.OLEIFERA SEED SAMPLES

Treatment Percent (%)	DM	CP	EE	CF	TA
Raw	94.22	26.25	29.37	23.40	4.54
Water washing	93.72	23.18	27.21	23.18	3.93
Thermal treatment	94.98	20.78	25.87	22.15	2.60
Autoclaving	95.10	25.15	27.10	23.10	3.80
Micronization	95.02	31.71	27.16	20.74	3.80
Multi-treatment	94.10	21.87	23.86	21.68	2.16

DM ⟶ Dry matter
CP ⟶ Crude protein
EE ⟶ Ether extract (fat)
CF ⟶ Crude fibre
TA ⟶ Total ash (mineral matter)

TABLE 2: EFFECTS OF VARIOUS TREATMENTS OF MOSM IN DIETS ON PERFORMANCE CHARACTERISTICS

Diets	**1**	**2**	**3**	**4**	**5**	**6**	**SEM**
Indices	CL	WW	BG	AU	MN	MT	
Feedintake (g/b/d)	33.93^{b}	33.56^{b}	36.10^{o}	22.89^{a}	21.00^{a}	31.82^{b}	0.56*
Weightgain (g/b/d)	7.63	8.45	13.42	7.73	4.16	14.15	1.25_{NS}
Growth rate(%)	235^{c}	255^{c}	389^{d}	175^{b}	117^{a}	407^{e}	1.83*
FeedGain(Ratio)	0.015^{b}	0.018^{b}	0.01^{a}	0.015^{b}	0.025^{c}	0.01^{a}	$58x10^{-3}$
Mortality rate(%)	2	0	1	0	0	0	

a-b-c-d-e means in rows not sharing common letters differed significantly (P<0.05).
'NS': No Significant difference (p>0.05)
KEY:
CL ⟶ Control
WW ⟶ Water washing
BG ⟶ Boiling
AU ⟶ Autoclaving
MN ⟶ Micronization
MT ⟶ Multi-treatment

TABLE 3: INFLUENCE OF DIFFERENTLY PROCESSED MOSM IN DIETS ON ORGANS WEIGHTS (g).

Diet	**1**	**2**	**3**	**4**	**5**	**6**	**SEM**
Organs	CL	WW	BG	AU	MN	MT	
Heart	1.56	1.57	2.10	1.51	1.06	0.10	0.19 NS
Lung	1.00^{b}	1.55^{b}	2.02^{b}	1.00^{b}	0.70^{a}	1.30^{b}	0.32*
Liver	8.53	9.52	11.00	6.52	3.01	9.51	0.10 NS
Gizzard	7.54^{b}	7.50^{b}	7.01^{b}	6.03^{b}	4.51^{a}	651^{b}	1.96*

KEY:
CL ⟶ Control
WW ⟶ Water washing
BG ⟶ Boiling
AU ⟶ Autoclaving
MN ⟶ Micronization
MT ⟶ Multi-treatment

TABLE 4: INFLUENCE OF DIETARY TREATED MOSM ON SOME BIOCHEMICAL PARAMETERS IN BROILERS.

Diet	**1**	**2**	**3**	**4**	**5**	**6**	**SEM** Parameter	CL
WW	BG	AU	MN	MT				
Total protein	50.00	57.50	42.00	51.00	60.00	50.00	0.6NS	(g/L)
Serum albumin	22^{a}	32^{b}	29^{b}	27^{b}	39^{c}	36^{c}	0.47*	(g/L)
Globulin (g/L)	15	16	18	19	19	12	0.1NS	
ALP (Iu/L)	1445	1770	2108	2557	2267	2007	0.2NS	
AST (Iu/L)	206^{f}	186^{c}	170^{d}	154^{c}	146^{b}	87^{a}	0.23*	
ALT (Iu/L)	101	102	83	79	78	52.4	NS	

KEY:

CL ⟶ Control
WW ⟶ Water washing
BG ⟶ Boiling
AU ⟶ Autoclaving
MN ⟶ Micronization
MT ⟶ Multi-treatment

TABLE 5: SERUM ELECTROLYTES INFLUENCED BY DIETARY MOSM TREATED BY VARIOUS METHODS (mmo/L)

Diets	**1**	**2**	**3**	**4**	**5**	**6**	**SEM**
Indices	CL	WW	BG	AU	MN	MT	
CA^{+}	0.63a	0.77a	1.37b	1.84b	1.87b	2.46c	1.82*
PO_4^{-2}	1.70^{a}	1.65^{a}	1.95^{a}	2.25^{a}	3.10^{b}	3.15^{b}	0.63*
Na^{+}	136^{b}	121^{a}	117^{a}	138^{b}	154^{c}	159^{c}	0.95*
K^{+}	4.45	5.10	5.55	6.55	6.8	7.0	$1.48N^{s}$
Mg^{2+}	1.75^{c}	1.10^{b}	1.10^{b}	0.9^{a}	0.8^{a}	0.7^{a}	0.20*
CI^{-}	71^{c}	49^{a}	55^{b}	88^{d}	91^{d}	103^{c}	0.64*
$HC0_{-3}$	24.5^{b}	18^{a}	20^{a}	19^{a}	21^{a}	19^{a}	0.26*

KEY:

CL ⟶ Control
WW ⟶ Water washing
BG ⟶ Boiling
AU ⟶ Autoclaving
MN ⟶ Micronization
MT ⟶ Multi-treatment

Discussion

Treated MOSM by the detoxicant methods of autoclaving increased the dry matter content while treatment by micro wave blanching increased dry matter and protein contents of the test feedstuff (MOSM). The increment in nutrients of the feedstuff by these methods is of nutritional advantage to the fed animals.

Consumption of the different processed MOSM in diets improved performance. Characteristics with regards to feed intake, weight gain, growth rate suggesting that subjecting the raw seed meal to any of the treatments, water-washing, thermal, autoclaving, micronization or combination of the methods before feeding is preferable and beneficial to the nutrient needs of the fed animals. In addition, the absence of mortality on all the test diets compared to the control diet lend support to the fact that detoxification of the treated seed meal has been effected.

Carcass quality showed that the lungs and gizzards weights were reduced despite treatments while the weights of organs, the hearts and livers were not affected relative to the reference diet. Since the liver which is the centre of handling all foreign antigens including toxins was unaffected on all the diets, this could mean that the detoxification methods adopted were effective.

Ingestion of dietary treated MOSM increased protein level in the fed birds with respect to the component serum albumin while those of total protein and globulin of the groups receive the test feedstuff in diets were comparable with values on the conventional diet ($p>0.05$) indicating that the rich nutrients nature of Moringa product, when processed, could meet the protein needs of poultry. Aspartate aminotransferase (AST) activity were converged following ingestion of treated MOSM based diets but the activities of alanine aminotransferase (ALT) and alkaline phosphatase (ALP) were not influenced by the treated MOSM in diets similar to the control diet. Both ALT and ALP besides other physiological functions in the body, are responsible for detoxification of toxins and toxicants in the body. Since the activity values of the two enzymes were comparable with the reference diet ($p>0.05$), it was suggestive that the anti-nutrients properties of MOSM when fed in the natural state were eliminated in the course of treating the seed meal. Finding on improvement in the biochemical values mentioned support the result obtained on the electrolyte profiling in the fed birds since feeding the variously treated seed meal in diets elevated blood levels of ca, PO4, Na^+, cl^-($p<0.05$) while maintaining that of K^+ comparable with the control diet.

Conclusion

Treating the raw Moringaoleifera seed meal increased nutrient content especially by autoclaving and microwave blanching.

Performance of birds were improved in feed intake, weight gain, feed conversion following treatment of the raw seed meal by water-washing, boiling, autoclaving, micronization and combination of the methods. No mortality was observed in the fed animals following treatment by the various methods before feeding. Dietary treated MOSM was friendly to vital organs like the heart and liver considering result on relative organ weight. Similar innocuous effect of the processed MOSM in diets was recorded on some of the biochemical determinants including protein

fractions, detoxicant enzymes (ALP, ALT), blood electrolytes concentration. Values obtained on diets containing treated MOSM were even superior in some cases relative to the reference diet.

Recommendation

The various treatment methods used hold great potential for detoxification of Moringa seed anti-nutrients when included at high level. However, supplementation is needed when methods like soaking, boiling that reduce protein content are adopted.

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