NUTRITIVE AND PHYTOCHEMICAL EVALUATION OF SOME SEEDS AS SUPPLEMENT IN LIVESTOCK DIET

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Abstracts

The study was carried out to evaluate the proximate composition and phytochemical values of black cumin seed (*Nigella sativa*), mustard seed (*Brassica juncea)* and pawpaw seed (*Carica papaya*) as potential ingredient and phytogenic feed additive for livestock. The phytochemical analysis and proximate composition of mustard seed, pawpaw seed and black cumin seed meal of the dried seed were determined using standard methods. Proximate composition shows that Mustard seed meal had the highest crude protein (18.68g/100g), while pawpaw seed meal had the least crude protein with a value of (15.78g/100g). Pawpaw seed meal had the highest fibre fraction (11.86g/100g) while mustard seed meal had the least value (5.69g/100g), phytochemical composition showed that alkaloid and tannin were high in mustard seed (526.33mg/100g and 43.33mg/100g respectively) and pawpaw seed had high phenol, saponin and flavonoid (206.0033mg/100g, 310.6733mg/100g and 8.3333mg/100g respectively), while black cumin seed had the lowest value for alkaloid, tannin, phenol, saponin, and flavonoid (17.7933mg/100g, 2.3433mg/100g, 31.5733mg/100g, and 0.4133mg/100g) respectively. Thymoquinone concentration in black cumin seed is (25.29mmol/kg), benzyl isothiocyanate in pawpaw (35.65mmol/kg), Allylisothiocyanate in mustard (14.57mmol/kg). This study showed that the seed meal of the investigated plants can nutritionally serve as fed ingredient and can also be used as phytogenic feed additives for ruminant and non-ruminant.

KEYWORDS: Mustard, pawpaw, black cumin, nutritive value, phytochemical values

Introduction

In 2006 there was a ban on the use of antibiotic growth promoters in animal feed and a full ban in the US in 2017 (Cherif *et al.*, 2018). This ban, raise the awareness of the consumers to health hazard of antibiotics, the rising case of illness leading to mortality of bird and reduction in performance due to pathogens in farm altogether causing economic losses has led to search for alternative growth promoter. Also the increasing human population and the need to meet the protein requirements of this populace led to decade of improvement in livestock industry (Hodges 2009). There has been introduction of antibiotic feed additives which became widely used in animal feed for many decade to increase feed efficiency (Abd El-Hack *et al.*, 2016). This improvement brought about increase in production (eggs, meat) by combating gut pathogens that could have competed with beneficial intestinal microbes for nutrient. The antibiotics (mostly medically important) were used as growth promoter by continual addition to diet at sub-therapeutic levels, thereby improving productivity and diseases prevention. However, this relentless utilization has led to the increasing resistance of pathogens to antibiotics and perhaps, the accumulation of antibiotic residues in animal products has led to resistance of transmissible microbes (food pathogens) to antibiotics in human (WHO 2017). Several studies have shown that herbs would not only be of health benefits but would also improve gut health of the birds, growth pattern, increase performance, increase appetite, improve feed conversion rate (F.C.R) and feed efficiency (Islam *et al.*,2017). This is due to the present of minerals (selenium, zinc, manganese, phosphorous, magnesium, and iron), and the presence of alkaloid, tannin, phenol, saponin and flavonoid) vitamin E, all of contribute to human health and can induce physiological changes in the body. Many non-therapeutic substitutes such as prebiotics, probiotics, symbiotics, organic acids, essential oils and plant extract have been studied (AllouI *et al.*, 2013). However, due to ease of access or local availability, plants and their extracts might be a promising panacea to this challenge (Faniyi *et al.*, 2016). They are known to have health benefits (such as appetite and digestion stimulants (Janz *et al.*, 2007) anti-microbial action, anti-inflammatory action, anti-oxidative action, immune-stimulant function and appetite/digestion stimulants. (Bodas *et al.*, 2012) on animals when used as feed additives in animal nutrition (Faniyi *et al.*, 2016).Aside the nutritional contribution of plants to diet, they naturally, contain plant secondary metabolite (bioactive components), which are responsible for the other medicinal action of plants. Thus these plant can function as nutraceuticals; these refers to crops containing plant secondary metabolites, which are considered for their beneficial effect upon health and also their direct contribution to the nutrition of animals (Waller and Thamsborg, 2004). Black cumin seed (*Nigella sativa*), Mustard seed (*Brassica juncea)* and Pawpaw seed (*Carica papaya)* have been used by few authors and are reported to improve productivity. However, there are discrepancies in these reports.

Pawpaw fruit (*Carica papaya*); the seed of these fruit has no edible benefit that endear human to eat it as they are always expunged when the fruit is eaten. However, the seed is rich in antioxidant, it contains proteolytic enzymes which is good for breaking down undigested protein in the digestive tract and helps to expunge intestinal parasites such as intestinal worms. AllouI *et al*., 2013

Black Cumin Seed (*Nigella sativa*): is used as a natural remedy due to the presence of antimicrobial, antioxidant and other pharmacological properties and improves nutrient utilization and potentially suitable for the use in poultry diet as a feed ingredient and contains studies reported that BCS may increase polyunsaturated fatty acid content and antioxidant properties in meat (Abd El-Hack *et al*., 2016).

Mustard Seed (*Brassica juncea*): This is available in white, brown and black varieties they are slightly bitter in taste and are astringent. The selenium content in mustard seeds provides good resistance against diseases. It contains magnesium and omega -3(Al-Jasass and Al-Jasser 2012). There are certain nutrients in mustard that prevents occurrence of disease.

This study is conducted to evaluate the nutritional qualities, phytochemical and mineral constituents of plants seed for their potential as feed additives for animals.

Material and methods

Sample collection: Three plants seed; pawpaw (*Carica papaya*) gathered from different south western Nigerian states (Ogun, Oyo, Ekiti, Ondo and Osun states), brown mustard (*Brassica juncea*) was obtained from a local market and packaged by TRS wholesale Co Ltd, United Kingdom and black cumin(*Nigella sativa*) originated from Sudan was obtained from Kaduna State, Northern Nigeria.

Preparation and production of seed meal: The pawpaw seeds were removed from the pawpaw fruit and sundried for 14 days. The dried pawpaw seed, brown mustard and black cumin seed were all milled prior to analysis. They were milled and kept in cellophane bags till required for analysis.

Chemical analysis

Proximate Analysis: Proximate analysis was conducted using A.O.A.C 2005 method

Phytochemicals

Tannin Determination: *The spectrometric method of AOAC (2005) and* Joslyn (1970) *was used for tannin analysis.*

Alkaloids Determination: *Henry (1993) and Allen (1992) method was used to analyse for Alkaloids*

Flavonoids Determination: *The Spectrophotometric method of Allen (1979) was used for Flavonoid Analysis.*

Saponin Determination: *Spectrophotometric method of Brunner (1984) was used for Saponin Analysis.*

Phenol Determination: 0.20g of sample was weighed into a 50ml beaker, 20ml of acetone was added and homogenize properly for 1hr to prevent lumping. The mixture was filtered through a Whatman No.1 filter paper into a 100ml Volumetric Flask using acetone to rinse and made up to mark with distilled water with thorough mixing.1ml of sample extract was pipetted into 50ml Volumetric flask,20ml water added,3ml of phosphomolybdic acid added followed by the addition of 5ml of 23% Na_2CO_3 and mixed thoroughly, made up to mark with distilled water and allowed to stand for 10min to develop bluish-green colour.

Standard Phenol of concentration range 0-10mg/ml was prepared from 100mg/l stock Phenol solution from Sigma-Aldrich chemicals, U.S.A. The absorbance of sample, as well as, that of standard concentrations of

Phenol was read on a Digital Spectrophotometer at a wavelength of 510nm.The percentage Phenol is calculated using the formula:

$$\frac{Absorbance of sample \times gradient factor \times dilution factor}{Wt. of sample \times 10{,}000}$$

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using SPSS 22.0 software package. Significant treatment means were compared using the Duncan multiple range test of the same package.

RESULTS AND DISCUSSION

Chemical composition of Mustard *Brassica juncea* seed, pawpaw *Carica papaya* seed and black cumin *Nigella sativa* seed are shown in Table 1 Mustard seed, pawpaw seed and black cumin seed were significantly different (p <0.001) from one another for crude protein (CP), crude fibre (CF), ash, ether extract (EE), organic matter (OM), nitrogen free extract (NFE). The values obtained for OM was 92.11, 88.59, 91.97 (g/100g) for Mustard, pawpaw and black cumin seed respectively. The ether extract of mustard seed (13.88g/100) was higher than that reported by (Sarker *et al.*, 2015) for black mustard (8.70%) but slightly lower than the values reported for brown mustard in this study (15.67%). The NFE (49.61g/100g) was higher than reported by Adejumo and Agboola (2016) as 28.42 and 37.4 for yellow and brown mustard. Table 2 shows the result of phytochemical compositions of Mustard seed (*Brassica juncea),* Pawpaw seed (*Carica papaya),* and Black cumin seed (*Nigella sativa*). The value for Mustard, Pawpaw, and Black cumin seeds for alkaloid, tannin, phenol, saponin and flavonoid were significantly different (p<0.001) from one another. The values (mg/100g) of alkaloid; (526.33, 407.67 and 495.33 mg/100g), tannin; (43.33, 28.00, and 37.00mg/100g), phenol; (187.00, 206.00 and 176.33 mg/100g), saponin; (116.33, 310.67 and 126.67 mg/100g), and flavonoid; (7.10, 8.33 and 5.50 mg/100g) for mustard, pawpaw and black cumin respectively. Phytochemicals in this study was similar to that of neem fruit as reported by (Ekanem, 2016). Furthermore, the neem fruit was able to reduce rumen protozoa which exist in a hydrogen exchange relationship with methanogens.

Table 1: Chemical composition (g/100g) of mustard, pawpaw seed and black cumin seed

Parameters	Mustard	Pawpaw	Cumin	SEM	P-Value
Crude Protein	18.68^{a}	15.78^{c}	16.68^{b}	0.42	0.000
Ether extract	13.88^{a}	3.68^{b}	2.87^{c}	1.77	0.000
Crude Fibre	5.69^{c}	11.86^{a}	6.36^{b}	0.98	0.000
Ash Content	4.25^{c}	5.29^{a}	5.09^{b}	0.16	0.000
Organic Matter	92.11^{a}	88.59^{c}	91.97^{b}	0.58	0.000
Moisture	7.89^{c}	11.41^{a}	8.03^{b}	0.53	0.000
NFE	49.61^{c}	51.99^{b}	60.96^{a}	1.73	0.000

a,b,c: Means with different superscripts along the same row are significantly different (p < 0.05)

Table 2: Phytochemicals composition (mg/100g) of mustard, pawpaw seed and black cumin seed

Parameters	Mustard	Pawpaw	Cumin	SEM	P-Value
Alkaloid (mg/100g)	526.33^{a}	407.67^{c}	495.33^{b}	17.79	0.000
Tannin (mg/100g)	43.33^{a}	28.00^{c}	37.00^{b}	2.34	0.001
Phenol (mg/100g)	187.00^{b}	206.00^{a}	176.33^{c}	4.40	0.000
Saponin (mg/100g)	116.33^{c}	310.67^{a}	126.67^{b}	31.57	0.000
Flavonoid(mg/100g)	7.10^{b}	8.33^{a}	5.50^{c}	0.41	0.000

a,b,c: Means with different superscripts along the same row are significantly different (p < 0.05).

Conclusion

The nutritional value of these plants seeds could be used as feed supplement and could also provide health benefit to animals due to its bioactive constituent. The phytochemical concentration shows that these seed can also be used in microbial modulation in regulation of pathogenic microbes in and for rumen manipulation in livestock

References

A.O.A.C., (2005). Official methods of Analysis of A.O.A.C International, Gaithersburg, MD. USA.

Abd El-Hack, M.E., Alagawany, M., Farag, M.R., Tiwari, R., Karthik, K., Dhama, K., (2016). Mutritional healthical and therapeutic efficacy of black cumin (*Nigella sativa*) in animals, poultry and humans, *International Journal of Pharmacolology*, 12, 232-248

Adejumo A.L. and Agboola O.S., (2016). Proximate Composition and Mineral Profile of Yellow and Brown Mustard Seeds from Nigeria.*World Rural Observ*8:71-75.

Al-Jasass, F.M., Al-Jasser M.S., 2012. Chemical Composition and Fatty Acid Content of Some Spices and Herbs under Saudi Arabia Conditions, *The Scientific World Journal*, 2012, 1-5

Allen commercial Organic Analysis (1979), Analysis of Analytical Methods Committee of Royal Society of Chemistry. AMC-RSC. Vol. IX: 156-189. pp. 222-239.

Allen commercial organic Analysis (1992), Royal Society of Chemistry, London,Vol. VI pp 167 – 171

AllouI, M. N., Szczurek, W and Świątkiewicz, S (2013). The usefulness of prebiotics and probiotics in modern poultry nutrition: a review Ann. Anim. Sci., Vol. 13, No. 1 17–32, DOI: 10.2478/v10220 012-0055-x

Brunne, J.H (1984): Direct Spectrophotometer determination of Saponin. Anal.Chem. 34, pg 1314 1326.

Cherif, M., Ben Salem H., Abidi S., 2018. Effect of the addition of *Nigella sativa* seeds to low or high concentrate diets on intake, digestion, blood metabolites, growth and carcass traits of Barbarine lamb, *Small Ruminant Research*, 158, 1–8

Ekanem, D.E (2016) Serum biochemistry, digestibility and microbial protein synthesis of West African dwarf rams fed a total mixed ration with graded levels of water washed neem fruit. M.sc dissertation, Animal Science Department, University of Ibadan, Ibadan 1-59.

Faniyi,T.O, Prates E. R, Adewumi, M. K, Bankole T, (2016).Assessment of herbs and spices extracts/meal on rumen fermentation: Review *PUBVET* v.10, n.5, p.427-438.

Henry, T.A (1993) – a textbook titled The plant Alkaloids pg 6-466

Hodges, J., (2009) Boundaries of Animal Production In: Trends in Animal Nutrition where are the boundaries? Delacon dossier N^{0}3 1-36

Islam, M. F., Haque M. N., Parvin A., Islam M. N., Alam M. N. and Sikder M. H. (2017). Effect Of Dietary Supplementation Of Garlic On Feed Conversion Ratio, Carcass Physiognomies And Haematological Parameters In Broilers. Bangl. Journal. Vet. Med. 15 (1): 7-11 ISSN: 1729-789 (Print), 2308-0922 (Online)

Janz, J. A. M., Morel P. C. H., Wilkinson, B. H. P and Purchas. R. W. (2007). Preliminary investigation of the effects of low-level dietary inclusion of fragrant essential oils and oleoresins on pig performance and pork quality. Meat Sci. 75:350–355.

Maisarah, A.M., Asmah, R. and Fauziah, O. (2014). Proximate analysis, antioxidant and antiproliferative activities of different parts of *Carica papaya*, *Journal of Nutrition and Food Science*, 4, 1043 1048

Methods of Vitamins Assay (2006) (8THedn), Interscience Publishers.

Sokunbi, O.A (2007). Growth performance and carcass attributes of pubertal boar fed dietary neem (Azadirachtaindica A.jus) Kernel. Tropical animal production investigations 10: 11-16.

Waller, P.J and Thamsborg S.M. (2004) Nematode control in 'green' ruminant production systems TRENDS in Parasitology 20: 493-496

World Health Organisation WHO (2017). Guidelines on use of medically important antimicrobials in food-producing animals. Geneva:World Health Organization; Licence: CC BY-NC-SA 3.0 IGO.