



## Rumen Content as Animal Feed: A Review

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### Abstract

The objective of this review is to highlight the nutritive value of rumen contents and their potential to use in animal feeds. In most developing countries feeding is the major factor limiting the production of livestock; because it constitutes up to seventy percent of the total cost of production. In the last years, researchers look for non-conventional feed ingredients to reduce the feed cost and hence cost of production. One of such non-conventional ingredients is the rumen content, which is readily available in abattoirs and slaughter houses, it's a good source of energy, protein (feed and microbial protein), minerals and vitamins specially vitamin B complex. The nutritive value of rumen contents varies mainly because the rumen content from different types of ruminants varies dramatically in their composition. The nutritive value of rumen content can be improved by using several methods: adding blood meal, molasses, poultry droppings, urea, enzymes and fermented feed such as silage. Rumen content can be added to diets by different levels according to the types of animals. It can be used as a cheap source of energy and protein with reduced feed cost and environmental pollution. Therefore, some studies concluded that rumen contents could be incorporated in the diets of animals without negative effects on diet acceptability and without any adverse effects on performance.

**Keywords:** Rumen content, Nutritive value, Anti-nutritional factors and replacement values.

### المستخلص

الهدف من هذا الاستعراض هو تسليط الضوء على القيمة الغذائية من محتوى الكرش وإمكانية استخدامها في الأعلاف الحيوانية. في معظم البلدان النامية تعتبر التغذية العامل الرئيسي الذي يحد من إنتاج الثروة الحيوانية، لأن تكاليف التغذية تصل إلى سبعين في المئة من التكاليف الإجمالية للإنتاج. في السنوات الأخيرة، بدأ العلماء والباحثين في البحث عن مكونات علف غير تقليدية للحد من تكاليف اللف وبالنالي تكاليف الإنتاج واحد من هذه المكونات غير التقليدية هو محتوى الكرش، والذي يتوفّر بسهولة في المسالخ والمجازر، حيث أنه مصدر جيد للطاقة والبروتين (بروتين الميكروبي)، والمعادن والفيتامينات وخاصة فيتامين ب المركب. تختلف القيمة الغذائية لمحتويات الكرش كثيراً بسبب أن المحتويات من أنواع مختلفة من الحيوانات المجترة تختلف بشكل كبير في تكوينها. يمكن تحسين القيمة الغذائية للمحتوى الكرش باستخدام العديد من الطرق: إضافة مسحوق الدم، المولاس، فضلات الدواجن، البيريريا والانزيمات أو التخمير مثل السيلاج. كما يمكن إضافة محتوى الكرش إلى الوجبات الغذائية على مستويات مختلفة وفقاً لأنواع الحيوانات. ويمكن استخدامه كمصدر رخيص للطاقة والبروتين مع تقليل تكاليف اللف وتقليل التأثير البيئي. وخلصت بعض دراسات على أنه يمكن إدخال محتوى الكرش في النظام الغذائي للحيوانات دون آثار سلبية على النظام الغذائي والقبول العام بدون أي آثار سلبية على الأداء.

**كلمات مفتاحية:** محتوى الكرش، القيمة الغذائية، عوامل مضادات التغذية و قيم الإحلال..

### Introduction

Shortages of animal feed resources often impose major constraints on the development of animal production in the tropics and sub-

tropics countries. However, from the production and processing of animals and plants for food production for humans and feed for animals many by-products tend to accumulate and can be utilized as livestock

feeds (Ensminger *et al.*, 1990). Considerable quantities of crop residues, agro-industrial by-products and animal by-products are generated every year in most developing countries. These are potentially suitable for the feeding of livestock. However, because of the lack of technical know-how they are lost or underutilized (Aregheore and Chimwano, 1991).

Animal by-products are the parts of slaughtered animal that are not directly consumed by humans. Its products commonly used as feed ingredients that are derived from unused parts of other animals, for example meat meal, bone meal, feather meal, blood, hides, skins, slaughter house waste and hatchery waste. The vast majority of this material is rendered or processed to produce a ground meal, which is used in the formulation of animal feed to improve protein levels. One of these is from abattoir wastes comprising rumen content, a potential alternative protein source (Olukayode *et al.*, 2008).

Rumen content is substantial wastes generated daily at abattoirs (Adeniji, 1995 and Odunsi *et al.*, 2004). It is a material from the rumen of ruminants which is the first stomach compartment of the ruminants. It is account for about 80% of the capacity of the adult ruminant stomach (Church, 1993). It is plant material at various stages of digestion rich in microbial protein (Emmanuel, 1978 and McDonald *et al.*, 1990). The bulk digestion of the rumen contents is an important source of energy, protein and vitamins especially vitamin B complex (Devendra, 1981). The feedstuff is relatively cheap, it's a waste constituting disposal problem at the abattoir and it is locally available (Adeniji and Oyeleke, 2008).

### **Rumen contents**

Rumen content is feed digested in the rumen of ruminant animals and include the contents of the rumen feed non digestible, these nutritional value as feed. Rumen contents from ruminant animals that are being slaughtered. It's abundantly available as slaughter house by-product and mainly considered as a waste material creating environmental pollution (Abouheif *et al.*, 1999). When ruminant animals are slaughtered the contents of their

rumen can become a viable feed resource. It should be dried immediately. It can also be ensiled, but it needs to be mixed with a readily fermentable source of carbohydrates in order to be ensiled properly.

Rumen content is fairly rich in crude protein and other micro-flora such as fungi, protozoa and bacteria (Esonu *et al.*, 2006 and Dairo *et al.*, 2005), where they are dried and crushed remixing within the diets of animal and poultry. These are assembled waste from slaughter houses immediately after slaughter, and is equipped with the rumen desiccation the components for about 3-5 days and then grind and packaged. Rumen contents like other animal by-products should be adequately heated in order to assure that disease agents are not spread.

Rumen contents are a good source of microbial protein, minerals, vitamins and energy. However, the nutrient content of rumen contents varies mainly because the rumen contents from different types of ruminant will vary dramatically in their composition (Ghosh, 1993).

Sommer (1990) found that dried rumen contents have a feeding value equivalent to oats. Also, Kozel (1977) reported that dried rumen contents contained high level of nutrients and those were comparable to the contents of quality meadow hay.

Goodrich and Meiske (1969) used a forced air oven to dry rumen contents and found that beside its high economical costs, drying temperature had adversely affected the feeding value of the crude protein component. Sun drying is an excellent approach for tackling this problem (Abdelmawla, 1990 and Khattab *et al.*, 1996).

### **Nutritive value of rumen contents**

Ruminant species occupy an important niche in modern agriculture; because of their unique ability to digest certain feedstuffs, especially roughages, efficiently. It's feeding roughages and it's fermented in the rumen and after slaughter there will be many semi fermented feedstuffs and microbial protein in the rumen, which may have appreciable nutritive value.

Cattle rumen contents (CRC): Its mushy and brownish in colour (Kamalu *et al.*, 2010), the chemical composition of CRC contain good quality of crude protein, fortunately, and this protein exhibits an adequate profile of essential amino acids. Esonu *et al.* (2006); Agbabiaka *et al.* (2012) and Elfaki and Abdelatti (2015) reported that the samples of rumen contents taken from cattle had high level of crude protein (ranged between 18.52 – 19.56%). Cattle rumen contents were chosen as the best source of nutrients, because of their relatively high protein contents and their amino acids. Amino acids in CRC were lysine, leucine, alanine, aspartate, arginine, valine, threonine and low methionine (Jovanovic *et al.*, 1997; Gohl 1982). It contains high crude fiber. The minerals composition of CRC were estimated by a lot of researchers, it was showed high level of calcium, phosphorus and magnesium (Agbabiaka *et al.*, 2012 and Elfaki and Abdelatti 2015).

Camel rumen contents (LRC): it is twiggy and greenish in colour. Examination of the solid digesta for forage residues revealed the presence of leaves and twigs in the camel rumen contents (Kamalu *et al.*, 2010). It contains low crude protein because camels are browsers and eat from low quality plants the in desert. It contains low ether extract. The crude fiber content, NDF and ADF, was high in LRC (Abouheif *et al.*, 1999).

Sheep rumen contents (SRC): crude protein content of SRC is comparable to the commonly used fodder like alfalfa hay and Rhodes grass hay and appears to be far superior to the commonly used residues like wheat straw (Abouheif *et al.*, 1999). Elfaki and Abdelatti (2015) reported that SRC was high in dry matter, crude protein; metabolizable energy, crude fiber and dry matter digestibility, while it contained high level of calcium, phosphorus and magnesium.

Goat rumen contents (GRC): It contains low crude protein and crude fiber. Nitrogen-free extract (soluble carbohydrates) are high in GRC; because goats are browsers; where forbs and leaves have thinner cell walls with more digestible and rapidly fermentable compounds such as sugar (Agbabiaka *et al.*, 2012). GRC

contains high lignin and cellulose, also it is rich in calcium and phosphorus, but it is low in dry matter digestibility and digestible crude protein (Elfaki and Abdelatti 2015).

Roe deer rumen contents (RRC): the dry matter amount of RRC varies with the season, it contains high amount of crude protein and low crude fiber; because Roe deers are highly selective feeders. Calcium and phosphorus in RRC are good; the amount of phosphorus is higher than the calcium, which probably occurred due to feed selection and presence of cereal grain in the diet (Djordjevic *et al.*, 2006). Djordjevic *et al.* (2006) studied the influence of the season of the year on the nutritive value of RRC and reported that the chemical analysis confirmed significant influence of the season on the amount of total nitrogen and crude protein, ether extract, crude fiber, ash and ammonia nitrogen. Calcium and phosphorus were not significantly influenced by the season. These findings of previous studies indicated that the composition of rumen contents were quite variable between species and probably influenced by the pre-slaughtered feeding regimen and the length of the holding period between feeding and slaughter (Abouheif *et al.*, 1999).

### **Anti-nutritional factors in rumen contents**

These factors include Tannins, phytates, phytin phosphorus, oxalates, saponins, phenols, glycosides and alkaloids. These factors are common in many animal fodders and hence rumen contents.

Tannic acid: it is common in rumen contents and other feeds. Tannin contents of rumen content range from 1.12 to 1.60% (Agbabiaka *et al.*, 2012). It cause decrease in digestibility, protein efficiency ratio (PER) and over all nutritive value (Liener, 1980).

Phytic acid: it is an anti-nutritional factor common in rumen contents and other animal feeds. Phytic acid of rumen contents range is 4.53 - 6.39% (Agbabiaka *et al.*, 2012). Phytic acid is common in rumen contents and other animal feeds and is the principal storage form of phosphorus in many fodders. Phytic acid occurs as complex phytin with divalent cations

or monovalent cations in discrete regions of the fodders and accounts for up to 80% of the total phosphorus content (Reddy *et al.*, 1982).

Rumen contents include other anti-nutritional factors as phytin phosphorus (1.28 - 1.80 mg/g), oxalate (0.41 - 0.77mg/g), saponin (0.19 - 0.22%) and alkaloids (0.11 - 0.14%) (Agbabiaka *et al.*, 2012).

### **Variation in composition of rumen contents**

The rumen contents from different ruminants are varying dramatically in their composition (Ghosh, 1993). It varies greatly according to the type of feed of slaughtered animals, and this is even more pronounced among feeding on alfalfa winter and summer on concentrated feeds.

Rumen contents from goats tended to have the highest dry matter and ash content. Rumen content of cattle contains higher protein ratio and crude fiber ratio more than other ruminants (Agbabiaka *et al.*, 2012).

The relative variation in crude protein content of cattle and others may be due to the effect of age, season and diversity of vegetation. The amount of lignin and cell wall thickness in plants determine to some extent the nutritional value. This also explains the distinct variation in crude fiber which is attributed to the morphology and chemistry of plants (Van Soest, 1996).

The anti-nutritional factor phytate, phytin phosphorus and oxalate values were higher in sheep and goat than cattle. Nevertheless, dried rumen contents from cattle were found to contain the highest concentration of phenol than goat and sheep (Agbabiaka *et al.*, 2012).

Sommer (1990) studied the influence of the season of the year and the type of feed on the nutritive value of rumen contents and reported that except for crude protein, there were no significant seasonal differences in other nutrients. Crude protein was found to be low in

the summer and high in the winter. Jovanovic and Cuperlovic (1977), Reddy and Reddy (1980) and Khattab *et al.*, (1996) also reported similar results.

### **Improvement of rumen content nutritional value**

The identification of non-conventional feed sources is driven by the desire to reduce feeding cost and to ensure profitability and sustainability of livestock production systems. Some non-conventional feed sources like rumen content are available but it needs to improve its nutritive value to include in livestock feeds. The nutritive value of rumen contents can be improved by using several methods; adding blood meal, molasses, poultry droppings, urea, enzymes and fermented feed such as silage.

Blood meal contains about 80% crude protein and it is very rich in lysine (Adeniji, 2013) and the nutritional value of blood meal increases when fed in combination with other protein sources (Dafwang *et al.*, 1986). Therefore a combination of rumen content and blood meal assures a potential alternative protein source. Some workers (Adeniji and Balogan 2001 and Mohammed *et al.*, 2011) recommended blood meal-rumen content mixtures as replacement for some of the conventional feeds in livestock diets. According to Adeniji and Balogun (2001, 2002), Mann (1984) and Dairo (2005); the composition and potentials of rumen content and blood meal rumen content mixture qualifies them as good sources of protein for monogastric animals. Also bovine blood meal/rumen content can replace soybean meal up to 60% level without any deleterious effects on carcass yield and organs weight of the finishing broilers (Onu *et al.*, 2011).

The ensiling rumen content with molasses is one of the simplest methods to improve its nutritional value for use in animal feed. Ferdowsi *et al.* (2012) ensiled rumen contents

with molasses and wheat straw to increase the dry matter and carbohydrate sources. The result showed that there was a significant increase in dry matter and crude protein and when increased the molasses level, the pH and ammonia nitrogen were decreased.

Animal waste such as poultry litter and poultry droppings have been found valuable and efficiently used for production functions of small ruminants (Maigandi and Owanikin, 2002). Poultry droppings, urea activates sludge and urea has been used as replacements or supplements for groundnut cake in sheep, goats and cattle diets (Murthy *et al.*, 1995; Uza *et al.*, 2002 and Bayemi *et al.*, 2004). Fajemisin *et al.* (2010) used rumen digesta- poultry droppings mixed meal to fed sheep. Results showed improvements in intake, digestion of dry matter, crude protein and crude fiber, at inclusion 25% which was acceptable and tolerable to the animals without any sign of ill health.

Elfaki *et al.* (2015) used enzymes with dried rumen contents in broiler diets, which resulted in a significant improvement of growth rate. The addition of barley grain as an organic carrier to the rumen contents resulted in lower ether extract, NDF, ADF and ash contents than in rumen contents alone (Abouheif *et al.*, 1999).

### **Rumen contents in animal feeding**

Various studies have been reported on the substitution of more expensive protein concentrates particularly animal by-product meals and rumen content which usually constitute a major source of dietary protein with less expensive and noncompetitive feedstuffs in livestock production (Akiyama, 1991; Fanimo *et al.*, 1988 and Agbabiaka, 2010).

Rumen contents could provide a valuable source of nutrients when included in diets for various classes of livestock. Previous studies

have generally indicated that dry rumen contents contained substantial amounts of crude protein and utilizable energy for ruminants (Messersmith *et al.*, 1974; Prokop *et al.*, 1974; Reddy and Reddy, 1980 and Ghosh and Dey, 1993).

**Rumen content in ruminants feeding:** Rios-Rincon *et al.* (2010) reported that dried ruminal contents may be substituted for forage in growing-finishing diets (30% forage level) for feedlot steers without negative effects on diet acceptability. Khan *et al.* (2014) concluded that rumen contents could replace 50% of conventional total mixed ration without any adverse effects on health of buffalo calves.

The dry matter intake, final carcass weight and carcass dressing percentage where not decreased when lambs are fed up to 50% dietary dried rumen contents, with reduction in feeding cost for each kg of body weight gain (Abouheif *et al.* 1999).

**Rumen content in poultry feeding:** Performance of broiler was not found to be depressed when 10-15 % dried rumen contents were fed (Roa, 1990). Dried rumen contents replaced 25, 50, 75 and 100% of the wheat bran in broiler diets and no depression in performance was observed (Sadhukhan, 1993). Okorie (2005) documented dried pulverized rumen content could be included in broiler finisher diets at 2.5% to 7.5% levels. However, broiler feed diets containing dried rumen content recorded higher body weight gain and reduced cost of production (Esonu *et al.*, 2006). Dietary sundried rumen content with blood meal up to 10% was beneficial for growth performance and that total replacement of fish meal was possible in broiler diets (Makinde *et al.*, 2008). Colette *et al.* (2013) concluded that dried rumen content when used in the feed, had no influence on the broiler physiology or hormonal functioning. Elfaki *et al.* (2015) also reported that inclusion of dried rumen content in broiler diets had no adverse effect on performance and

biochemical values of plasma in broiler chicks and it can be used up to 10% as cheap source with reduced feed cost and environmental pollution.

Including dried rumen contents up to 9% in the diets of layers had no effect on yolk color (Riswantiyah, 1988). Increased digestible dry matter, digestible crude protein, digestible crude fiber and egg yield was observed when layers were fed dried rumen contents (Singh, 1988). Adeniji and Balogun (2003) reported performance pullets at the growing phase to be not influenced by the inclusion of blood rumen content meal, the growth rate of lay tended to increase with the increasing level of blood rumen content meal in the diet and egg weights were not influenced. Pullet chicks can tolerate up to 15% enzyme-supplemented rumen content in their diets (Adeniji and Jimoh, 2007). Adeniji and Oyeleke, 2008 also reported profitability of pullet chicks to increase as the level of rumen content was increased in diets.

Rumen content in quail feeding: Mishra *et al.* (2015) reported that up to 30% dried blood rumen content could be incorporated in the diets of Japanese quails without any adverse effects on its performance. Performance of quail fed dried rumen contents showed significant improvement in body weight and growth rate and the feed intake increased significantly by increasing the proportion of rumen contents in diets (AbdEl-Galil and Khidir, 2001).

Rumen content in rabbits feeding: When dried rumen contents replaced 25% of the hay in a rabbit diet, growth was increased (AbdEl-Rahman, 1989). Rumen contents were not found to ensile well, so additional fermentable carbohydrates need to be added (McCaskey, 1996). Ojebiyi and Saliu (2014) documented that rumen content/ blood meal (50:50) mixture can be included in the diet of growing rabbits to replace 10% groundnut cake and palm kernel cake without compromising growth performance. Inclusion of blood-rumen content

mixture up to 40% level in the diets had not adversely affect performance, digestibility, blood parameters and carcass measurement of growing rabbits (Mohammed *et al.*, 2011; 2013 and 2014).

Rumen content in fish feeding: Agbabiaka *et al.*, 2011 reported that dried rumen content at 40% could replace soybean in the diet of *Oreochromis niloticus* fingerlings to increase performance, body weight gain and feed intake. Conclusion

In conclusion, this review had shown that the rumen contents had high nutritional value. Animals consumed different types of forage as found in their rumen. The types of forage eaten in turn influenced rumen content characteristics. Rumen contents are a cheap source of energy, protein and other nutrients; it can be included in animal feeds.

## References

- Abd El-Galil, K. and Khidir, R.E. (2001). Effect of dried rumen content in diets on the performance of growing Japanese quails. *J. of Agric. Sci. Mansoura Univ.*, 26 (1): 179-186.
- Abdelmawla, S.M. (1990). A Study on the performance Weaned male buffalo calves sed ration containing poultry waste. Ph. D Thesis, Ain Shams Univ., Egypt.
- Abouheif, M.A.; Kradiees, M.S. and Al-selblood, B.A. (1999). The utilization of rumen content-brely meal in diets of growing lambs. *Asian- Australasian J. Anim. Sci.*, 12: 1234-1240.
- Adeniji, A.A. (1995). The Value of bovine blood-rumen content meal as pullets. Ph. D Thesis, University of Ilorin, Nigeria.
- Adeniji, A.A. (2013). Effect of replacing blood vegetable waste meal for soybean meal in broiler finisher diet. *Sch. J. Agric. Sci.*, 3(1): 21-24.
- Adeniji, A.A. and Balogun, O.O. (2001). Evaluation of blood rumen content mixture in

- the diets of starter chicks. *Nig. J. Anim. Prod.*, 28(2): 153-157.
- Adeniji, A.A. and Balogun, O.O. (2002). Utilization of flavour treated blood rumen content mixture in the diets of laying hens. *Nig. J. Anim. Prod.*, 29(1): 34-39.
- Adeniji, A.A. and Balogun, O.O. (2003). Influence of bovine blood-rumen content meal in the diets of growing pullets on their subsequent laying performance. *Ghana J. Agric. Sci.*, 36: 47-51.
- Adeniji, A.A. and Jimoh A. (2007). Effect of replacing maize with enzyme supplemented bovine rumen content in the diets of pullet chicks. *International Journal of Poultry Science*, 6(11): 814-817.
- Adeniji, A.A. and Oyelcke, M.M. (2008). Effects of dietary girt fed on the utilization of rumen content by pullet chicks. *Journal of Applied Sciences Research*, 4 (10): 1257-1260.
- Agbabiaka, L.A. (2010). Evaluation of some underutilized protein feedstuffs in diets of (*Clarias gariepinus*) fingerlings. *Int. J. Trop. Agric. Food Syst.*, 4: 10-12.
- Agbabiaka, L.A., Anukam, K.U and Nwachukwu, U.N. (2011). Nutritive value of dried rumen digesta as replacement for soybean in diets of Nile Tilapia (*Oreochromis niloticus*) fingerlings. *Pak. J. Nutr.*, 10: 568-571.
- Agbabiaka, L.A.; Madubuike, F.N. and Amadi, S.A. (2012). Studies on nutrients and anti-nutrients of rumen digesta from three most domesticated ruminants in Nigeria. *Pakistan Journal of Nutrition*, 11 (7): 580- 582.
- Akiyama, D.M. (1991). The use of soyabean product and other plant protein supplements in aquaculture feeds. In: Processing of Aquaculture Feed Processing and Nutrition workshop, D.M. Akiyama and R.K.H. Tan (Eds). American Soybean Association, Singapore, pp: 199-206.
- Aregheore, E.M. and Chimwano, A.M. (1991). Agro-industrial by-products and crop residues in Zambia: availability, utilization and potential value in ruminants nutrition. In: Stares, J.E.S., Said, A.N.; Kategile, J.A. (Eds.), The Complementarity of Feed Resources for Animal Production in Africa. Proceedings of the Joint Feed Resources Networks Workshop, Garborone (Botswana) African Feed Resources Network, International Livestock Centre for Africa (ILCA), Addis Ababa (Ethiopia), pp. 223-238.
- Bayemi, P.H.; Tiabou, E.B.; Ngoemdjom, A.; Kanga, P.; Mbanya, J.; Ndi, C.; Nfi, A. and Mangeli, O. (2004). Effect of replacing cottonseed cake with poultry droppings on weight gain of growing cattle at Bambui, Cameroon. *Tropical Animal Health and Production*, 33(1): 49-56.
- Church, D.C. (1993). *Digestive Physiology and Nutrition of Ruminants*. vol 1., Published by D.C. church, pp: 143-189.
- Colette, N.T.N., Fotsa, J.C., Etchu, K.A. and Ndamukong, K.J.N. (2013). Effects of dried rumen content and castor oil seed cake diets on haematological indices, serum biochemistry and organoleptic properties of broiler birds. *J. Agric. Sci*, 2 (9): 120-125.
- Dafwang, I.I.; Olomu, J.M.; Offiong, S.A. and Bello, S.A. (1986). The effect of replacing fishmeal with blood meal in the diets of laying chickens. *J. Anim. Prod. Res.*, 6: 81-92.
- Dairo, F.A.S.; Aina, O.O. and Asafa, A.R. (2005). Performance evaluation of growing rabbits feed varying levels of rumen content and blood rumen content mixture. *Nig. J. Anim. Prod.*, 32: 67-72.
- Devendra, C. (1981). *FAO Study Production Year Book*. FAO, Rome, Italy.
- Djordjevic, N.; Popovic, Z. and Grubic, G. (2006). Chemical composition of the rumen contents in roe deer (*Capreolus capreolus*) as potential quality indicator of their feeding. *Journal of Agricultural Science*, 51(2): 133-140.
- Elfaki, M.O.A. and Abdelatti, K.A. (2015). Nutritive evaluation of rumen content from cattle, camel, sheep and goat. *Global Journal of Animal Scientific Research*, 3(3): 617-621.
- Elfaki, M.O.A.; Abdelatti, K.A. and Malik, H.E.E. (2015). Effect of dietary dried rumen

- content on broiler performance, plasma constituents and carcass characteristics. *Global Journal of Animal Scientific Research*, 3(1): 264-270.
- Emmanuel, B. (1978). Effects of rumen contents of fraction thereof on performance of broilers. *Br. Poult. Sci.*, 19: 13-16.
- Ensminger, M.E.; Oldfield, J.E. and Heinemann, W.W. (1990). *Feeds and Nutrition*. The Ensminger Publishing Company, USA, pp. 593-666.
- Esonu, B.O.; Ogbonna, U.D.; Anyanwu, G.A.; Emelanom, O.O.; Uchegbu, M.C.; Etuk, E.B. and Udedibe, A.B.I. (2006). Evaluation of performance, organ characteristics and economic analysis of broiler finisher fed dried rumen digesta. *Int. Poult. Sci.*, 5: 1116-1118.
- Fajemisin, A.N.; Fadiyimu, A.A. and Alokan, J.A. (2010). Dry matter, fiber consumption and body weight gain of west African dwarf sheep fed sundried or fermented rumen digesta-poultry droppings mixed diets. *App. Trop. Agric.*, 15(1): 84-89.
- Fanimo, A.O.; Mudama, E.; Umukoro, T.O. and Oduguwa, O.O. (1988). Substitution of shrimp waste meal for fishmeal in broiler chicken rations. *Trop. Agric. (Trinidad)*, 73: 201-205.
- Ferdowsi, H.; Rezakhani, A. and Afshar, S. (2012). Survey on the ensiling of the rumen contents and wheat straw with molasses. *International Research Journal of Applied and Basic Science*, 3(12): 2534-2539.
- Ghosh, T.K. and Dey, A. (1993). Availability of rumen contents and their utilization in diets for goats. *Indian J. Anim. Sci.*, 63:1194-1196.
- Göhl, B. (1982). *Les aliments du bétail sous les tropiques*. FAO, Division de Production et Santé Animale, Roma, Italy.
- Goodrich, R.D. and Meiske, J.C. (1969). The value of dried rumen contents as a ration ingredient for finishing steers. *The Univ. Minnesota Beef Cattle Feeders Day Res. Rep.*, B-24: 31-36.
- Jovanovic, M. and Cuperlovic, M. (1977). Nutritive value of rumen contents for monogastric animals. *Anim. Feed Sci. Technology*, 2(4): 351-360.
- Kamalu, T.N.; Okpe, G.C. and Williams, A. (2010). Rumen content characteristics and herbage digestibility of cattle and camel grazing native pasture in a Sahel savanna ecosystem. *Animal Research International*, 7(2): 1194-1198.
- Khan, M.W.; Pasha, T.N.; Koga, A.; Anwar, S.; Abdullah, M. and Iqbal, Z. (2014). Evaluation and utilization of rumen content for fattening of Nili-Ravi male calves. *The Journal of Animal and Plant Sciences*, 24 (Suppl.1): 40-43.
- Khattab, H.M.; Abdelmawla, S.M. and Singer, A.M. (1996). Nutritional evaluation of rumen contents as a slaughterhouse waste in sheep rations. *Egyptian J. Anim. Prod.*, 33: 173-186. (Suppl.)
- Kozel, V. (1977). New forms of feeding and nutrition of farm animals in relation to mechanization. (Cited by Sommer, 1990).
- Liener, I.E. (1980). In: *Toxic Constituents in Plant Food Stuffs*, 2ed. I.E. Liener, Edit., Academic Press, New York.
- Maigandi, S.A. and Owanikin, O.T. (2002). Effect of drying methods on the mineral composition of fore-stomach digesta. *Proc., 7th Ann. Conf., Anim. Sci. Ass. of Nig. (ASAN)*, Nigeria.
- Mann, M. (1984). The autonomous power of the state: its origins mechanisms and results. *In Eur. J. Soc.*, 25(02): P. 185.
- McDonald, P.; Edward, R.A. and Greenhalgh, J.F.D. (1990). *Animal Nutrition*, 4th Edition, Longman Sci.Tech, UK, p 375-397.
- Messersmith, T.L.; Fulton, W.R. and Klopfenstein, T.J. (1974). Dried paunch feed as a roughage source in beef finishing ration. *J. Anim. Sci.*, 39: 246-249.
- Mishra, J.; Abraham, R.J.J.; Rao, V.A.; Rajini, R.A.; Mishra, B.P. and Sarangi, N.R. (2015). Chemical composition of solar dried blood and the ruminal content and its effect on performance of Japanese quails. *Veterinary World*, 8(1): 82-87.

Mohammed, G.; Igwebuike, J.U. and Alade, N.K. (2011). Performance of growing rabbits fed graded levels of bovine blood-rumen content mixture. *Agriculture and Biology Journal of North America*, 2(4): 720-723.

Mohammed, G.; Adamu, S.B.; Igwebuike, J.U.; Alade, N.K. and Asheikh, L.G. (2013). Effect of feeding graded levels of camel blood-rumen content mixture on nutrient digestibility and carcass measurement of growing rabbits. *African Journal of Agricultural Research*, 8(48): 6318-6322.

Mohammed, G.; Igwebuike, J.U.; Adamu, S.B.; Alade, N.K. and Asheikh, L.G. (2014). Effect of feeding different blood-rumen content mixtures on blood parameters and carcass measurements of growing rabbits. *International Journal of Science and Nature*, 5(1): 61-66.

Murthy, K.S.; Reddy, M.R. and Reddy, G.V.N. (1995). Utilization of cage layer droppings and poultry litter feed supplements for lambs and kids. *Small Ruminant Research*, 16(3): 221-225.

Odunsi, A.A.; Akingbade, A.A. and Farinu, G.O. (2004). Effect of bovine blood-rumen digesta mixture on growth performance, nutrient retention and carcass characteristics of broiler chickens. *Journal of Animal and Veterinary Advances*, 3 (10): 663-667.

Ojebiy, O.O. and Saliu, A.S. (2014). Effects of feeding bovine rumen content- blood meal (50:50) mixtures on performance and slaughter characteristics of growing rabbits. *The Journal of Animal and Plant Sciences*, 24(2): 430-434.

Okorie, K.C. (2005). The effects of dried pulverized rumen content on the performance carcass and organ characteristics of finisher broiler. *Anim. Prod. Res. Adv. (Abstract)*.

Olukayode, M.; Babafunso, S. and Segum, A. (2008). Conversion of abattoir wastes into livestock feed: Chemical composition of sun dried rumen content blood meal and its effect on performance of broiler chickens. *Tropenage Conference*, Hohenheim, Germany.

Onu, P.N.; Otuma, M.O.; Odukwe, C.A. and Aniebo, A.O. (2011). Effects of different levels of bovine blood rumen content mixture on productive performance, carcass characteristics and economics of production of finisher broilers. *Int. J. Food Agric. Vet. Sci.*, 1(1): 10-16.

Prokop, M.J.; Klopfenstein, T.J. and Messersmith, T. (1974). Blood and paunch meal in ruminant rations. *J. Anim. Sci.*, 39: 250-252.

Reddy, M.R. and Reddy, V.S. (1980). A short note on the proximate composition of rumen digesta from bovine and ovine species and its utilization as a component of livestock feed. *Indian Vet. J.*, 57:429-431.

Reddy, N.P.; Salthe, S.K. and Salunkhe, D.K. (1982). Phytates in legumes and cereals. *Adv. Food Res.*, 28: 1- 92.

Rios Rincon, F.G.; Bermudez-Hurtado, R.M.; Estrada-Angulo, A.; Juarez-Reyes, A.S. and Pujol-Manriquez, C. (2010). Dried ruminal contents as a substitute for Alfalfa hay in growing-finishing diets for feedlot cattle. *Journal of Animal and Veterinary Advances*, 9(10): 1526-1530.

Sommer, A. (1990). Nonconventional feeds in cattle nutrition. In: *Nonconventional Feedstuffs in the Nutrition of Farm Animals*. K. Boda, Edit., Elsevier Science Publishers, Amsterdam, pp. 186-204.

Uza, D.V.; Agada, D.A. and Ayoade, J.A. (2002). The effect of supplementing Bunaji weaner cattle feed with dried poultry manure based concentrate diets. *Tropical Journal of Animal Science*, 5(2): 95-101.

Van Soest, P.J. (1996). Allometry and ecology of feeding behavior and digestive capacity in herbivores: A review. *Zoo Biol.*, 15: 455-479.