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Extent of rumen contents use in livestock diets among farmers in Uganda

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This study was conducted with the aim of finding how rumen contents are used in livestock diets, problems encountered and areas that needs improvement to enhance livestock production. One hundred livestock farmers from Kampala, Wakiso and Mukono districts were interviewed using a structured questionnaire. The results showed that majority of the work force involved in livestock farming were middle aged adults between 30 and 45 years contributing 37% of total work force; this was followed by young adults between 20 and 30 years contributing 26% of the work force. The highest household (HH) size was (1-5) people contributing 68% of the total HH structure. Poultry farming, indigenous birds in particular were the most practiced enterprise among the respondents. High feed input prices (67%) were reported as the biggest problem faced by livestock farmers, followed by feed adulteration (44%). The use of peels and industrial by-products was reported as the most commonly used alternative feeding strategies to increasing feed prices. The use of rumen contents was still low and limited to pigs and layers. Inadequate knowledge in relation to rumen content inclusion rates in livestock diets was reported as the major hindrance to utilization of rumen contents in livestock. In general, farmers need sensitization from extension staff and research scientists with regard to efficient use of rumen contents in livestock diets.

Key words: Feed scarcity, inclusion levels, rumen content processing.

INTRODUCTION

Rumen content is partially digested feed found in the fore stomach of ruminants. They are fairly rich in crude protein as they contain microbial protein from bacteria, fungi, and protozoa (Agbabiaka et al., 2012). Rumen contents are also important source of energy, minerals and vitamins, especially vitamin B complex (Ravindra et al., 2017; Sakaba et al., 2017). These attributes make rumen contents a potential candidate feed ingredient for livestock (Cherdthong, 2019) and could also be vital in reducing the competition between man and animal for food. Despite these attributes that make rumen content a potential livestock feed ingredient, it is still largely underutilized which complicates its efficient disposal and therefore making it a potential environmental pollutant.

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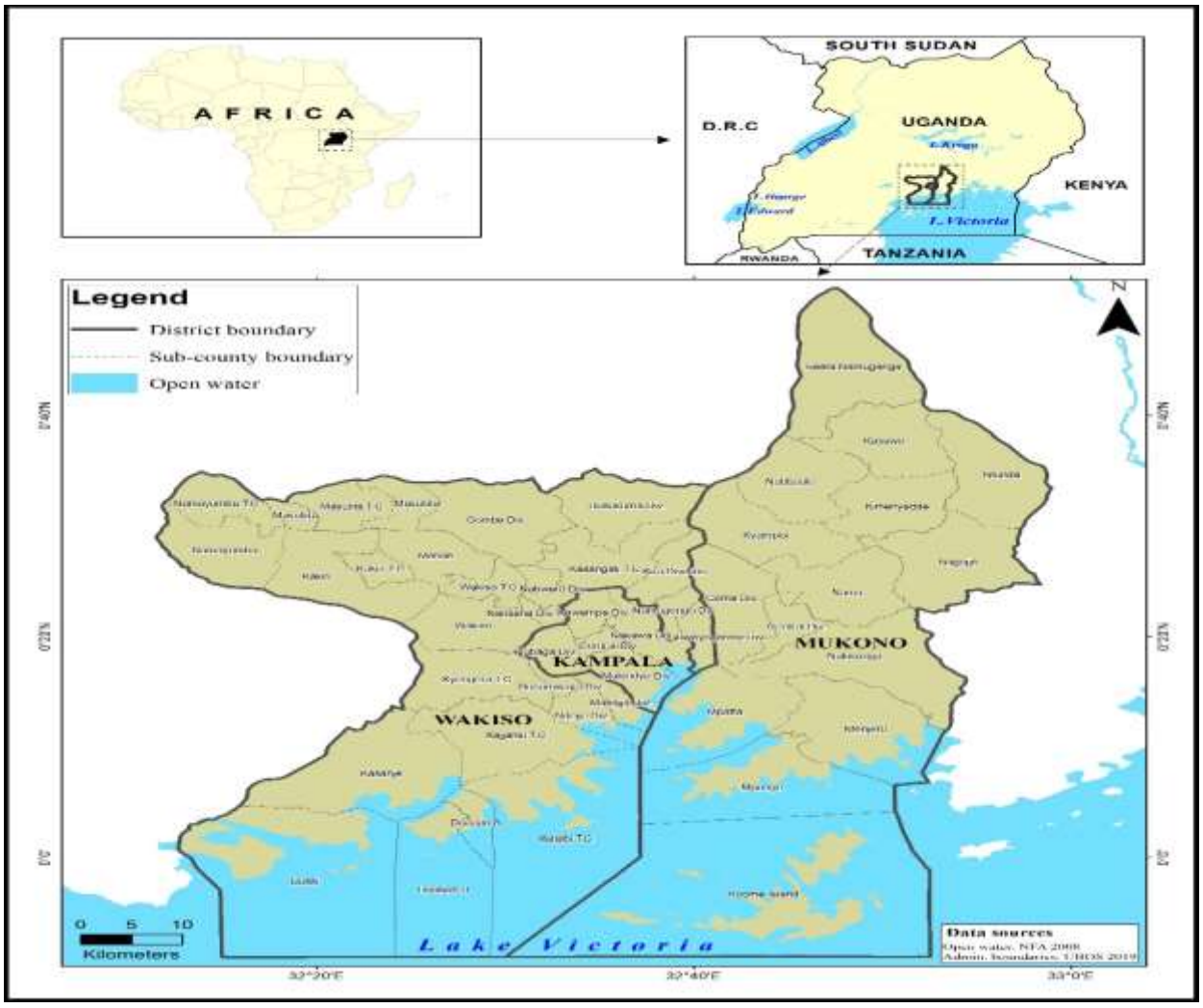

Figure 1. Map showing the location of study area, source of the map.
Source: UBOS (2016).

Enormous volumes of rumen content wastes are being generated on daily basis from slaughterhouse operations in the urban settings which creates disposal challenges (Uddin et al., 2018). Improper disposal of rumen contents can lead to environmental pollution which negatively impacts on people's wellbeing. Feeding livestock with slaughterhouse wastes would not only result in reducing feed costs but also immensely contribute to the safe disposal of wastes through recycling (Dairo et al., 2005; Esonu et al., 2006). It has also been reported that when incorporated in livestock diets, rumen content has no adverse effects on animals as long as critical care is taken for balanced feed formulation that meets the animal's nutrition requirements. In this study, the extent of rumen content usage in livestock diets among the farming communities in Uganda and the associated constraints in order to boost livestock production was investigated.

METHODOLOGY

Description of the study areas

The study was conducted in three Districts (Wakiso, Mukono and Kampala) in central Uganda. Kampala city is located 45 km north of the Equator at 0°19'6"N and 32°34'60"E (Figure 1). Wakiso district is located at approximately 20 km northwest of Kampala, at 00°24'N, 32°29'E coordinates, while Mukono district is located 27 km from Kampala at 00°20′N, 32°45′E. The districts were chosen for the study because of their close proximity to the city center and being one of the fastest growing peri-urban areas in Uganda.

Data collection

Interviews were conducted targeting people who knew more about the area (key informants). These included veterinary doctors, health inspectors, abattoir chair persons and elders. The sample size was determined according to formula by Yamane (1967).

$n = N/(1 + N * (e)2$

Where, n is the sample size, N is the population size, and e is the acceptable standard error; e=0.05.

The sample size was calculated based on 95% confidence level. Considering a population of about 130 livestock farmers who utilize rumen contents in livestock diets around the central districts in Uganda, a total of 100 participants were interviewed, 30 from Kampala, 33 from Mukono and 37 from Wakiso.

Both qualitative and quantitative data were collected using a structured questionnaire with both open and closed end questions. Qualitative data included, sex, marital, education status, feeding and feed resource utilization, potential constraints, use of animal wastes in livestock feeds and other alternative feeding strategies. On the other hand, quantitative data were family size, flock size and proportion of rumen content use in the livestock diets. Focus group discussions were also carried out with key informants in order to get deep understanding of people's feeling about the subject matter.

Data analysis

The filled questionnaires were coded and entered into the SPSS version 22 computer software (IBM SPSS statistics). The data was then subjected to descriptive statistics, cross tabulations and Pearson's Chi square of association.

RESULTS

Demographic characteristics of the respondents

The results of demographic characteristics of the respondents are shown in Table 1. The result shows that majority of the work force involved in livestock farming are middle-aged adults between 30 and 45 years contributing 37% of total work force, followed by young adults between 20-30 years contributing 26% of the labor force. The young (10-20 years) and old people (60-90 years) contributed the least to the labor force at livestock farm with 2 and 6% respectively.

In relation to family position, the highest percentage of the work force in livestock farming operations (51%) is contributed by the fathers while mothers contributed 46%.

Household (HH) size was grouped in three categories: small (1-5), medium (5-10) and large (>10) people. The highest percentage of HH size was (1-5) people accounting for 68%, followed by (5-10) people category contributing 23%, while the least was the >10 category with least 8%.

In relation to education level, the highest percentage of the respondents had attained at least secondary education (48%), followed by people who attained primary education, and then university education and advanced level of education. People who did not go to school contributed the lowest percentage.

Animal types kept by the farmers

The kind of livestock kept by the respondents is shown in Table 2. The highest number of respondents had indigenous chicken, followed by dairy cattle and small ruminants (sheep and goat). The number of respondents with pigs and layers was similar.

Challenges faced by farmers

The challenges faced by the farmers that hinder their smooth operations are shown in Table 3. High prices of inputs was reported as the biggest problem farmers experienced followed by adulteration of feeds, feed scarcity and limited land.

Alternative feeding strategies used by farmers

In order to cope with the feed related problems, farmers employ various strategies as shown in Table 4. Use of peelings was the most widely employed strategy by the farmers with 44%, followed by use of industrial by-products 34%, others 28%, use of kitchen swill 23%, and use of forages and concentrates were the least used at 21%.

Use of rumen content in livestock diets

Rumen contents were used in pig rations (23%), followed by layers (13%) at $P<0.05$. Use of rumen contents in indigenous chickens was not a common practice among respondents. However, no respondent reported use of rumen contents in broiler rations (Table 5).

Degree of rumen contents use in the study area

Level of use of rumen contents among farmers in the study area differed significantly ($p<0.001$), with Kampala district having the highest number of farmers (18) using rumen contents in livestock diets, followed by Wakiso (16) and Mukono (4) (Table 6).

Proportion of rumen content use in different livestock

The different levels of rumen content use in livestock diets as revealed by the respondents is shown in Table 7. Overall rumen contents were mostly used in pigs and layer diets. In layers diets, most of the respondents (85.8%) incorporated rumen contents at 20% inclusion level. In pig diets, a big percentage of the respondents (77.4%) could not quantify the amount of rumen contents they used in pig rations.

Benefits realized by the farmers with use of rumen content in livestock diets

Farmers who used rumen contents in pig and layer diets revealed several benefits as shown in Table 8.

Table 1. Distribution of respondent's demographic characteristics**.**

Demographic characteristic	Livestock farmers (n=100)	
	Frequency	%
Age (years)		
10-20	2	2.0
20-30	26	26.0
30-45	37	37.0
45-60	25	25.0
60-90	6	6.0
Position in family		
Head	51	51.0
Mother	46	46.0
Son	2	2.0
Daughter	1	1
Marital status		
Single	5	5.0
Married	89	89.0
Divorced	1	1.0
Widowed	3	3.0
House hold size		
1-5	68	68.0
5-10	23	23.0
>10	8	8.0
Education level		
None	5	5.0
Primary	24	24.0
Secondary	48	48.0
Advanced level	10	10.0
University	10	10.0

Table 2. Animals kept among livestock farmers.

Animal type	N	Minimum	Maximum	Mean	SEM
Dairy	43	1	20	3.28	0.48
Sheep and goats	36	1	10	4.25	0.41
Layers	33	300	10000	1780.30	496.88
Broilers	25	100	5000	724.00	190.18
Pigs	33	1	100	9.70	2.98
Indigenous chicken	46	1	100	17.46	2.64

SEM; Standard error of the mean.

Problems encountered with use of rumen contents

Appropriate rumen content inclusion rates, drying, rumen content offensive smell and rumen content contaminants in order of importance were the challenges encountered by the farmers with use of rumen contents in livestock diets.

Advice farmers needed for efficient utilization of rumen contents in livestock diets

Farmers stated several areas where they needed advice in relation to efficient use of rumen content for improved livestock production. Overall, most farmers needed advice in pig ration formulation, followed by advice in

Table 3. Challenges faced by the farmers**.**

Parameter	Frequency	%*
Limited land	10	10.0
Scarcity of feeds	34	34.0
High prices of inputs	67	67.0
Adulteration of feeds	44	44.0
Drought	32	32.0
Limited water supply	8	8.0

*Percentage more than 100 because farmers stated more than one problem.

Table 4. Alternative feeding strategies employed in livestock feeding.

Strategy	Frequency	%*
Peels	44	44.0
Forages	21	21.0
Concentrates	21	21.0
Industrial by products	34	34.0
Left overs	23	23.0
Others	28	28.0

*Percentage more than 100 because farmers stated more than one feeding strategy used.

Table 5. Use of rumen contents in livestock diets.

Type of animal	Use (%)	Do not use (%)	P-value
Pigs	23	15	0.0001
Layers	13	25	0.0006
Indigenous chicken	1	37	0.38
Other animals	2	36	0.142

poultry feed formulation. The kind of advice needed include level of rumen content inclusion in the diets, rumen content processing methods and its storage in order of importance.

DISCUSSION

Demographic characteristics of the respondents

The study showed livestock farming in the area of study was dominated by the young age group (30-45 years). This implies that people within this age bracket are energetically fit to execute the required duties as opposed to older people. Household (HH) size (1-5 people) was the highest, and is line with the findings of UBOS (2018) which revealed an average of 4.5 persons per household. Of the total respondents, the majority (48%) had attained at least secondary education. These results despite being lower, agree with the findings of Katongole et al. (2012) while investigating strategies for coping with feed scarcity among urban and peri-urban livestock farmers in Kampala, Uganda.

Animal types kept by the farmers

Poultry enterprise (layers, broilers indigenous chicken) was the predominantly practiced among the livestock farmers. This may be due to the fact that chicken is easier to rear and can survive with minimal input at household level (Kperegbeyi et al., 2009). More so, according to FAOSTAT (2016), poultry meat and eggs are among the most commonly consumed animal food source as it is not discriminated among cultures and religions, thus making it a key component in food security and nutrition of most households in the study area. Poultry is mostly crucial among smallholder farmers, resource poor people in the urban and rural areas and is also mainly produced in large scale and intensive operations, which thus makes it one of the fastest growing subsectors globally. Poultry also has a short reproduction and production cycle and can be sold off quickly in case of a need; more so, because poultry convert household wastes into edible products like meat and eggs, could be one of the reasons they are found in almost every household (FAO-AGAL, 2016).

Most respondents kept indigenous chicken followed by dairy, sheep and goat. This finding differs from that of Katongole et al. (2012) who reported dairy cattle as the most reared livestock specie. The reason for this could be as a result of change in land tenure, increasing urbanization of what used to be peri-urban districts surrounding Kampala, the capital city of Uganda. This change in land use has eroded most agricultural land (Sabiti and Katongole, 2016). As a consequence, most urban dwellers have been left with small pieces of land which has forced many to keep birds that require small area of land as opposed to large ruminants. This is also emphasized by the United Nations report of 2011 that urbanization presents unprecedented environmental, social, economic and political challenges. Globally, expansion of cities not only leads to loss of agricultural land but also changes in hydrology and natural habitat (UN, 2011).

Challenges faced by livestock farmers

High prices of agricultural inputs remain the biggest problem encountered by livestock farmers, followed by adulteration of animal feeds, feed scarcity and limited land. High feed prices are not unique to Uganda but a major problem facing most developing countries. In Uganda, fish meal and maize are the predominant protein and energy feed ingredients used in livestock ration

Table 6. Use of rumen contents in the study area.

Kampala {n (%)}	Mukono {n (%)}	Wakiso {n (%)}	P-value
18(47.4)	4(10.5)	16(42.1)	0.0001

Table 7. Proportion of rumen contents used in pigs and layers.

Inclusion level	Pigs (%)	Layers (%)
5%	9.7	7.1
15%	3.2	7.1
20%	9.7	85.8
No limit	77.4	0

Table 8. Benefits realized by the farmers with use of rumen contents in livestock diets.

Pigs	Layers
Increased pig growth	Good chicken growth
Reduced feed costs	Yellow yolk
	Reduced feed costs

formulation. These feed ingredients are also subject to competition from humans, thus aggravating the situation during periods of scarcity. In the end, the livestock sector suffers the most; this is further exacerbated by feed dealers who subject most feed ingredients to adulteration. This has not only left livestock farmers to a double loss but also exposed them to substantial livelihood risk. The competition for inputs drastically affects farmer's profit margins which consequently hinders their expansion programs (Brandnock, 2012).

Alternative feeding strategies used by farmers

To curb the problem of the ever increasing feed prices, farmers reportedly used mostly peelings from bananas, sweet potatoes and cassava. These are subjected to welting and sometimes boiling so as to reduce inherent anti-nutritional factors and also to increase digestibility by the animals. Other farmers indicated that banana peelings are chopped into small pieces, dried and given to the birds, which slows birds from losing a lot of weight in case of feed scarcity. However, this needs scientific backing to give more informed guidance to farmers. Industrial by-products used by the farmers included, wheat bran, wheat pollard, brewer's waste and by products from slaughter houses. Other farmers were buying and stocking feeds during the harvest season when the prices are lower in preparation for periods of scarcity which was in line with the findings of Katongole et al. (2012). Concentrates used by the farmers include Hendrix, Intercol and Kafica, which are mostly imported into the country and their use is justified by the need to curb rampant feed adulteration by the local feed manufactures.

Use of rumen contents in livestock diets

Rumen content was mostly used in pig and layers diets by 23 and 13% of the respondents respectively. The inclusion of rumen contents in pig diets was reportedly easier than in layer rations because it does not involve milling which also reduces on the cost. This is because most farmers perceive pigs as animals that eat almost everything offered to them. However, despite this notion, pigs too need well formulated feeds for better performance (Mwesigwa et al., 2013). A few of the respondents reported giving flesh rumen contents to pigs without any further processing, with the fresh rumen content usually mixed with a little maize bran and given to the pigs. Despite this being an innovative survival strategy, the nutritional adequacy of this approach to pig feeding remains questionable (Kasule, 2012) and may in fact even affect production efficiency of the pigs. Rumen contents were not used in broiler diets because farmers did not envisage its usefulness to broilers.

Degree of use of rumen contents in the study area

Kampala had the highest level of rumen content use in

livestock diets among the study areas. According to discussion with key informants, the idea of rumen content use in livestock diets started at Nalukolongo Abattoir in Kampala as a pilot project over five years way back. This has been spreading to other areas; since then, however, the pace has been low due to lack of knowledge in efficient utilization of rumen contents in livestock diets.

Proportion of rumen content use in different livestock

The study found that rumen contents were mostly used in pigs and layer diets with varying inclusion levels. Despite rumen contents being reported as having no anti-nutritional factors (Agbabiaka et al., 2012), there is an optimum inclusion level in livestock diets that must not be surpassed, beyond which animal performance becomes compromised. In this study, 85.8% of the respondents incorporated rumen contents in layer diets at 20% inclusion level. Despite achieving their objective of egg yolk color change, the 20% rumen content inclusion level is quite high for proper layer growth performance (Odunsi, 2003). Available literature shows a reduction in average daily feed intake (AFI), hen daily egg production (HDEP), egg weight and shell thickness with increasing levels of rumen contents in layer diets (Odunsi, 2003; Efrem et al., 2016).

In pig diets, a high percentage of the respondents (77.4%) could not quantify the amount of rumen contents they use. Despite the fact that numerous feed ingredients provide nutrients that pigs require to grow, pigs too require balanced feed ration that provide optimum energy, proteins, and vitamins for better growth performances (Adesehinwa, 2008; Mwesigwa et al., 2013). Moreover, rumen contents are high in fiber that can limit feed intake and lead to poor growth due to insufficient feed utilization. Thus, the notion by most farmers that pigs can eat everything offered to them without catering for optimum nutritional needs requires mindset change for improved pig performance. No respondent indicated use of rumen contents in broiler diets as they envisaged no beneficial effects in these types of birds. However, there seems to be a knowledge gap, since use of rumen contents has been reported to improve broiler performance (Said et al., 2015; Inci et al., 2013).

Problems encountered with use of rumen contents

Optimum inclusion rates of rumen contents in livestock rations was the greatest challenge encountered, followed by the drying process and bad smell while contaminants in the rumen contents was the least challenge encountered by livestock farmers. In general, farmers lacked proper guidance with regard to use of rumen content in livestock diets. This has also been reported by other researchers (Kasule et al., 2014; Tadesse et al., 2017). It could be one of the reasons why the use of rumen content in livestock diets is not widely spread among farmers. In relation to drying of rumen content, some farmers reported being burnt by the heat generated from rumen contents with some getting itches and skin rushes. Bad smell from rumen content was also encountered by several farmers. Among the contaminants reported in rumen contents included, polythene bags, metallic objects and tree thorns. The sharp objects usually pierce hands during sun drying of rumen contents. In general, most feedstuffs contain contaminants from diverse sources (Lange et al., 2018). The contaminants are ingested during feeding by livestock, and polythene bags are most prevalent in livestock reared in peri-urban areas than those from rangeland areas. This is due to enormous use of plastic bags in urban and peri-urban areas. Uganda is currently yet to implement the law on barning the used plastic bags. Unrestricted disposal of plastic bags not only lead to environmental pollution but limit the sustainability of life support systems, social harmony and human health (Aurah, 2013). It is therefore imperative to limit exposure of livestock to such contaminants as it leads to depression, reduced milk outlet, bloat and eventually economic loss (Nandwa, 2014) and in extreme cases, death of livestock.

Advice farmers needed for efficient utilization of rumen contents in livestock diets

Farmers stated several areas where they needed advice in relation to efficient use of rumen contents for improved livestock production. Overall, most farmers indicated that they need advice in pig and poultry feed formulation. The kind of advice needed include levels of inclusion of rumen content in the diets, rumen content processing methods and its storage in order of importance. This revelation is in line with the findings of Kasule et al. (2014) who reported farmer's own feed rations being nutritionally lacking and therefore needed advice on how to formulate nutritional quality feed and to ensure profitable and sustainable livestock production. However, this still seems a daunting challenge that calls for collective efforts and political will.

Conclusion

The study established that use of rumen contents in livestock diets was still not widely spread among farmers despite scientific strives showing its potential for livestock production. Rumen content was mostly used in pigs and layers diets. Generally, farmers lacked knowledge on effective inclusion levels of rumen content in livestock diets to optimize animal production

performance, therefore necessitating detailed information on this potential feed resource for livestock production.

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CONFLICT OF INTERESTS

The authors have no conflict of interest

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