Original Research Paper

Volume-8 | Issue-4 | April-2018 | PRINT ISSN No 2249-555X

Physics

EFFECT OF GINGER POWDER (ZINGIBER OFFICINALE) ON SELECTED RUMEN AND BLOOD SERUM CONSTITUENTS IN SHEEP

Al-Azazi, A,SH	Faculty of Agriculture and Veterinary Medicine ,Thamar University, Yemen
Tayeb, F.A	Faculty of Veterinary Medicine, Cairo University, Giza, Egypt, 12211
Baraka, T.A	Faculty of Veterinary Medicine, Cairo University, Giza, Egypt, 12211
Khalaf, A.M	Faculty of Pharmacy & Medical Sciences, Al-Ahliyya Amman University, Amman, Jordan *Corresponding Author

ABSTRACT This experiment was carried out to investigate the effect of ginger powder (Zingiber officinale) on rumen and blood constituents. Ten Egyptian native sheep, their ages ranged between 1.5 - 2.5 years, and body weights 30 - 45kg. they divided into two equal groups. The first group (control group) was fed on traditional ration only, the second (experimental group) was given ginger powder (500mg /kg body weight orally) in the morning before feeding for 5 days. In first day in both groups rumen juice and blood samples were collected in the morning before feeding (considered 0 hour) and at 2nd, 4th, 6th and 8th hours of supplementation with ginger. In treated group rumen and blood samples were taken daily before feeding from first day up to fifth day of experiment. Results generally showed that ginger made significant changes in fermentation patter in rumen and blood serum constituents among hours, while by days it caused marked increases in rumen calcium and VFAs. On the other hand ginger maintained rumen protozoal activity, TPC, pH, rumen ammonia concentration, serum total protein, serum calcium and inorganic phosphorus, BUN, creatinine and GGT within normal range. Regarding fermentation pattern on hours and changes that occurred in both rumen and blood serum constituents may suggest a recommendation for using ginger supplementation as 500mg /kg body weight orally for 3-5days in treatment of indigestion and maintenance of normal rumen function. Further investigation should be applied on diseased cases to confirm the effect of ginger as therapeutic agent in such cases.

KEYWORDS : : Ginger powder, Sheep, Rumen and Blood Constituents).

Introduction

Herbs and spices are known to have health benefits such as appetite and digestion stimulants, anti-microbial action, anti-inflammatory action, anti-oxidative action and immunostimulant function on animals when used as feed additives in animal nutrition. For effective use of herbs and spices, they can be added to feed as dried plants or as extracts. Ruminants have been adapted to fill an important ecological niche because of their specially adapted digestive tract that allows them to survive on fibrous feeds(Faniyi et al. 2016).

Ginger (Zingiber officinale) belonging to Zingiberacae family is one of the famous spices all over the world, it has a long history of medicinal use for more than 2000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity(Ghosh et al.2011) It contains, carbohydrates, fatty oil, protein, crude fiber, volatile oil and contains minerals such as iron, calcium and phosphorous and also vitamins such as thiamine, riboflavin, niacin and vitamin C. (Polasa and Nirmala 2003). In last years , many studies have focused on the potential of ginger in the modification of rumen fermentation (Busquet et al. 2006, Zhang et al. 2011, Al-Khayat 2011, El samarany 2015, Soroor and Moeini 2015).

This study was applied to investigate the effect of ginger powder (Zingiber officinale)supplement on rumen physical, cellular, biochemical constituents and blood serum biochemical constituents in apparently healthy Egyptian sheep in various sampling times: (0, 2nd, 4th, 6th and 8th hours) and (1st, 2nd, 3rd , 4th and 5th days) of supplement.

Material and Methods

Animals and experimental design:

A total number of 10 clinically healthy non-pregnant ewes, belong to Department of Medicine and Infectious Diseases, Faculty of Veterinary Medicine, Cairo University, were used in the current study. Their ages ranged from 1.5-2.5 years, and their body weights ranged from 30 - 45kg (mean weight 35.9 kg). Sheep were divided randomly into two equal groups. The first group considered as control group (Gp 1) fed on traditionaly offered ration included five sheep, the second group (Gp 2) was given ginger powder obtained from a local market, dissolved in a sufficient amount of water; in the morning before feeding the traditionally offered ration for 5 days. The dose (500mg /kg body weight) was determined after Iqbal, et al. (2006), Badreldin, et al. (2008) and Matthews et al. (2016).

Samples:

Rumen fluid and blood serum were collected from each animal. Samples were taken in the morning before feeding (0 hour) and after 2nd, 4th, 6th and 8th hours of treatment. In experimental group (Gp 2), sampling extended up to fifth day of experiment daily in the morning before feeding and treatment.

The rumen juice samples (about 100 ml) were collected, by using a rubber stomach tube ,in dry clean cup and taken to the laboratory for examination. Color, odor, consistency, pH and protozoal activity were examined immediately after sampling, then samples were sieved through a 4 folds of sterile gauze, used as :2ml fixed with strong acids to determine volatile fatty acids concentration, 2 ml for determination of ammonia concentration, 2 ml fixed and stained with methylene green formal saline for microscopic examination. A sample of 10 ml of strained rumen juice was centrifuged for 15 minutes at 3000 rpm and the supernatants were collected to determine the biochemical constituents (calcium and phosphorus). The blood samples were collected by puncture of jugular vein, using vacutainers for separation of serum for biochemical analysis (Coles, 1986).

Laboratory examination:

Rumen samples were examined immediately for physical properties include (color, odor, consistency, pH) according to Alonso (1979), Dirksen and Smith (1987) and Radostits et al. (2007), Microscopic examination include protozoal activity according to El-Saifi (1969) and Alonso (1979), Rumen total protozoal count(TPC) according to Ito et al. (1994), Biochemical examination which include total volatile fatty acid (TVFAs) concentration estimated by Macro Kgeldahl steam distillation method as described by Eadie et al. (1967), rumen ammonia nitrogen concentration estimated using specific kits produced by Spectrum Company, Egypt, according to the method of Burtis and Ashwood (1996), rumen Calcium, and Inorganic phosphorus using specific kits produced by Spectrum Company, Egypt, according to the method described by Young (1990), Young (1991).

Blood serum samples examination include estimation of serum total protein by using specific kits produced by Spinreact Company, Spain; according to method described by Young (2001), serum albumin by using specific kits produced by Spectrum Company, Egypt, according to the method described by Tietz (1990), serum globulin level was

calculated mathematically by subtracting albumin values from the total serum protein values, albumin and globulin (A /G) ratio calculated by dividing the albumin value by the globulin value, blood urea nitrogen (BUN) according to the method described by Tietz (1990), serum Gamma-glutamyltransferase (GGT) according to the method described by Saw et al. (1983), serum creatinine according to the method of Tietz (1986), serum calcium according to the method described by Young (1990), serum phosphorus according to the method described by Young (1991), all were estimated using specific kits produced by Spectrum Company, Egypt.

Statistical analysis:

Statistical analysis of obtained data was carried out by SPSS program version 21 using k independent samples T test, kruskal- Wallis and one-way ANOVA with Duncan"s post- hoc test. According to Nie et al. (1975) and Levesque, (2007).

Results and Discussions

The results of physical and cellular constituents of rumen fluid in sheep before and after treatment with ginger were summarized in table 1 and 2, the color was yellowish-brown, odor was aromatic, consistency was slimy to slightly viscous. These findings were similar to that observed in control group and that was in agreement with Anderson and Rings (2008), Karapinar et al.(2008). Along the experiment no significant difference (P>0.05) was noticed in protozoal activity and TPC between different times of sampling. These findings were similar to that observed in control group and also in agreement with that recorded by Pugh and Baird (2012), Orabi (2015) and Saber (2016). These results indicate that ginger had no effects on TPC. El samarany (2015) showed that the number of microorganisms significantly increased (P<0.05) at 3 hrs post feeding of ginger powder and decreased at 6 hrs post feeding. Regarding rumen pH value in first day of sampling, there was significant decrease (P<0.05) at 2nd, 4th, 6th and 8th hours after treatment,while in the control,this decrease was highly significant (P<0.01). Rumen pH values in control group were in agreement with that recorded by Baraka (2012) and Baraka and Abdl-Rahman (2012). Among the experimental sampling days, there were no significant differences (P>0.05)and the highest value was at 2nd day. This findings showed that ginger decreased the pH in the rumen during the few hours of treatment when compared with control group. In this connection, Zhang et al. (2011) and El samarany (2015) reported that ginger had no effects on rumen pH, while Al-Khayat (2011) reported a decrease in the rumen pH.

The results of rumen biochemical constituents of sheep before and after treatment with ginger were summarized in table 3 and 4. For rumen TVFAs concentration in first day of sampling, there was significant increase (P<0.05) at 8th hour after treatment, but for days of sampling, there was slight increases in TVFAs concentration at 2nd and 4th days after treatment. Soroor and Moeini (2015) recorded no effects, while decreases in their values was recorded by Zhang et al. (2011).

For rumen ammonia N2 concentration in first day of sampling, high significant decrease (P<0.01)was noticed starting at 2nd hour until 8th hour, and lowest value was at 4th hour and this finding is slightly different with that observed in control group. Among the experimental days, no significant difference at (P>0.05) was noticed, and the lowest value was at 5th day. This result indicate that ginger supplementation tend to reduce rumen ammonia N2 concentration after few hours of treatment. Zhang et al. (2011) showed that addition of ginger powder cause no significant difference on rumen ammonia-N2 concentration in sheep while Soroor and and Moeini (2015), El samarany (2015) reported decreased ammonia N2 concentration.

Table No. 1. Physical and cellular constituents of rumen fluid in regard to sampling times (0, 2, 4, 6, 8th hours) with and without ginger powder

Variables	Treatment	0 hour	2nd hour	4th hour	6th hour	8th hour
Color	Gp 2	yellowish-brown				
	Gp 1	yellowish-brown				
Odor	Gp 2	Aromatic				
	Gp 1	Aromatic				
Consistency	Gp 2	Slimy- Slightly viscous				
Consistency	Gp 1	Slimy- Slightly viscous				
Protozoa activity	Gp 2	2.20±0.37	2.60±0.24	2.40±0.24	2.40±0.24	2.40±0.24
	Gp 1	2.20 ±0.20	2.60 ±.025	2.40 ±0.25	2.40 ±0.40	2.40 ±0.25
TPC (×104/ml)	Gp 2	13.80±4.22	4.20±1.49	6.90±1.87	8.30±1.54	14.90±6.96
	Gp 1	28.60±4.67	17.60±4.41	14.60±3.40	16.60±4.51	20.20±5.43
pH	Gp 2	7.08±0.06a	6.70±0.10b	6.74±0.14b	6.62±0.12b	6.62±0.12b
	Gp 1	6.92 ±0.04a	6.60±0.03b*	6.52±0.04b*	6.42±0.07b*	6.52±0.09b*

a, b,c, Mean values have the similar symbol or symbols within the same raw are not significantly different at P≤0.05.
*. significant at the 0.01 level

Table No. 2. Effect of ginger powder on physical and cellular constituents of rumen fluid in regard to sampling days (1st-5th day)

Variables	1st day (control)	2nd day	3th day	4th day	5th day
Color	yellowish-brown				
Odor	Aromatic				
Consistency	Slimy- Slightly viscous				
Protozoa activity	2.20 ±0.37	1.80 ±0.20	2.60 ±0.24	2.40 ±0.24	2.60 ±0.25
TPC (×104/ml)	13.80±4.22	12.40 ±3.29	15.40 ±4.19	12.90 ±2.60	10.80 ±2.49
pH	7.08 ±0.06	7.18 ±0.06	7.08 ±0.06	7.02 ±0.08	7.02 ±0.05

Regarding rumen calcium in first day, there were no significant differences (P>0.05) occurred and higher values were at 4th and 8th hours. These findings were similar to that observed in control and was within the same ranges. Our results were in agreement with that recorded by Saber (2016), however, lower value was reported by Abdl-Rahman (2000). Among the experiment days, significant increase (P<0.05) was occurred in calcium level at 5th day. This result indicated that ginger supplementation tend to increase rumen calcium level. High negative correlation between rumen pH and rumen calcium was recorded (R= -0.826) which explain that reduction in pH causes increase in calcium absorption (Dirksen and Smith 1987) .

In relation to rumen inorganic phosphorus in first day of sampling, there was no significant difference (P>0.05) occurred. These findings were different with that observed in control group where significant decreases (P<0.05) occurred at 2nd, 4th, 6th and 8th hours. Among the experiment days, no significant difference (P>0.05) noticed. These results showed that ginger tend to maintain the rumen inorganic phosphorus level within normal values in the first day when compared with the control group

Table No. 3. Rumen fluid biochemical constituents in regard to sampling times (0, 2, 4, 6, 8th hour) with and without ginger powder

Variables	Treatment	0 hour	2nd hour	4th hour	6th hour	8th hour
TVFAs (mmol/L)	Gp 2	43.50±3.77a	46.70±2.99ab	47.90±4.26ab	47.70±2.15ab	55.60±3.43b
	Gp 1	37.10±2.49a	40.70±3.13a	44.60±1.56ab	53.20±3.08b*	65.10±6.36c*
Ammonia N2 (mmol/L)	Gp 2	1.90±0.45a	0.63±0.23b*	0.31±0.09b*	0.42±0.12b*	0.64±0.28b*
	Gp 1	0.97±0.19a	0.74±0.34ab	0.19±0.01b	0.19±0.01b	0.32±0.11b
Calcium (mg/dL)	Gp 2	2.73±.31	4.15±.68	5.31±1.70	5.25±1.26	5.31±1.38
	Gp 1	4.70±.773	7.36±.902	8.88±1.198	9.84±3.36	10.30±2.39
Phosphorus (mg/dL)	Gp 2	79.77±3.64	71.79±4.31	74.26±1.17	73.39±3.29	72.92±3.86
	Gp 1	50.68±4.07a	36.13±2.10b	27.39±3.42b*	37.03±4.58b	32.75±4.19b*

a, b,c, Mean values have the similar symbol or symbols within the same raw are not significantly different at P≤0.05.
*. significant at the 0.01 level.

Table No. 4. Effect of ginger powder on rumen biochemical constituents in regard to sampling days (1st – 5th day)

Variables	1st day (control)	2nd day	3th day	4th day	5th day
TVFAs (mmol/L)	43.50±3.77	50.10±7.15	48.60±3.56	53.80±5.28	48.90±2.22
Ammonia N2 (mmol/L)	1.90±0.45	1.83±0.48	1.66±0.51	1.06±0.18	1.04±0.32
Calcium (mg/dL)	2.73±.31a	4.41±0.91ab	4.34±0.49ab	4.54±0.48ab	5.10±0.47b
Phosphorus (mg/dL)	79.77±3.64	85.80±4.04	80.32±2.94	83.27±3.46	80.57±5.35

a, b,c, Mean values have the similar symbol or symbols within the same raw are not significantly different at P≤0.05.
*. significant at the 0.01 level.

The serum biochemical constituents of sheep before and after treatment with ginger were summarized in table 5 and 6. For serum total protein in first day of sampling, no significant difference (P>0.05) was reported, the lowest value was at 2nd hour and the highest value was at 4th and 8th hours. Among the experiment days, there was gradual increase and the peak of significant increase (P<0.05) occurred at the 5th day. This finding suggest that ginger treatment tend to increase serum total protein.Similar finding was stated by EL-Gohary et al. (2012)where they reported significant increase (P<0.05) in total proteins by ginger powder supplementation in goat.

In relation to serum albumin, no significant difference (P>0.05) occurred in first day of sampling. These findings were similar to that observed in control group. Similarly, no significant differences (P>0.05) occurred among the experiment days. These results indicated that ginger supplementation had no effects on serum albumin, contrary to the finding reported by EL-Gohary et al. (2012) where they reported an increase in serum albumin. For serum globulin in first day of sampling, no significant difference (P>0.05) occurred between different sampling times before and after treatment with ginger, the lowest value was at 2nd hour. These findings were different with that observed in control group where significant increase at (P<0.05) occurred at 2nd hour. Among the experiment days, there was significant increase (P<0.05) occurred at the 5th day when compared with zero time, 2nd day, 3th day, 4th day. EL-Gohary et al. (2012), reported an increase in serum globulin.

In regard to serum A/G ratio, in first day of sampling, there were no significant difference (P>0.05) occurred between zero time and other times after treatment. Significant increase (P<0.05) occurred at 2nd hour when compared with 4th, 6th and 8th hours after treatment.The lowest value was at 8th hour and the highest value was at 2nd hour. This finding was similar to that observed in control group, where no significant difference (P>0.05) occurred between zero time and other times after treatment. Among the experiment days, significant decrease (P<0.05) was noticed in A/G ratio at 5thday when compared with zero time. Gp2 and Gp1 presented similar trend of fluctuation in values but within normal ranges.

Regarding blood urea nitrogen, in first day of sampling no significant difference at (P>0.05) occurred, the lowest value was at 8th hour and the highest value was at 2nd hour. This finding was similar to that observed in control group. Among the experiment days, no significant differences at (P>0.05) occurred between different days of sampling before and after treatment, the lower values were at 2nd and 5th days. This finding indicated that ginger supplementation had no effect on BUN,contrary to the finding by EL Gohary et al. (2012) who reported significant (P<0.05) increase in BUN.

Table No. 5. Serum biochemical constituents in regard to sampling times (0, 2, 4, 6, 8th hour) with and without ginger powder

Variables	Treatment	0 hour	2nd hour	4th hour	6th hour	8th hour
Total protein (g/dL)	Gp 2	6.18±0.21	5.28±0.61	6.29±0.62	5.89±0.26	6.29±0.17
	Gp 1	6.24±0.16ab	6.84±0.32b	6.07±0.21a	6.07±0.19a	6.16±0.07a
Albumin (g/dL)	Gp 2	3.16±0.29	2.93±0.21	2.72±0.16	2.64±0.07	2.58±0.07
	Gp 1	2.32±0.02	2.21±0.06	2.32±0.03	2.33±0.07	2.30±0.08
Globulin (g/dL)	Gp 2	3.02±0.33	2.35±.59	3.57±.59	3.25±0.24	3.71±0.16
	Gp 1	3.93±0.17a	4.62±0.32b	3.76±0.23a	3.75±0.15a	3.86±0.06a
A/G ratio	Gp 2	1.16±0.25ab	1.69±.46a	0.83±0.12b	0.83±0.07b	0.70±0.04b
	Gp 1	0.59±0.03ab	0.49±0.04a	0.63±0.05b	0.63±0.02b	0.59±0.03ab
BUN (g/dL)	Gp 2	22.28±3.69	23.62±2.11	23.33±2.64	19.21±2.45	16.00±2.35
	Gp 1	20.43±4.84	21.44±4.07	19.23±4.74	14.35±4.28	16.93±5.46
Calcium (mg/dl)	Gp 2	9.90±0.14ab	11.02±0.65b	8.19±0.54a	10.00±0.85ab	9.59±1.08ab
	Gp 1	9.37±0.65	9.54±1.17	9.69±0.31	10.50±0.85	10.15±0.62
Phosphorus (mg/dl)	Gp 2	8.15±0.70	8.05±0.76	8.00±0.77	6.87±0.87	6.69±0.62
	Gp 1	9.41±0.78a	9.62±0.35a	9.32±0.84a	7.75±0.68ab	6.57±1.07b
Creatinine (mg/dl)	Gp 2	1.48±0.06	1.33±0.13	1.26±0.05	1.50±0.09	1.29±0.08
	Gp 1	0.98±0.06	0.92±0.07	0.86±0.05	0.82±0.06	0.84±0.06
GGT (U/L)	Gp 2	32.88±2.20	36.36±3.04	35.98±4.26	37.44±2.89	36.67±3.77
	Gp 1	45.93±3.88	43.23±2.25	46.31±3.11	45.31±2.55	47.01±1.74

a, b,c, Mean values have the similar symbol or symbols within the same raw are not significantly different at P≤0.05.

*. significant at the 0.01 level

Concerning serum calcium, in first day of sampling, there were no significant difference (P>0.05) occurred between zero time and 2nd, 4th, 6th, 8th hours after treatment with ginger, the highest value was at 2nd hour and significant increase was noticed (P<0.05) when compared with 4th hour. This finding was similar to that observed in control group where no significant different (P>0.05) had occured between zero time and 2nd, 4th, 6th, 8th hours. Among the experiment days, there were no significant differences at (P>0.05) occurred, the highest value was at 2nd day, and the lowest value was at zero time. This finding indicated that ginger had no effect on serum calcium. EL-Gohary et al. (2012) showed significant increase (P<0.05) of Ca in blood plasma of does.

In regard to serum inorganic phosphorus, in first day of sampling, there were no significant differences (P>0.05) occurred between different times of sampling. These findings were different with that observed in control group where significant decrease (P<0.05) occurred in inorganic phosphorus level at 8th hour when compared with zero time, 2nd, 4th hours. Among the experiment days, no significant difference (P>0.05) occurred and the highest value was at 4th day. These results showed that ginger supplementation increased serum inorganic phosphorus level specially at first day when compared with control group. In the first day of sampling, serum Creatinine and GGT showed no significant differences (P>0.05) between different sampling times. This finding was similar to that observed in control group. Similarly, among the experiment days, no significant differences (P>0.05) occurred in Creatinine and GGT between different days of sampling. These results indicated that ginger supplementation had no effects on serum Creatinine and GGT and these results were in agreement with EL-Gohary et al. (2012).

Table No. 6. Effect of ginger powder on serum biochemical constituents in regard to sampling days (1st – 5th day)

Variables	1st day (control)	2ndday	3th day	4thday	5thday
Total protein (g/dL)	6.18±0.21a	6.64±0.67ab	6.29±0.09ab	6.7±0.45ab	7.98±0.83b
Albumin (g/dL)	3.16±0.29	2.94±0.13	2.93±.05	2.56±0.15	3.18±0.26
Globulin (g/dL)	3.02±0.33a	3.69±0.57a	3.36±.09a	3.80±0.57a	5.59±0.79b*
A/G ratio	1.16±0.25a	0.86±0.12ab	0.88±.03ab	0.75±0.14ab	0.64±0.13b
BUN (g/dL)	22.28±3.69	17.13±2.39	25.32±3.77	20.86±1.86	17.20±1.64
Calcium (mg/dl)	9.90±0.14	11.49±0.85	10.30±0.76	10.61±0.71	10.58±0.49
Phosphorus (mg/dl)	8.15±0.70	8.51±1.83	8.47±1.18	8.53±0.67	8.03±1.41
Creatinine (mg/dl)	1.48±0.06	1.46±0.11	1.41±0.12	1.44±0.08	1.66±0.06
GGT (U/L)	32.88±2.20	38.21±3.65	35.51±1.76	36.28±2.93	36.52±2.08

References

1. Abdl-Rahman, M.A. (2000). Some Studies on the Rumen of Goats. Ph. D. Thesis, Fac. Vet. Med., Cairo Univ., Egypt, 135 pages.
2. Al-Khayat , D. A. A. (2011).Effect of using Zingiber officinale in the activity and account of Bacteria and Parasital protozoa and Echological status of rumen of Awassi ewes. Alanbar. J. Vet. Sci., 1.(4): 60-66.
3. Alonso, A. (1979). Diagnostic Analysis of Rumen Fluid. The Veterinary clinics of North America. Large animal practice, 1(2):363-376.
4. Anderson , D.E. and Rings, M. (2008). Current Veterinary Therapy: Food Animal Practice, Elsevier Health Sciences. 715 p.
5. Badreldin, H. A., Gerald, B., Musbah, O. T., Abderrahim, N.(2008). Some phytochemical, pharmacological and toxicological properties of ginger (Zingiber officinale Roscoe): A review of recent research. Food and Chemical Toxicology 46 ; 409–420.
6. Baraka, T.A. (2012). Comparative Studies of Rumen pH, Total Protozoa Count, Generic and Species Composition of Ciliates in Camel, Buffalo, Cattle, Sheep and Goat in Egypt. The Journal of American Science, 8(2):655-669.
7. Baraka, T. and Abdl-Rahman, M. (2012). In Vitro Evaluation of Sheep Rumen Fermentation Pattern after Adding Different Levels of Eugenol-Fumaric Acid Combinations. Veterinary World, 5(2):110-117.
8. Burtis, C.A. and Ashwood, E.R. (1996). Tietz fundamentals of clinical chemistry,4th ed. Philadelphia: W.B. Saunders:755.
9. Busquet, M., Calsamiglia, S., Ferret, A. and Kamel, C. (2006). Plant extracts affect in vitro rumen microbial fermentation. J. Dairy Sci. 89, 761–771.
10. Coles, E.H. (1986).Veterinary clinical pathology. 4th Ed. W.B. Saunders Company, Philadelphia, London and Toronto.
11. Dirksen, G. and Smith, M. (1987). Acquisition and Analysis of Bovine Rumen Fluid. The Bovine practitioner, 22: 108-116.
12. Eadie, J.M.; Hobson, P. and Mann, S. (1967). A Note on Some Comparisons between the Rumen Content of Barley-Fed Steers and That of Young Calves Also Fed on a High Concentrate Ration. Animal production, 9(02):247-250.
13. El samarany, W. H. (2015). Effect of crushed ginger root feeding on rumen fluid characters and digestion efficiency in Awasi sheep. Egyptian J. Nutrition and Feeds,18(2) Special Issue: 39-42.
14. EL-Gohary, E. S. H., EL-Saadany, S. A., Abd- Elkhabeer, M. A. and Aiad, . M. (2012). Effect of supplementing some medicinal herbs and plants on the performance of lactating goats: 1- productive and reproductive performance. J. Animal and Poultry Prod., Mansoura Univ., Vol.3 (5): 199 – 213
15. El-Saifi, A. A. (1969). The Diagnostic Value of Ruminal Juice Examination in Cases of Indigestion in Buffaloes. M.Sc. Thesis, Fac. Vet. Med., Cairo Univ., Egypt, 128 p.
16. Faniyi,T.O., Prates, E.R., Adewumi, M.K., and Bankole, T. (2016) Assessment of herbs and spices extracts/meal on rumen fermentation: Review. Pubvet, Mai.,(10),5: 427-438.
17. Ghosh, A.K., Banerjee, S., Mullick, H.I.and Banerjee, J. (2011). Zingiber officinale: a natural gold. Int. J. Pharma. Bio Sci. 2: 283–294.
18. Gupta ,S.K. and Sharma, A. (2014). Medicinal properties of Zingiber officinale Roscoe - A Review. Journal of Pharmacy and Biological Sciences, (9), 5: 124-129.
19. Iqbal, Z., Lateef, M., Akhtar, M.S., Ghayur, M.N., Gilani, A.H. (2006). In vivo anthelmintic activity of ginger against gastrointestinal nematodes of sheep. J. Ethnopharmacol. 106, 285–287.
20. Ito, A., Imai, S. and Ogimoto, K. (1994). Rumen Ciliate Composition and Diversity of Japanese Beef Black Cattle in Comparison with Those of Holstein-Friesian Cattle. Journal of Veterinary Medical Science, (56), 4: 707-714.
21. Karapinar, T.; Dabak, M.; Kizil, O. and Balikci, E. (2008). Severe Thiamine Deficiency in Sheep with Acute Ruminal Lactic Acidosis. Journal of veterinary internal medicine, 22(3):662-665.
22. Levesque, R. (2007).Programming and data management: Agide for SPSS and SAS users,Fourth Edition,chicago, USA.
23. Matthews, K.K., O'Brien, D.J., Whitley, N.C., Burke, J.M., Miller, J.E. and Barczewski, R.A.(2016). Investigation of possible pumpkin seeds and ginger effects on gastrointestinal nematode infection indicators in meat goat kids and lambs. Small Ruminant Research 136; 1–6.
24. Nie, N.H.; Bent, D.H. and Hull, C.H. (1975). Spss: Statistical Package for the Social Sciences, McGraw-Hill New York.
25. Orabi, M.I. (2015). Some Studies on Effect of Drainage Water on Sheep Health. M.Sc. Thesis, Fac. Vet. Med., Cairo Univ., Egypt, 77 p.
26. Polasa, K. and Nirmala, K. (2003). Ginger: Its role in xenobiotic metabolism. ICMR Bulletin 33:56-62.
27. Pugh, D.G. and Baird, A.N. (2012). Sheep and Goat Medicine, Elsevier Saunders. 621 p.
28. Radostits, O., Gay, C., Hinchcliff, K. and Constable, P. (2007). Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses, 10th. Ed., Elsevier Saunders. 2156 p.
29. Saber, M.M.A. (2016). Clinical and laboratory evaluation of rumen fermentation pattern of sheep in health and diseases. M.Sc. Thesis, Fac. Vet. Med., Cairo Univ., Egypt, 145p.
30. Saw, M., Stromme,J.H., London,J.L., Theodorsen, l. (1983). IFCC method for g-glutamyltransferase[(g-glutamyl), peptide:amminoacidgglutamyltransferase, EC2.3;2.2]. Clin. Chem Acta.135:315F-338F.
31. Soroor, M. N. S. & Moeini, M. M. (2015). The influence of ginger (Zingiber Officinale) on in vitro rumen fermentation patterns. Annual Research & Review in Biology, 5, 54-63.
32. Tietz, N.W. (1986).Textbook of clinical chemistry. Philadelphia: WB Saunders. pp 1271-1281.
33. Tietz, N.W., ed. (1990). Clinical guide to laboratory tests. 2nd .Ed. Philadelphia: WB Saunders; 26-29.
34. Young, D.S. (1990). Effects of drugs on clinical laboratory tests. AACC press, Washington, D.C.
35. Young, D.S. (1991). Effects of drugs on clinical laboratory tests. 3ed., AACC press, Washington (DC),1990; supplement No.1.
36. Young, D.S. (2001). Effects of Disease on Clinical Laboratory Tests. 4th. Ed., AACC Press, Washington (DC)
37. Zhang, T.T., Yang, Z.B., Yang, W.R., Jiang S.Z. and Zhang, G.G. (2011). Effects of dose and adaptation time of ginger root (Zingiber officinale) on rumen fermentation. Journal of Animal and Feed Sciences, 20(3): 461-471.