Open Access

Check for updates

Research Article

Journal of Veterinary and Animal Sciences
ISSN (Print): 0971-0701, (Online): 2582-0605
https://doi.org/10.51966/jvas.2026.57.1.146-151

Impact of dietary addition of *Saccharomyces cerevisiae* on digestibility and blood parameters in Malabari kids#

J. Udhayakumar[1], V. Dildeep[1*], K. Ally[1], K. George Sherin[2], Lasna Sahib[3] and N. Geetha[4]

[1]Department of Animal Nutrition, College of Veterinary and Animal Sciences, Mannuthy, Thrissur,[2]Centre for Pig Production and Research, Mannuthy, [3]Livestock Research Station, Thiruvazhamkunnu, [4]Department of Livestock Production Management, College of Veterinary and Animal Sciences, Pookode, Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala

Citation: Udhayakumar, J., Dildeep, V., Ally, K., George Sherin, K., Lasna, S. & Geetha, N. (2026). Impact of dietary addition of *Saccharomyces cerevisiae* on digestibility and blood parameters in Malabari kids. *Journal of Veterinary and Animal Sciences,* 57(1), 146-151 https://doi.org/10.51966/jvas.2026.57.1.146-151

Received: 07.10.2025 Accepted: 22.12.2025 Published: 31.03.2026

Abstract

A feeding experiment was conducted to assess the effect of live Saccharomyces cerevisiae addition on nutrient digestibility and haemato-biochemical parameters in Malabari kids. Eighteen kids, aged three to four months, were selected from the University Goat and Sheep Farm, Mannuthy and assigned to three dietary treatments (T1, T2 and T3) in a completely randomised design. Kids in T1 were fed a concentrate mixture containing 22 per cent CP and 70 per cent TDN, those in T2 received the same concentrate mixture with 3g S. cerevisiae (1×10^{10} CFU/g), and those in T3 were fed a concentrate mixture with 20 per cent CP and 70 per cent TDN along with 3 g S. cerevisiae (1×10^{10} CFU/g) for 91 days. Ad libitum green fodder and weighed quantity of feed were offered daily to all groups. Digestibility trial and blood samples collection were conducted at the final week of the experiment. The digestibility coefficients of nutrients were similar. There was no statistically significant difference ($P > 0.05$) in blood haemoglobin, serum albumin, calcium, phosphorus, blood urea nitrogen and creatinine values. Serum total protein was significantly higher ($P < 0.05$) in T3 compared to T2 and serum glucose was significantly lower ($P < 0.05$) in T2 compared to T1. It can be concluded that feeding diet containing 22 per cent CP and 70 per cent TDN and 20 per cent CP and 70 per cent TDN added with 3g of S. cerevisiae had no adverse effect on the nutrient digestibility and haemato-biochemical parameters in Malabari goat kids.

Keywords: *Saccharomyces cerevisiae, nutrient digestibility, haemato-biochemical parameters, Malabari kids*

According to the 20th livestock census (2019), the goat population of India is approximately 148.88 million, highlighting the species as largest small ruminant group in the country. Rearing of goats in India holds a significant role in the rural economy, particularly for small, marginal and landless farmers. It serves as a reliable source of supplementary income to the farmers and is known as the poor man's cow (Gupta et al., 2023). Feeding is often the major expense in goat production. Whether goats are raised for meat or milk, providing high quality feed is essential for maximizing profit potential (Roy & Rana., 2024). Achieving an optimal balance of nutrients is necessary to support their growth and productivity. Probiotics, when used act as a growth promoters and provide health benefits to the animal. Hence, it can be used as an alternative for conventional antibiotics (Arsene et al., 2021).

**Corresponding author: dildeep@kvasu.ac.in Ph:9446442974*
#Part of MVSc thesis submitted to Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala

Among the different microbial additives, *Saccharomyces cerevisiae* has received particular attention in small ruminant nutrition. It optimizes the rumen fermentation by favouring the growth of cellulolytic and lactic acid utilizing bacteria (Newbold et al., 1996) and also enhances enzymatic activity and stabilizes rumen pH (Cuenca et al., 2022; Mohammed et al., 2018). But the effect of *S. cerevisiae* on digestibility and health status of Malabari kids are not yet studied. Based on this consideration, this study aims to assess the effect of diets added with live *S. cerevisiae* in Malabari kids on nutrient utilisation and haemato-biochemical parameters.

Materials and methods

Experimental animals

Eighteen Malabari kids of three to four months age of either sex were selected from the University Goat and Sheep farm, Mannuthy, These animals were randomly distributed into three treatment groups (T1, T2 and T3), each consisting of six kids, ensuring maximum uniformity in terms of age, sex, and initial body weight by using completely randomized design. The kids were housed individually in well cleaned and hygienic pens for 91 days. The kids were kept under uniform feeding and management system throughout the experimental period.

Experimental feed

The kids in T1 were fed with concentrate mixture containing 22 per cent CP and 70 per cent TDN, the kids in T2 were fed with concentrate mixture containing 22 per cent CP and 70 per cent TDN along with 3 gram *S. cerevisiae* – SACOMILK HF (10^{10} CFU/gram) and the kids in T3 were fed with concentrate mixture containing 20 per cent CP and 70 per cent TDN along with 3 gram *S. cerevisiae* – SACOMILK HF (10^{10} CFU/gram). *Ad libitum* green fodder was given in all the experimental groups daily and kids were fed as per the ICAR feeding standards (2013). The quantity of experimental feed and green grass offered to animals and balance if any, were recorded throughout the experimental period.

Digestibility trial

A digestibility trial for five days duration was conducted at the last week of feeding trial by total collection method. During the digestion trial, quantities of daily feed offered, faeces voided, and residue left were recorded. Later, the dung voided by each animal were collected quantitatively uncontaminated with urine, feed residue or dirt in individual containers, on a continuous 24 hour basis during the digestion trial. The entire quantity of pellets voided by each animal during 24 hours were weighed separately at morning 8 AM every day and stored in double lined polythene bags. The samples collected each day were stored in deep freezer (-20º C) for further analysis. At the end of the trial, samples collected for the five consecutive days from each animal were pooled, mixed and representative samples were taken after thorough mixing for chemical analysis. The moisture was determined immediately and the crude protein in dung samples was estimated using the fresh samples. Balance samples were dried and ground for rest of the analysis as per standard procedure (AOAC, 2016). Proximate analysis of feed, green grass, left overs and dung were done as per the standard procedures (AOAC, 2016) and fibre fraction of feed, fodder and dung samples by Goering and Van Soest (1970). From the pooled sample, representative samples were taken for analysis. The apparent digestibility coefficient of nutrients was calculated. Minerals like calcium and phosphorus in the feed samples were analysed by the conventional precipitation and titration method as per AOAC (2016).

Haemato-biochemical parameters

Blood samples were collected from all the animals at last week of the feeding trial. The serum was separated after centrifugation of blood samples at 3000 rpm for 10 minutes. Whole blood was used to determine the haemoglobin (cyan methaemoglobin method) and serum samples were used to determine serum total protein (Jong and Vegeter, 1950), albumin (Doumas et al., 1971), blood urea nitrogen (BUN) (modified Berthelot method), serum creatinine (AOAC, 2016), glucose (GOD-PAP methodology), calcium (AOAC, 2016) and phosphorus (Bernhart & Wreath, 1955) by semiautomatic analyser using standard kits.

Statistical analysis

The statistical analysis of data was done as per Snedecor and Cochran, 1994. The data collected on digestibility trial and haemato-biochemical parameters were analysed statistically using SPSS version 24.0.

Results and discussion

Chemical composition

The chemical composition of experimental diets and green fodder fed to experimental kids are depicted in Table 1.

Digestibility of nutrients

Data on nutrient intake, outgo and digested (g/day) during the digestibility trial of experimental kids maintained on three dietary treatments are presented in Table 2.

The digestibility coefficients of nutrients like DM, CP, CF, EE, NFE, NDF and ADF were statistically similar ($P>0.05$) and are presented in Table 3.

Similarly, Obeidat et al. (2018) reported that the digestibility of dry matter, crude protein, neutral detergent

Table 1. Chemical Composition[1] of experimental diets and green fodder fed to experimental kids, (%)

S. No.	Nutrients	Feed I	Feed II	Hybrid Napier
1	Moisture	9.90 ± 1.28	9.83 ± 0.37	78.60 ± 0.95
2	Crude protein	21.96 ± 0.26	20.03 ± 0.19	15.96 ± 0.04
3	Crude fibre	8.56 ± 0.10	9.45 ± 1.07	30.37 ± 0.04
4	Ether extract	3.20 ± 0.001	3.09 ± 0.005	1.61 ± 0.02
5	Total ash	7.32 ± 0.16	8.50 ± 0.12	10.25 ± 0.02
6	Nitrogen free extract	58.38 ± 0.68	58.37 ± 1.14	41.81 ± 0.08
7	Neutral detergent fibre	28.89 ± 1.52	30.82 ± 0.18	58.18 ± 0.56
8	Acid detergent fibre	8.86 ± 0.40	11.68 ± 0.26	33.42 ± 1.57
9	Acid detergent lignin	1.83 ± 0.02	1.88 ±0 .88	8.77 ± 0.34
10	Acid Insoluble Ash	0.66 ± 0.04	1.05 ± 0.08	3.19 ± 0.05
11	Calcium	0.64 ± 0.02	0.65 ± 0.04	0.61 ± 0.01
12	Phosphorus	1.02 ± 0.04	0.99 ± 0.04	0.36 ± 0.01

[1]Mean values of six replicates with SE
Values from 2-12 expressed on DM Basis

Table 2. Data[1] on digestibility trial of experimental kids maintained on three dietary treatments, (g/day)

Parameters	Dietary treatments		
	T1	T2	T3
Dry matter, (g/day)			
Intake	411.96 ± 47.81	473.85 ± 52.42	324.39 ± 49.80
Outgo	131.62 ± 9.02	153.50 ± 8.09	104.29 ± 19.51
Digested	280.34 ± 40.15	320.35 ± 46.40	220.11 ± 32.56
Crude protein, (g/day)			
Intake	80.16 ± 9.31	92.20 ± 10.23	62.65 ± 9.58
Outgo	20.32 ± 1.26	22.37 ± 1.44	16.06 ± 3.19
Digested	59.85 ± 8.38	69.83 ± 8.93	46.60 ± 6.64
Crude fibre, (g/day)			
Intake	72.71 ± 8.43	83.64 ± 9.16	42.60 ± 6.75
Outgo	37.17 ± 2.59	36.74 ± 2.49	23.49 ± 3.97
Digested	35.54 ± 7.35	46.91 ± 9.14	19.11 ± 3.00
Ether extract, (g/day)			
Intake	10.36 ± 1.21	11.91 ± 1.32	9.08 ± 1.40
Outgo	2.39 ± 0.14	3.17 ± 0.10	2.00 ± 0.48
Digested	7.97 ± 1.15	8.74 ± 1.28	7.09 ± 0.95
Nitrogen free extract, (g/day)			
Intake	213.56 ± 24.79	245.64 ± 27.25	181.54 ± 27.67
Outgo	51.90 ± 4.47	67.17 ± 3.80	46.19 ± 8.81
Digested	161.66 ± 20.44	178.47 ± 23.93	135.35 ± 20.39
Neutral detergent fibre, (g/day)			
Intake	169.33 ± 19.64	194.78 ± 21.43	115.60 ± 18.02
Outgo	62.72 ± 5.01	67.60 ± 3.56	42.96±7.75
Digested	106.61 ± 17.67	127.18 ± 23.76	72.64 ± 11.18
Acid detergent fibre, (g/day)			
Intake	80.07 ± 9.29	92.12 ± 10.09	50.30 ± 7.94
Outgo	49.40 ± 3.95	50.54 ± 2.09	30.89 ± 6.10
Digested	30.67 ± 6.92	41.58 ± 9.95	19.41 ± 3.18

[1]Mean values of six replicates with SE

Table 3. The digestibility coefficient[1] of nutrients of three experimental rations fed to Malabari kids, (%)

Parameters	Dietary Treatments			P value
	T1	T2	T3	
Dry matter	67.21 ± 1.74	66.42 ± 2.54	68.42 ± 2.00	0.800^{ns}
Crude protein	73.87 ± 1.57	75.08 ± 1.46	75.09 ± 1.63	0.816^{ns}
Crude fibre	47.00 ± 4.34	53.78 ± 5.52	45.16 ± 2.13	0.344^{ns}
Ether extract	75.95 ± 2.19	72.08 ± 2.56	79.26 ± 2.11	0.120^{ns}
Nitrogen free extract	75.33 ± 0.81	71.79 ± 1.81	74.94 ± 1.97	0.267^{ns}
Neutral detergent fibre	61.79 ± 2.98	62.85 ± 4.79	62.88 ± 1.85	0.968^{ns}
Acid detergent fibre	36.81 ± 3.95	42.38 ± 5.61	39.78 ± 4.22	0.703^{ns}

[1]Mean values of six replicates with SE,ns-non significant (P > 0.05)

fibre and acid detergent fibre did not differ significantly among treatment groups of 6 months old female Awassi lambs fed diets with *S. cerevisiae.* Kowalik et al. (2016), reported that the supplementation of *S. cerevisiae* CNCM I 1077 to Corriedale rams did not exert any marked effect on the total tract digestibility of crude fibre. Hassan and Saeed (2013) also reported that ether extract digestibility was statistically similar in 4 to 6 months old male Awassi lambs fed concentrate diets containing 13.5 per cent crude protein along with 0.5 per cent *S. cerevisiae*. Osita et al. (2020), found that nitrogen free extract digestibility did not differ significantly among West African Dwarf lambs fed high-roughage or high-concentrate diets supplemented with 0, 0.75, and 1.5 grams of *S. cerevisiae* per kilogram.

In contrast to these results, Wang et al. (2022) found that the digestibility of dry matter, crude protein, neutral detergent fibre and acid detergent fibre was significantly improved in 3- to 4-month-old male Hu sheep when supplemented with low and high levels of yeast culture. Hassan and Saeed (2013) observed a significant increase in the digestibility of crude fibre and nitrogen free extract in 4 to 6 months old male Awassi lambs fed a concentrate diet containing 13.5 per cent crude protein along with supplementation of 0.5 per cent *S. cerevisiae*. Abd El-Ghani (2004) found a significant improvement in the digestion coefficient of ether extract in Zaraibi goats aged between 12 and 24 months and were supplemented with 3 grams of yeast (*S. cerevisiae*) per day. It could be inferred that dosage of *S. cerevisiae* used in the present study was not enough to exert a significant effect on digestibility of nutrients.

Haemato-biochemical parameters

The haemato-biochemical parameters are presented in Table 4. Blood haemoglobin, serum albumin, calcium, phosphorus, blood urea nitrogen and creatinine were statistically similar (P > 0.05).

The serum glucose levels obtained in *S. cerevisiae* supplemented group T2 and T3 were statistically lower (P < 0.05) and the findings are contrary to other studies using goat kid diet added with *S. cerevisiae*. The reason for the variation observed cannot be ascertained but the values obtained were within the normal range (Kaneko et al., 2008) of goat kids. Serum total protein in the present study was significantly higher (P < 0.05) in T3 group when compared to T2 group, indicating a better immune status. Hossain et al. (2012) also indicated a better immune status when higher serum total protein levels were obtained in growing Kankrej calves fed on a diet with a 50:50

Table 4. Haemato-biochemical parameters[1] of experimental kids maintained on three dietary treatments

Parameters	Dietary Treatments			P value
	T1	T2	T3	
Haemoglobin (g/dL)	11.89 ± 0.56	11.15 ± 0.78	10.82 ± 0.87	0.598^{ns}
Serum glucose (mg/dL)	71.81^{a} ± 5.03	54.22^{b} ± 5.85	58.55^{ab} ± 2.35	0.044*
Serum total proteins (g/dL)	5.92^{ab} ± 0.32	5.66^{b} ± 0.22	6.60^{a} ± 0.12	0.033*
Serum albumin (g/dL)	2.69 ± 0.06	2.67 ± 0.08	2.76 ± 0.10	0.750^{ns}
Serum calcium (mg/dL)	12.94 ± 0.61	13.17 ± 1.48	12.38 ± 1.98	0.927^{ns}
Serum phosphorus (mg/dL)	8.93 ± 0.41	9.33 ± 0.90	8.58 ± 0.99	0.803^{ns}
Blood urea nitrogen (mg/dL)	11.83 ± 0.65	11.65 ± 0.68	11.33 ± 0.68	0.867^{ns}
Serum creatinine (mg/dL)	0.87 ± 0.12	0.64 ± 0.09	0.69 ± 0.08	0.241^{ns}

[1]Mean values of six replicates with SE, ns-non significant (P>0.05)

*Mean of different treatment having different alphabets as superscripts within a row differ significantly (P < 0.05)

concentrate-to-roughage ratio, supplemented with 10 g of live *S. cerevisiae*.

The haemoglobin concentration, serum albumin, calcium, phosphorus, blood urea nitrogen (BUN) and creatinine in the present study were statistically ($P > 0.05$) similar in all the groups. Enculescu (2021) in Romanian Black and Spotted dairy cows (aged 5–8 years) reported a similar finding, where albumin, total calcium and inorganic phosphorus concentrations did not differ significantly by the addition of 80 g/head/day of *S. cerevisiae*. Ozsoy et al. (2013) also reported no notable influence of yeast supplementation on BUN levels in hybrid male goat kids (Saanen × Sami cross), aged 3.5 to 4 months, supplemented with four different levels of yeast culture (0, 1.5, 3.0, and 4.5 per cent) in diet. Abdalla et al. (2013) observed no alteration in serum creatinine levels of 75 days old buffalo calves supplemented with *S. cerevisiae* at 0, 30, and 60 g/calf/day indicating no notable damage on kidney function.

But Ghazanfar et al. (2015) in Sahiwal dairy heifers aged between 5 and 7 months, supplemented daily with 5 g of *S. cerevisiae* strain 1026 reported a enhanced haemoglobin concentration.

Conclusion

It can be concluded that feeding a diet containing 22 per cent CP and 70 per cent TDN, and 20 per cent CP and 70 per cent TDN added with 3g of *S. cerevisiae* (1×10^{10} CFU/g) had no adverse effect on the nutrient digestibility and haemato-biochemical parameters in Malabari goat kids. The level of addition of *S. cerevisiae* viz 3g (1×10^{10} CFU/g) was not enough to provide any statistically significant effect on nutrient digestibility and health benefit and hence no statistically significant improvement in growth was observed. Future studies should aim to evaluate higher levels of *S. cerevisiae* supplementation in Malabari goat kids.

Acknowledgements

The authors are thankful to the Dean, College of Veterinary and Animal Sciences, Mannuthy for providing the facilities necessary to carry out the study.

Conflicts of interest

The authors declare that they have no conflict of interest.

References

Abdalla, O. A., El-Boshy, M. E., Hamid, F. M. A., & Ali, N. M. (2013). Clinicopathological studies of dietary supplementation of *Saccharomyces cerevisiae* in calves. *Journal of American Science, 9*(9), 298–306.

Abd El-Ghani, A. A. (2004). Influence of diet supplementation with yeast culture (*Saccharomyces cerevisiae*) on performance of Zaraibi goats. *Small Ruminant Research, 52*(3), 223–229. https://doi.org/10.1016/j.smallrumres. 2003.06.002

Arsene, M. M. J., Jorelle, A. B., Sarra, S., Viktorovna, P. I., Davares, A. K., Ingrid, N. K., Steve, A. A., Andreevna, S. L., Vyacheslavovna, Y. N., & Carime, B. Z. (2021). Short review on the potential alternatives to antibiotics in the era of antibiotic resistance. *Journal of Applied Pharmaceutical Science, 12*(1), 29–40. https: //doi.org/10.7324/JAPS.2021.120102

Association of Official Analytical Chemists. (2016). *Official methods of analysis* (20th ed.). AOAC.

Bernhart, D. N., & Wreath, A. R. (1955). Colorimetric determination of phosphorus by modified phosphomolybdate method. *Analytical Chemistry, 27*(3), 440–441. https://doi.org/10.1021/ac60099a035

Cuenca, M., Chauca, J., Garcia, C., & Siguencia, H. (2022). *Saccharomyces cerevisiae* as a replacement alternative to growth-promoting antibiotics in animal feed. *Archives of Zootechnics, 71*(273), 61–69.

Doumas, B. T., Watson, W. A., & Biggs, H. G. (1971). Albumin standards and the measurement of serum albumin with bromcresol green. *Clinica Chimica Acta, 31*(1), 87–96. https://doi.org/10.1016/0009-8981(71)90365-2

Enculescu, M. (2021). Effects of *Saccharomyces cerevisiae* addition in dairy cows diets. *Bulletin of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca: Animal Science and Biotechnologies, 78*(1). https://doi.org/10.15835/buasvmcn-asb:2020.0022

Ghazanfar, S., Anjum, M. I., Azim, A., & Ahmed, I. (2015). Effects of dietary supplementation of yeast (*Saccharomyces cerevisiae*) culture on growth performance, blood parameters, nutrient digestibility and fecal flora of dairy heifers. *Journal of Animal and Plant Sciences, 25*(1), 53–59.

Goering, H. K., & Van Soest, P. J. (1970). *Forage fiber analyses (Apparatus, reagents, procedures, and some applications).* United States Department of Agriculture, ARS.

Gupta, V. K., Nain, D., Singh, B., & Dewry, R. K. (2023). Advances and innovations in goat reproductive management: A comprehensive review. *Indian Journal of Livestock, Veterinary and Animal Sciences, 3*(1), 119.

Hassan, S. A., & Saeed, A. A. (2013). Effect of feeding different levels of dietary protein and addition of baker's yeast (*Saccharomyces cerevisiae*) on productive parameters of Awassi lambs. *Journal of Agricultural Science and Technology, 4*, 8–72.

Hossain, S. A., Parnerkar, S., Haque, N., Gupta, R. S., Kumar, D., & Tyagi, A. K. (2012). Influence of dietary supplementation of live yeast (*Saccharomyces cerevisiae*) on nutrient utilization, ruminal and biochemical profiles of Kankrej calves. *International Journal of Applied Animal Sciences, 1*(1), 30–38.

Indian Council of Agricultural Research. (2013). *Nutrient requirement of animals: Sheep, goat and rabbits* (3rd ed.). ICAR.

Jong, H. H., & Vegeter, J. J. (1950). Determination of serum proteins with the biuret test. *Pharmaceutisch Weekblad, 85*(39–40), 755–764.

Kaneko, J. J., Harvey, J. W., & Bruss, M. L. (2008). *Clinical biochemistry of domestic animals* (6th ed.). Academic Press.

Kowalik, B., Skomial, J., Miltko, R., & Majewska, M. (2016). The effect of live *Saccharomyces cerevisiae* yeast in the diet of rams on the digestibility of nutrients, nitrogen and mineral retention, and blood serum biochemical parameters. *Turkish Journal of Veterinary and Animal Sciences, 40*(5), 534–539. https://doi.org/10.3906/vet-1511-37

Mohammed, S. F., Mahmood, F. A., & Abas, E. R. (2018). A review on effects of yeast (*Saccharomyces cerevisiae*) as feed additives in ruminants performance. *Journal of Entomology and Zoology Studies, 6*(2), 629–635.

Newbold, C. J., Wallace, R. J., & McIntosh, F. M. (1996). Mode of action of the yeast *Saccharomyces cerevisiae* as a feed additive for ruminants. *British Journal of Nutrition, 76*(2), 249–261. https://doi.org/10.1079/BJN19960029

Obeidat, B. S., Mahmoud, K. Z., Obeidat, M. D., Ata, M., Kridli, R. T., Haddad, S. G., Titi, H. H., Jawasreh, K. I., Altamimi, H. J., Subih, H. S., & Hatamleh, S. M. (2018). The effects of *Saccharomyces cerevisiae* supplementation on intake, nutrient digestibility, and rumen fluid pH in Awassi female lambs. *Veterinary World, 11*(7), 1015. https://doi.org /10.14202/vetworld.2018.1015-1020

Osita, C. O., Ani, A. O., & Ogwuegbu, M. C. (2020). Growth performance and nutrient digestibility by sheep fed diets containing yeast (*Saccharomyces cerevisiae*). *International Journal of Recent Innovative Academic Research, 4*(8), 12–20.

Ozsoy, B., Yalcin, S., Erdogan, Z., Cantekin, Z., & Aksu, T. (2013). Effect of dietary live yeast culture on fattening performance on some blood and rumen fluid parameters. *Revue de Médecine Vétérinaire, 164*(5), 263–271.

Roy, A., & Rana, T. (2024). Feeds, feeding equipment and feeding habits of goats. *Trends in Clinical Diseases, Production and Management of Goats, 1*(9), 113–133. https://doi.org/10.1016/B978-0-443-23696-9.00002-X

Snedecor, G. W., & Cochran, W. G. (1994). *Statistical methods* (8th ed.). Iowa State University Press.

Wang, J., Zhao, G., Zhuang, Y., Chai, J., & Zhang, N. (2022). Yeast (*Saccharomyces cerevisiae*) culture promotes the performance of fattening sheep by enhancing nutrients digestibility and rumen development. *Fermentation, 8*(12), 719. https://doi.org/10.3390/fermentation8120719 ■