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Full length articles

Short Communications

Full Length Articles

Changing Pattern of Livestock Products Trade in India

Arya S. Nair, M.Thirunavukkarasu[1], A.Serma Saravana Pandian[2], G.Senthilkumar[3] and C.Balan[4]

Department of Animal Husbandry Statistics and Computer Applications, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai - 600007

ABSTRACT

Data on Indian import and export of livestock products from 2010-11 to 2016-17 were collected from the reports of FAO and APEDA and used for forecasting the future direction of international trade using Markov Chain analysis. The transition probability matrix indicated that India could not retain its previous export of dairy products to Afghanistan and Oman. India's previous export of dairy products to the UAE market was retained at 23.70%. The remaining 58.70% was diverted to other countries. The probability of retention of the present quantity of dairy products imported was the highest for other countries (96.40%), followed by import from Denmark (44.20%). India could not retain its previous import of dairy products from France, Turkey and Italy during the period. The probability of retention of the present quantity of processed meat export was the highest for UAE (39.70%), followed by other countries (36.9%). India could not retain its previous export of processed meat to Qatar and Maldives. There was 100% probability of shifting of export to India from Sri Lanka to other countries, and from Spain to Sri Lanka. There were 93.50% and 69.70% probabilities to shift India's import from Belgium to Sri Lanka and from Thailand to Sri Lanka, respectively. India's previous buffalo meat export to Iraq market was retained at 59.60%. The remaining 40.40% was diverted to other countries (33.70%) and Indonesia (6.60%). Malaysia showed only 7.90% probability to retain its export market from India and its remaining 92.00% share was found directed to Vietnam. India was having 100% probability to retain the import of buffalo meat from Belgium, followed by New Zealand (70.50%) and Australia (26.80%). The probability of retention of export of poultry products to the Maldives was at 65.10%. India could not retain its previous export of poultry products to Japan and Vietnam. Vietnam's share of poultry products imports from India was diverted to other countries (86.10%). India's previous poultry products import from France market was retained at 52.00% and 48% was diverted to others (39.30%).

Key Words: Livestock products, Trade, Pattern, Markov Chain, India

Corresponding author Email Id:
[1]Professor and Head and Corresponding Author
[2]Assistant Professor, Dept. of Animal Husbandry Economics, Madras Veterinary College, Chennai
[3]Assistant Professor, Dept. of Animal Husbandry Economics, Madras Veterinary College, Chennai
[4]Assistant Professor

INTRODUCTION

Livestock sector has become one of the fastest growing agricultural subsectors in India. Its share of agricultural GDP was 25.6% in 2016-2017. This phenomenal growth is driven by the rapidly increasing local demand for livestock products, owing to the population growth, urbanization and increasing incomes in the country and also the increasing export opportunities for livestock products. As a result, livestock sector in India has undergone perceptible changes in its size, composition and productivity in the last few decades, transforming itself from a low-profile backyard venture to the status of a promising industry.

However, at the current level of productivity and the need to comply with the emerging standards across the world, the export competitiveness of Indian livestock products is not encouraging. Hence, this study attempts to unravel the future state of livestock export and import of livestock products in the country.

MATERIALS AND METHODS

Data on import and export of livestock and dairy products (annual trade data) from 2010-11 to 2016-17 were collected from FAO and APEDA. Livestock products considered for the analysis were dairy products, poultry products, processed meat and cara beef. Five major export destinations and five major importers were considered in this study. Markov chain analysis was employed for data analysis. The structural changes in nation wise share of trade in livestock products were analyzed by estimating the transitional probability using the Markov chain model. This model is a stochastic process which describes the finite number of possible outcomes S_i (i=1, 2…, r) of a discrete random variable X_t (t=1, 2…, t) and this assumes that the probability of an outcome on the t^{th} trial depends only on the outcome of the proceeding trial and this possibility is constant for all time periods (Lee *et al.,* 1965).

Central to Markov chain analysis is the estimation of the transitional probability matrix, 'P'. The element 'P_{ij}' of this matrix indicates the probability that trade will switch over from country 'i' to country 'j' over time. The diagonal element 'P_{ij}' measures the probability that the trade share of a country will be retained. An examination of this matrix will indicate the loyalty of an importing country to a particular country's exports (Dent, 1967).

In the study, the average export to a particular country would be considered as a random variable which depends only on its past export to that country and following a first order Markov model. It can be denoted algebraically as,

$$E_{ij} = \sum_{i=1}^{r} E_{it-1} \quad P_{ij} + e_{ij}$$

where,

E_{ij} = Export from India during the year't' to j^{th} country

E_{it-1}= Export to i^{th} country during the year t-1

P_{ij}= Probability that export will shift from i^{th} country to j^{th} country

e_{ij}= Error term, which is statistically independent of E_{it-1}

r = number of importing countries.

The transitional probabilities P_{ij}, which can be arranged in a [c × r] matrix, have the following properties.

$0 \leq P_{ij} \leq 1$.

$\sum_{i=1}^{r} P_{ij} = 1$ for all i.

Thus, the expected export shares of each country during the period 't' can be obtained by multiplying the exports to these countries in the previous period (t-1) with the transitional probability matrix. Similarly, the future export share of the importing countries is estimated. The transitional probability matrix is estimated in the Linear Programming (LP) framework by a method referred to as minimization of Mean Absolute Deviation (MAD). The LP formulation is stated as:

Min $OP^* + I_e$

Subject to

$XP^* + V = Y$

$GP^* = 1$

$P^* \geq 0$

where

P* - vector of the probability P_{ij}

O - vector of zero

I_e - dimensional vector of areas and e - vector of absolute errors

Y - vector of exports to each country

X - block diagonal matrix of lagged values of Y

V - vector of errors

G - grouping matrix to add the row elements of P arranged in P*, to unity

RESULTS AND DISCUSSION

Markov analysis is the way of analyzing the current movement of trade to predict its future movement. The results of the analysis were expected to identify the reliable trading partners and to assess the probability of retention of old partners in livestock products trade. In the transition probability matrix, the rows identify the current state of trade to different countries and the column identifies the alternatives to which the trade pattern could move. The transition probabilities computed based on the quantity of trade of livestock products are prescribed in this section.

The transitional probability matrix constructed for India's export of dairy products trade is presented in Table 1, which depicts a broad indication of changes in the direction of the export of dairy products from India. The period considered for this analysis was seven years from 2010-11 to 2017-18. The four major countries to which India exported dairy products which were considered for the analysis were USA, UAE, Afghanistan, Oman and with the remaining importing countries grouped as others. As could be seen from the table, the transition probability matrix indicated that India could not retain its previous export of dairy products to Afghanistan and Oman during the study period. The entire share of Afghanistan was directed to USA (71.10%), followed by other countries (16.10%) and Oman (12.80%). Again, the whole share of Oman was directed to UAE (100.00%), followed by other countries (16.10%) and Oman (12.80%).

Table - 1. Transitional probability matrix for India's export of dairy products

Country	USA	UAE	Afghanistan	Oman	Others
USA	**0.042**	0.958	0.000	0.000	0.000
UAE	0.000	**0.237**	0.076	0.100	0.587
Afghanistan	0.711	0.000	**0.000**	0.128	0.161
Oman	0.000	1.000	0.000	**0.000**	0.000
Others	0.000	0.000	0.000	0.000	**1.000**

India's previous export dairy products to the UAE market were retained to the level of 23.70% during the current period. The remaining 58.70% was diverted to other countries, followed by Oman (10.00%) and Afghanistan (7.60%). However, UAE has a higher probability to gain Oman's market (100%), as already stated. India's previous export to other countries market was retained at the same level (100%) during the current period and the other countries have a higher probability to gain UAE's export market (58.70%), followed by Afghanistan's market (16.10%).

Table 2 presents the transitional probability matrix for India's import of dairy products. The four major exporting countries analyzed were France, Turkey, Denmark, Italy and with the remaining countries being grouped as others. The transitional probability matrix for imports of dairy products reveals that the probability of retention of the present quantity of dairy products imported is the highest in other countries (96.40%), followed by import from Denmark (44.20%). India could not retain its previous import of dairy products from France, Turkey and Italy during the period.

Table - 2. Transitional probability matrix for India's import of dairy products

Countries	France	Turkey	Denmark	Italy	Others
France	**0.000**	0.000	0.000	0.000	1.000
Turkey	0.000	**0.000**	0.385	0.000	0.615
Denmark	0.000	0.000	**0.442**	0.000	0.558
Italy	0.000	0.000	0.000	**0.000**	1.000
Others	0.021	0.000	0.008	0.007	**0.964**

The entire share (100%) of France was directed to other countries. Turkey's import share was directed to Denmark (38.50%) and to other countries (61.50%). However, 55.80% of India's import would be now from other countries.

The transitional probability matrix constructed for India's export of poultry products trade is presented in Table 3, which depicts a broad indication of changes in the direction of the export of poultry products from India. The period considered for this analysis was seven years from 2010-11 to 2017-18. The four major countries to which India exported poultry products which were considered for the analysis were Oman, Maldives, Japan, and Vietnam and with the remaining importing countries grouped as others. The probability of retention of

the quantity of export of poultry products to the Maldives was at a level of 65.10% during the study period. The remaining was diverted to Oman (32.90%) and Vietnam (1.90%).

India could not retain its previous export of poultry products to Japan and Vietnam during the study period 2010-11 to 2017-18. The entire export share of Japan was directed to other countries. Vietnam's share of poultry products imports from India was diverted to the other countries (86.10%), with 13.90% going to Oman. Probability of retention of the present quantity of export of poultry products to Oman was at the level of 32.70% and remaining was diverted to other countries (56.80%), Vietnam (8.50%) and Maldives (2.00%). Oman has a higher probability to get the export market of other counties (75.70%), Maldives (32.90%) and Vietnam (13.90%).

Table - 3. Transitional probability matrix for India's export of poultry products

Countries	Oman	Maldives	Japan	Vietnam	Others
Oman	**0.327**	0.020	0.000	0.085	0.568
Maldives	0.329	**0.651**	0.000	0.019	0.000
Japan	0.000	0.000	**0.000**	0.000	1.000
Vietnam	0.139	0.000	0.000	**0.000**	0.861
Others	0.757	0.025	0.046	0.022	**0.150**

The four major importing countries for poultry products taken for this analysis were Poland, France, Germany, Brazil with the remaining importing countries grouped as others. As could be seen from Table 4, the transition probability matrix indicated that India's previous poultry products import from the France market was retained to the level of 52.00% and the remaining 48% was diverted to others (39.30%), Brazil (8.50%) and Poland (0.20%). However, France had a higher probability to gain other countries' share (57.90%) and Poland's export market (25.00%). India could not retain its previous import of poultry products from Brazil and other countries. The entire share of Brazil was diverted to Poland (64.70%) and Germany (35.30%).

Table - 4. Transitional probability matrix for India's import of poultry products

Countries	Poland	France	Germany	Brazil	Other
Poland	**0.125**	0.250	0.203	0.423	0.000
France	0.002	**0.520**	0.000	0.085	0.393
Germany	0.346	0.000	**0.431**	0.000	0.223
Brazil	0.647	0.000	0.353	**0.000**	0.000
Other	0.309	0.579	0.000	0.111	**0.000**

The transitional probability matrix constructed for India's export of processed meat trade is presented in Table 5, which depicts a broad indication of changes in the direction of export of processed meat from India. The period considered for this analysis was seven years from 2010-11 to 2017-18.

Table - 5. Transitional probability matrix for India's export of processed meat

Countries	UAE	Qatar	Maldives	Myanmar	Others
UAE	**0.397**	0.000	0.000	0.000	0.603
Qatar	0.000	**0.000**	0.000	0.000	1.000
Maldives	0.000	0.000	**0.000**	0.000	1.000
Myanmar	0.002	0.825	0.000	**0.173**	0.000
Others	0.048	0.486	0.000	0.096	**0.369**

The four major countries to which India exported poultry products which were considered for the analysis were UAE, Qatar, Maldives, Myanmar and with the remaining importing countries grouped as others. The computed probabilities revealed that the probability of retention of present quantity of processed meat export is highest in UAE (39.70%), followed by other countries (36.9%) and Myanmar (17.30%). In the case of UAE, the remaining 60.30% of the export market share will be shifted to other countries. India could not retain its previous export of processed meat to Qatar and Maldives during the study period. However, Qatar having higher probability to gain 82.50% market shares of Myanmar, and from other countries, it was of 48.60%. Qatar and Maldives had 100% probability and UAE having 60.30% probability of shifting of export market to other countries.

The direction of import from the different countries like Sri Lanka, Spain, Thailand, Belgium and other countries were assessed from the computed transitional probability matrix, given in Table 6. It can be understood from the matrix that all the four main countries are not able to retain its export to India during the study period of 2010-11 to 2017-18. There was 100% probability of shifting of export to India from Sri Lanka to other countries, and from Spain to Sri Lanka. It was also noticed that there was 93.50% probability to shift India's import from Belgium to Sri Lanka and 69.70% probability to shift from Thailand to Sri Lanka. Other countries had a higher probability of 88.80% to retain their present levels of imports to India in future years.

The transitional probability matrix constructed for India's export of buffalo meat trade is presented in Table 7, which depicts a broad indication of changes in the direction of export of buffalo meat from India. The period considered for this analysis was seven years from 2010 – 11 to 2017 – 18. The four major countries to which India exported poultry products which were considered for the analysis were Vietnam, Malaysia, Indonesia, Iraq and with the remaining importing countries grouped as others. As could be seen from the table, the transition probability matrix indicated that India's previous buffalo meat export to the Iraq market was retained to the level of 59.60% during the current period. The remaining 40.40% was diverted to other countries (33.70%) and Indonesia (6.60%).

Table - 6. Transitional probability matrix for India's import of processed meat

Countries	Sri Lanka	Spain	Thailand	Belgium	Others
Sri Lanka	**0.000**	0.000	0.000	0.000	1.000
Spain	1.000	**0.000**	0.000	0.000	0.000
Thailand	0.697	0.199	**0.000**	0.103	0.000
Belgium	0.935	0.062	0.003	**0.000**	0.000
Others	0.052	0.026	0.008	0.027	**0.888**

Table - 7. Transitional probability matrix for India's export of buffalo meat

Countries	Vietnam	Malaysia	Indonesia	Iraq	Others
Vietnam	**0.359**	0.118	0.000	0.000	0.522
Malaysia	0.920	**0.079**	0.000	0.000	0.000
Indonesia	0.313	0.127	**0.378**	0.181	0.000
Iraq	0.000	0.000	0.066	**0.596**	0.337
Others	0.429	0.048	0.003	0.025	**0.493**

However, Iraq had a probability to gain 18.10% of the market share of Indonesia and 2.50% of other countries. Malaysia showed only 7.90% probability to retain in the export market from India and its remaining 92.00% share was found to be directed to Vietnam. India's previous Buffalo meat export to the other countries market was retained to the level of 49.3% during the current period. The remaining share was directed to Vietnam (42.90%), Malaysia (4.80%), Iraq (2.50%) and Indonesia (0.30%). However, other countries had a higher probability to gain Vietnam's export market (52.20%), followed by Iraq's export market (33.70%).

Table 8 depicts the transitional probability matrix of India's previous buffalo meat import from various countries. From the matrix, it was observed that India having 100% probability to retain the import market from Belgium, followed by New Zealand (70.50%) and Australia (26.80%). The remaining 29.50 per cent of New Zealand was directed to other countries (29.40%) and Belgium (0.10%). However, New Zealand had 100% probability to gain the import market share of other countries and 21.90% market share of Australia. Australia's import market shares were found to be diverted to other countries (51.10%) and New Zealand (21.90%). Netherland was found to be failed 100% in retaining its current state of import market and the whole market is found to be shifted to other countries.

Table - 8. Transitional probability matrix for India's import of buffalo meat

Countries	New Zealand	Belgium	Australia	Netherland	Others
New Zealand	**0.705**	0.001	0.000	0.000	0.294
Belgium	0.000	**1.000**	0.000	0.000	0.000
Australia	0.219	0.000	**0.268**	0.000	0.511
Netherland	0.000	0.000	0.000	**0.000**	1.000
Others	1.000	0.000	0.000	0.000	**0.000**

On examination of the temporal and compositional changes in livestock exports and assessment of export competitiveness and factors affecting the growth of livestock export, it was reported that India was competitive in export of bovine meat (Kumar, 2010). The export of buffalo meat was found to have increased consistently, fuelled by poor domestic demand. However, the export of mutton did not have any prospects in the short-run, as even the domestic demand was not met. Also, India was not competitive in the export of milk and milk products. He identified domestic policy initiatives and increased production and productivity as the key factors for increasing the export of livestock products.

On examining India's meat exports, structure, composition and future prospects, it was found that since 1981, India made impressive strides in export of meat items, both in quantity and value terms (Suresh *et al.,* 2012). Buffalo meat exports increased heavily from 7.6 million tons in TE 1992–93 to 56 million tons in TE 2010-11 (Kumar *et al.*, 2012). Studying the changing direction of trade of sheep and goat meat in India, by analyzing the data of 20 years (1991 – 2011), using Markov Chain analysis, it was also found that India's previous export to the United Arab Emirates was retained at the level of 17% and import from Thailand retained at 100% during the period (Shilpashree *et al.,* 2017).

In spite of the promising trends in both population and production of livestock and poultry in the country, the export potentials of livestock and poultry products from India to other countries only look gloomy if the trends are analysed. This points to the fact that the country has to effectively tackle challenges it faces in food safety issues. With the surplus production of milk and egg being the remarkable feature of Indian livestock and poultry industry, unless food safety issues are strictly considered and addressed, the country will not be able to fully exploit the export potentials in the near future. Also, exploring all possible avenues for further processing and value addition of livestock and poultry products will help to achieve the desired results. Necessary focus to retain the existing target countries for export of livestock products and to persuade the other potential importing countries would require formulation and following up of globally acceptable food safety standards.

REFERENCES

Dent, W.T. (1967). Application of Markov analysis to international wool flows. *Review of Economics and Statistics*, **49(2):**613-616.

Kumar, A. (2010). Exports of livestock products from India: Performance, competitiveness and determinants. *Agricultural Economics Research Review*, **23:**57-67.

Kumar, A, Shiv, J and Chitra Y. (2012). Export of buffalo meat from India: Performance and prospects. Indian Journal of Animal Sciences, 82: 1578-1583.

Lee, T.C., Judge, G.G and Takayama T. (1965). On estimating the transitional probabilities of Markov process. *Journal of Agricultural Economics*, **47:**742-762.

Shilpashree, J., Pandian, A.S.S. Kumaravel, N. and Thangarasu (2017). Changing direction of trade of sheep and goat meat in India-An Application of Markov Chain Analysis. *Research Journal of Chemical and Environmental Science*, **5(3):**85-88.

Suresh, A., Kavita, B. and Chaudhary K.R. (2012). India's meat export: Structure, composition and future prospects. *Indian Journal of Animal Sciences,* **82**:749-56.

Influence of Standard Tannin and Standard Saponin on Methane Mitigation and Rumen Fermentation Characteristics for Ruminants

A. Bharathidhasan

Veterinary University Training and Research Centre,
Tamil Nadu Veterinary and Animal Sciences University,Vellore -632009.

ABSTRACT

Methane is one of the important green house gas, which is normally emitted from ruminants and represents a loss of feed energy by 8-12 per cent. A huge number of feeding strategies are used to mitigate the methane emission from ruminants for sustainable animal production. Hence an experiment was conducted to study the influence of standard tannin (ST) and standard saponin (SS) on methane mitigation and rumen fermentation characteristics for ruminants by in vitro gas production technique (IVGPT). The IVGPT was carried out by incubating the Cumbu Nappier hybrid (CN-CO4) grass and rumen liquor with ST + SS at varying levels viz., 0, 1.03 per cent + 0.78 per cent, 2.06 per cent + 1.56 per cent, 3.09 per cent + 2.34 per cent and 4.12 per cent + 3.12 per cent of substrate in six replicates for a period of 24 hours in shaking water bath. After 24 hours the total gas production and pH were measured and methane was estimated in Gas Chromatography. The in vitro true dry matter digestibility (IVTDMD) was estimated and methane emission (ml) per 100 mg truly digested substrate was calculated. The rumen fermentation characteristics were also studied. The total gas production was significantly ($p<0.0$) decreased in all ST + SS added groups and the maximum reduction was observed in 3.09 per cent ST + 2.34 per cent SS added group than control. The methane emission was significantly ($p<0.01$) decreased by 26.03, 29.75, 38.02 and 40.91 per cent in 1.03 per cent + 0.78 per cent, 2.06 per cent + 1.56 per cent, 3.09 per cent + 2.34 per cent and 4.12 per cent + 3.12 per cent ST + SS supplemented groups respectively than control. The minimum level of ST + SS that reduced the methane emission per 100 mg truly digested substrate (35.64 per cent) was 3.09 per cent + 2.34 per cent when compared to control. The rumen fermentation characteristics viz. ammonia nitrogen, IVTDMD, bacterial and protozoal population was significantly decreased in ST + SS added groups than control. The pH of the fermented medium was not altered in all the treatment groups. The TVFA, propionic acid and butyric acid were significantly increased in standard tannin and saponin added groups than control. The acetic acid and acetate to propionate (A/P) ratio were significantly reduced in ST + SS treated groups when compared to control. It was concluded that at minimum concentration of 3.09 per cent ST + 2.34 per cent SS significantly reduced the methane emission and methane (ml) per 100 mg of truly digested substrate ($p<0.01$) than control without any adverse effect on rumen fermentation characteristics by IVGPT.

Key Words: Tannin, saponin, methane, *in vitro* rumen fermentation, ruminants

Email ID: bdhasana@gmail.com

INTRODUCTION

Methane (CH_4) is a fermented product of ruminants and normally emitted to the environment. 15-30 per cent of the methane was produced from rumen fermentation (Moss *et al.,* 2000) and causes global warming. The CH_4 emission also represents a loss of gross energy of feed by 8-12 per cent, leads to lowersing the animal production. Therefore, decreasing the methane emission is desirable for improved efficiency of the digested energy utilization for production (Johnson and Johnson 1995) in terms of growth, milk production and also reducing the negative effect on climate change (global warming). There are a number of feeding strategies used for reducing the methane emission for sustainable production in ruminants. The use of antibiotics, ionophore compounds and many chemical feed additives have been shown to decrease the methane emission in ruminants and these may cause resistance and residual effect in the product (Patra and Saxena, 2011). Alternative to these compounds are plant metabolites like tannins, saponin and organic acids that have been shown to selectively modulate the rumen microbial populations resulting in an improvement of rumen fermentation and nitrogen metabolism and a decrease in methane production (Bharathidhasan *et al.*, 2016 and Bharathidhasan*,* 2018).

Generally the tannins are combined together with proteins to form complexes due to the presence phenolic hydroxyl groups and have been found to be toxic for some of the rumen microbes, especially ciliate protozoa, fiber degrading bacteria and methanogenic archaea, and as a result methanogenesis in the rumen can be reduced. Earlier studies also reported reduction in methane emissions consequent to feeding high levels of tannins (Ramirez-Restrepo and Barry, 2005; Hess *et al*., 2006). Similarly plants rich in saponins are known to decrease the methane production in the rumen (Bharathidhasan *et al.*, 2013). The majority of research on saponin has been employed to exploit it for inhibition of rumen ciliate protozoa, which might improve the efficiency of microbial protein synthesis by reducing microbial protein turnover and enhance protein flow to the duodenum and finally reduce methane production. Saponin in *Yucca* extracts (Wallace *et al.,* 1994) and in tropical forage tree like *Sesbania grandiflora* (Newbold *et al.*, 1997) are natural defaunating agents and by reacting with cholesterol in protozoal cell membrane, these saponins decrease the availability of hydrogen ions for methanogens leading to decrease in methane production. Hence the present experiment was carried out with an objective to study the combined effect of standard tannin and standard saponin on mitigation of methane emission and rumen fermentation characteristics by *IVGPT* in forage based diet for ruminants.

MATERIALS AND METHODS

The *in vitro* gas production technique (Menke and Steingass, 1988) was conducted to evaluate the influence of ST + SS at different levels viz. 0, 1.03 + 0.78 per cent, 2.06 per cent + 1.56 per cent, 3.09 + 2.34 per cent and 4.12 + 3.12 per cent, of substrate (*Pennisetum purpureum* x P*ennisetum glaucum*) in six replicates on rumen methane mitigation for ruminants (**Table 1**). The standard tannin (CAS

No.1401-55- 4; EC No.215-753-2; MDL No.MFCD00066397) and standard saponin (CAS No.8047-15- 2; EC No.232-462-6; MDL No.MFCD00081981) was procured from M/s. Sigma Aldrich. The substrate Hybrid Cumbu Nappier (CN- CO4) grass (*Pennisetum purpureum* x P*ennisetum glaucum*) was used for this study.

Table 1. Experimental design to identify the level of standard tannin and standard saponin needed to reduce methanogenesis

Treatment*	Inclusion level of standard tannin + standard saponin (per cent of substrate)	Quantity of standard tannin + standard saponin included to 200 mg of substrate inoculated
1 (Control)	0	0 mg
2	1.03 + 0.78	2.06 mg +1.56 mg
3	2.06 + 1.56	4.12 mg + 3.12 mg
4	3.09 + 2.34	6.18 mg + 4.68 mg
5	4.12 + 3.12	8.24 mg + 6.24 mg

*Each treatment was carried out with six replicates

The *in vitro* gas production study was carried out with rumen fluid collected by rumen extraction pump from three cattle maintained on grazing and it was squeezed through four layers of gauze in to an Erlenmeyer flask under continuous flushing with CO_2 and it was maintained at the temperature of 39 ^oC. Then rumen fluid was mixed with media as described by Menke and Steingass (1988). The substrate Hybrid Cumbu Nappier grass (CN-CO4) was dried and milled to pass through 1 mm sieve and 200 mg was weighed and taken in 100 ml calibrated syringes and weighed quantity of standard tannin + standard saponin at various levels were added to the syringes in six replicates. Then 30 ml of rumen inoculum was anaerobically transferred to glass syringe and it was incubated in a shaking water bath at 39 ^oC for 24 hrs. At the end of the incubation period the total gas was measured and pH also determined in fermentation fluid. The gas samples were collected in vacuotainer for estimation of methane.

Estimation of methane

Methane concentration was estimated using Gas Chromatography (Perkin Elmer, Claurus 500 model) fitted with Flame Ionization Detector (FID) and capillary column (30 meter length and 250 micrometer diameter). Helium was used as carrier gas with oven temperature at 60^o C, injector temperature at 100^{o}C and detector temperature at 110^{o}C. Methane concentration in samples (per cent) was calculated using the following formula.

$$\text{Methane concentration (per cent)} = \frac{\text{Peak area of sample gas}}{\text{Peak area of standard gas}} \times \text{Methane concentration in standard (per cent)}$$

$$\text{Methane emission (ml)} = \frac{\text{Methane concentration (per cent)}}{100} \times \text{Net gas production (ml)}$$

Estimation of rumen fermentation characteristics

The fermented fluid after 24 hrs incubation was collected for estimation of rumen fermentation characteristics. The ammonia nitrogen was estimated by steam distillation as per the method of Makkar and Becker (1996). The *in vitro* true dry matter digestibility (*IVTDMD*) was determined after the addition of Neutral Detergent Solution (NDS) with fermented dry matter in Fibretec ((Van Soest and Robertson, 1988). The volatile fatty acids were estimated as per the method of Chase, (1990). Bacterial (Gall e*t al.,* 1949) and protozoal (Moir, 1951) population were also counted by using the standard procedure.

Statistical analysis

The data collected on various parameters was statistically analyzed as per the method of Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Effect of standard tannin and standard saponin on rumen methane mitigation

The effect of standard tannin and standard saponin on total gas (ml), methane (ml), percentage of methane on total gas production and methane (ml) per 100 mg of truly digested substrate are presented in **Table 2**.

The total gas production was significantly ($p<0.01$) decreased in all standard tannin and standard saponin supplemented groups and it was lowered by 17.11, 17.93, 22.00 and 25.75 per cent in 1.03 per cent + 0.78 per cent, 2.06 per cent + 1.56 per cent, 3.09 per cent + 2.34 per cent and 4.12 per cent + 3.12 per cent ST + SS added groups respectively than control. Similarly, Getachew *et al*. (2008) observed that the addition of purified quebracho tannins to alfalfa hay decreased the rate of gas production significantly ($p<0.01$) with increased level of tannin from 0 to 150 mg/kg DM by *IVGPT*. The decrease in the rate of total gas production was due to the increasing the level of purified gallic acid and tannic acid which might suggest that the rumen microbes were decreased while degrading the gallic acid and tannic acid by *in vitro* (Getachew *et al*., 2008; Bharathidhasan *et al*., 2018). Vieira and Borba (2011) also reported that the effect of tannin using 2.5 per cent and 5.0 per cent *Quebracho* extracts significantly ($p<0.05$) decreased the total gas production than control. The addition of standard saponin in the present study further reduced the total gas production which might be due to the antiprotozoal effect of saponin (Istiqomah *et al.,* 2011). Further Makkar *et al*. (1998) also observed that saponin from *Acacia auriculoformis* decreased the total gas production. The addition of tannin and saponin in the present study might have inhibited the rumen microorganisms specially the protozoa and methanogens decreasing the rumen fermentation which lead to decreased total gas production (Jayanegara *et al*., 2010).

Table 2.Effect of ST + SS in combination on total gas (ml), CH_4 (ml), percentage of CH_4 on total gas production and CH_4 (ml) per 100 mg of truly digested substrate by *IVGPT* (Mean# ± S.E)

Treatment	Inclusion level of ST + SS (per cent of substrate)	Total gas (ml)	CH_4 (ml)	per cent of CH_4 on Total gas production	CH_4 (ml) per 100 mg of truly digested substrate
1	0 (Control)	12.27 ± 0.19^{c}	2.42 ± 0.01^{c}	19.75 ± 0.37^{c}	2.02 ± 0.01^{d}
2	1.03 + 0.78	10.17 ± 0.18^{b}	1.79 ± 0.06^{b}	17.61 ± 0.35^{b}	1.52 ± 0.04^{c}
3	2.06 + 1.56	10.07 ± 0.30^{b}	1.70 ± 0.09^{b}	16.89 ± 0.43^{ab}	1.46 ± 0.09^{bc}
4	3.09 + 2.34	9.57 ± 0.32^{ab}	1.50 ± 0.05^{ab}	15.65 ± 0.37^{a}	1.30 ± 0.04^{ab}
5	4.12 + 3.12	9.13 ± 0.20^{a}	1.43 ± 0.06^{a}	15.63 ± 0.30^{a}	1.22 ± 0.04^{a}

Mean of six observations; NS Not significant,

Means bearing different superscripts in the same column differ significantly ($p<0.01$)

The methane production was significantly ($p<0.01$) decreased in all the treatment groups than control. The decrease in methane production was lowered by 26.03, 29.75, 38.02 and 40.91 per cent in treatment 2, treatment 3, treatment 4 and treatment 5 respectively than control. The minimum level that reduced the maximum methane was 3.09 + 2.34 per cent of ST +SS.

In early, Bhatta *et al*. (2009) observed that the addition of *quebracho* tannin (7.62 per cent hydrolysable tannin and 1.33 per cent condensed tannin) at 5, 10, 15, 20 and 25 per cent of substrates like timothy hay (65): concentrates (35) decreased the methane production by 10.2 to 41.7 per cent in *IVGPT*. Jayanegara *et al*. (2010) also reported that the simple phenolics like cinnamic, caffeic, p-coumaric and ferulic acids decreased the methane production significantly ($P<0.05$) when added at 5 mM. They also reported that addition of purified chestnut and sumach (hydrolysable tannin) at 1mg/ml to *in vitro* rumen fermentation system containing hay: concentrate (70:30) decreased ($P<0.05$) methane production by 6.5 and 7.2 per cent respectively. The methane emission was decreased by 18 – 52 per cent by the addition of saponin from 1.2 mg to 3.2 mg/L (Lila *et al.,* 2003). Guo *et al*., (2008) observed that saponin at 0.4mg/ml significantly ($P<0.01$) reduced the methane release by 76 per cent than control by *in vitro*. Other scientists also reported a reduction in methane production by saponin rich plant such as *Yucca shidigera*, *Quillajia saponaria Acacia concinna* (Patra *et al*., 2006; Holtshausen *et al*., 2009) *Sapondis mukorassi* fruit pulps (Agarwal *et al*., 2006), *Knautia arvensis* leaves and *Sesbania sesban* leaves (Goel *et al*., 2008).

The highly significant ($p<0.01$) decrease in percentage of methane on total gas production was observed in all ST + SS added groups than control. The minimum level at 3.09 + 2.34 per cent of ST +SS was able to reduce the maximum methane on total gas production by 20.76 per cent when compared to control. On accordance to the study Pellikaan *et al*. (2011) who observed a reduction of methane emission on total gas production by 16.30 per cent and 15.85 per cent by the addition of condensed tannin and hydrolysable tannin at 100g/kg respectively when compared to control by *in vitro* study. Further, the addition of 0.3, 0.6, 0.9 g/litter of saponin significantly ($P<0.05$) reduced the methane levels by 23.43, 24.93 and 25.30 per cent respectively by *IVGPT* (Feng *et al*., 2012).

The methane (ml) per 100 mg of truly digested substrate was significantly ($p<0.01$) reduced by 24.75, 27.72, 35.64 and 39.06 per cent respectively in treatment 2, treatment 3, treatment 4 and treatment 5 than control. The minimum level at 3.09 per cent ST + 2.34 per cent SS was reduced the methane (ml) per 100 mg of truly digested substrate to the maximum extent when compared to control. Similar to the present study Castro –Montoya *et al*. (2011) also observed that the purified condensed tannin like *quebracho* tannin and mimosa tannin at 0.5, 0.75 and 1.0 mg/ml decreased ($P<0.001$) the methane emission per 100 mg true dry matter digestibility by 25, 30.77 and 36.54 per cent ($p=0.001$) and 23.08, 32.69 and 40.38 per cent respectively in in *quebracho* tannin and mimosa tannin than control. They also found that the purified hydrolysable tannin like sumach tannin and chestnut tannin at 0.5, 0.75 and 1.0 mg/ml decreased the methane emission (ml) per 100 mg true dry matter digestibility by 17.31, 23.08 and 30.76 per cent respectively in sumach tannin ($P=0.003$) and 13.46, 17.31 and 21.25 per cent respectively in chestnut tannin ($P = 0.007$) than control. Also the addition of condensed tannin and hydrolysable tannin at 10 per cent decreased the methane emission per gram of organic matter by 24.48 per cent and 17.88 per cent respectively than control (Pellikaan *et al*., 2011). The methane emission in mmol per 200 mg of dry matter addition of gross saponin of *Tribulus terrestris* supplementation at 0.30, 0.60 and 0.90 g/litre of incubation medium significantly ($P<0.05$) decreased by 26.67, 28.89 and 31.11 per cent than control (Feng *et al*.,2012).

The effect of tannin and saponin on reduction of methanogenesis in the present study could be expected since they affect the activities of rumen microbes, mainly inhibiting the bacterial and protozoal population. Further the antiprotozoal activities of tannin and saponin would decrease the methane production since a portion of methanogens are attached to the protozoa (Goel and Makkar, 2012; Bharathidhasan *et al.,* 2013; Bharathidhasan, 2018). Tavendale *et al*. (2005) suggested two modes of the action of tannin on methanogenesis: first directly affecting the activity or population of methanogens resulting in lower methane emission and second, indirectly by reduced hydrogen production by lowering the feed degradation. Similar suggestion was also reported by Jayanegara *et al*. (2011) for decreased methane emission while using tannin in the diet. Further saponin also decreases

the number of protozoal population as a result of cell death by forming complexes with cell membranes (Cheeke, 1999). The saponins modify the ruminal fermentation by suppressing ruminal protozoa and selectively inhibit some bacteria. The symbiosis of protozoa with methanogenic bacteria is well established in the rumen and selective suppression of protozoa has been suggested to reduce the methane production (Cheeke, 1999). Hence the combined effect of ST + SS was able to reduce the methane emission in the present study.

Effect of standard tannin and standard saponin on rumen fermentation characteristics

The effect of standard tannin and standard saponin on ammonia nitrogen, (mg/100ml), bacterial count, protozoal count, i*n vitro* true dry matter digestibility (*IVTDMD*) and pH are presented in **Table 3** and total volatile fatty acid (TVFA), acetic acid, propionic acid, butyric acid and acetate propionate (A/P) ratio are presented in **Table 4**.

The ammonia nitrogen content was significantly ($p<0.01$) reduced by 5.13, 10.18, 10.66 per cent in treatment 3, treatment 4 and treatment 5, respectively than control. Similarly, the addition of 2 mg/ml of *Moringa oleifera* aqueous methanol extract which contained 1.11 per cent of hydrolysable tannin decreased the total ammonia nitrogen by 13.63 per cent than control (Alexander *et al*., 2008). Pellikaan *et al*. (2011) also reported that the ammonia nitrogen was significantly ($P<0.01$) decreased by 35.18 and 33.38 per cent in condensed and hydrolysable tannin addition at 100g/kg substrate than control. Sliwinski *et al*. (2002) observed that the addition of *Yucca schidigera* extract containing saponin at 100 mg sarsaponin per kg dry matter to the basal diet containing grass silage, barley grain and grass hay decreased the ammonia nitrogen significantly ($P<0.05$) by 21.32 per cent than control. Hess *et al*. (2003) also reported that the effects of three saponin rich tropical fruits viz. 100 mg/g of *Sapindus saponaria* (Saponin 1.2 per cent and CT 0.32 per cent), *200 mg/g of Enterolobium cyclocarpum* (Saponin 0.39 per cent and CT 1.04 per cent) *or 200 mg/g of Pithecellobium saman* (Saponin 0.34 per cent and CT 1.22 per cent) or no tropical fruit supplemented diets decreased the ammonia nitrogen ($P<0.05$) by 17 per cent with *Pithecellobium saman* compared to other treatments. Hanim *et al*. (2009) also reported that that supplementation of saponin at 2 per cent and 3 per cent of substrate decreased ($P<0.01$) the ammonia concentration by 16.9 and 16.5 per cent respectively than control. The decreased ammonia nitrogen in the present study might be due to the binding of tannins with protein, which resists the rumen degradation, thereby reducing ammonia nitrogen in the rumen (Vieira and Borba, 2011).

There was a significant ($p<0.01$) difference in *IVTDMD* while supplementing the ST+SS in forage based diet. The reduction of *IVTDMD* was very limited from 1.94 per cent to 3.66 per cent in treatment groups than control. The decrease in *IVTDMD* in the present study was very less when compared to the earlier study by Alexander *et al*. (2008) who reported that the addition of 0.75 and 1.0 mg/ ml

of *Moringa oleifera* aqueous methanol extract significantly (P<0.05) decreased the apparent dry matter digestibility (but not the true dry matter digestibility) 7.94 and 13.53 per cent than control. Sliwinski *et al*. (2002) observed that the addition of *Castanea sativa* wood extracts containing the hydrolysable tannin at 0.5 and 2.5 g per kg dry matter did not influence the organic matter degradation in the treatment groups by *RUSITEC*. Further, the purified condensed tannin like quebracho tannin and mimosa tannin and hydrolysable tannin like sumach tannin and chestnut tannin at 0.5, 0.75 and 1.0 mg/ml of *in vitro* rumen fermentation study did not influence the *IVTDMD* in all treatment groups (Castro – Montoya *et al*., 2011).

Table 3. Effect of SS + ST on ammonia nitrogen, (mg/100ml), bacterial count, protozoal count, *in vitro* true dry matter digestibility (*IVTDMD*) and pH (Mean[#] ± S.E)

Treatment	Inclusion level of ST + SS (per cent of substrate)	Ammonia Nitrogen (mg/100ml)	*In vitro* true dry matter digestibility (*IVTDMD*)	Bacterial count (X 10^8)	Protozoal count (X 10^5)	pH [NS]
1	0 (Control)	35.07 ± 0.22 [c]	59.91 ± 0.03 [c]	4.65 ± 0.04 [d]	3.65 ± 0.06 [d]	7.05 ± 0.08
2	1.03 + 0.78	34.17 ± 0.34 [bc]	58.75 ± 0.06 [ab]	4.13 ± 0.02 [c]	3.30 ± 0.05 [c]	6.87 ± 0.12
3	2.06 + 1.56	33.27 ± 0.22 [b]	58.22 ± 0.18 [a]	3.95 ± 0.04 [b]	2.99 ± 0.06 [b]	6.90 ± 0.06
4	3.09 + 2.34	31.50 ± 0.27 [a]	57.72 ± 0.23 [a]	3.69 ± 0.05 [a]	2.67 ± 0.03 [a]	6.73 ± 0.03
5	4.12 + 3.12	31.33 ± 0.40[a]	58.60 ± 0.31 [ab]	3.73 ± 0.02[a]	2.68 ± 0.02 [a]	6.77 ± 0.15

[#] Mean of six observations; [NS] Not significant, Means bearing different superscripts in the same column differ significantly (p<0.01)

Earlier reports suggested that the degradability of feed became decreased due to the inclusion of different plant extracts containing tannin and saponin in incubation media (Lila *et al*., 2003; Patra and Saxena, 2010; Santara *et al*., 2012). They concluded that the higher level of tannin and saponin might be detrimental to the rumen microbes leading to decrease in the rumen fermentation and digestibility to the maximum.

The bacterial count in all ST + SS treated groups was significantly (p<0.01) decreased than in control. The minimum dose with maximum reduction of bacterial load was by 20.65 per cent observed in 3.09 + 2.34 per cent ST + SS treated group than control. Similarly Sliwinski *et al*. (2002) reported that the addition of *Castanea sativa* wood extracts containing the hydrolysable tannin at 0.5 g and 2.5 g per kg dry matter to the basal diet with grass silage, barley grain and grass hay based diet reduced the bacterial count by 3.14 and 11.55 per cent respectively than control in *Rusitec*. The earlier work of Tagari *et al*. (1965) observed

that the cellulolytic and proteolytic bacteria growth was inhibited by pod tannins in an artificial rumen. It has been stated that tannins from carob pod extract changed the morphology of bacteria to produce antimicrobial activity (Heins *et al*., 1964). Hence inhibitory activity of tannins against bacteria has been implicated due to the ability of tannins to form complexes with the cell wall and membrane bacteria causing morphological changes of the cell wall and the extracellular enzymes secreted (Smith *et al*., 2005). Further the addition of saponin with tannin in the present finding agrees well with Wallace *et al*. (1994) who reported that saponins inhibit the growth of *Butyrivibrio fibrisolvens* and *Strptococcus bovis* bacteria. It seems that saponins show a more marked antibacterial activity against Gram positive than against Gram negative bacteria (Patra and Saxaena, 2010).

The protozoal count was significantly (P<0.05) reduced in all tannin and saponin treated groups than control. The reduction in protozoal count was 9.59, 18.08, 26.85 and 26.57 per cent in 1.03 + 0.78, 2.06 + 1.56, 3.09 + 2.34 and 4.12 + 3.12 per cent of ST + SS added groups, respectively than control. Similarly, Makkar *et al*. (1995) reported that the quebracho tannin significantly reduced the numbers of total protozoa, Entodiniomorph and holotichs, the effect being higher on Holotrichs which may increase the efficiency of microbial protein synthesis in the rumen. Also Patra *et al*. (2006) observed the tannin extracted with ethanol and methanol from *Terminalia chebula* decreased the numbers of total protozoa. Anti protozoal properties of tannins from *Lotus striata* and *Lotus cuneata* have been reported in many studies (Animut *et al*., 2008) Quebracho and mimosa tannin (Bhatta *et al.,* 2009).

In accordance to the present study, reduction in protozoal count by the addition of saponin was reported by Bharathidhasan *et al.* (2013). Hess *et al*. (2003) reported that the effects of *Sapindus saponaria containing s*aponin at 1.2 per cent and condensed tannin at 0.32 per cent decreased the protozoal population significantly (P<0.05) by 53.97 per cent than control. Hu *et al*. (2005) observed that the addition of tea saponin reduced the protozoal numbers significantly (P<0.05) by 19, 25, 45 and 79 per cent for 2, 4, 6 and 8 mg respectively of total saponin than control. Similarly, Guo *et al*. (2008) observed that tea saponin at 0.4 mg/ml reduced the protozoal count by 51 per cent (P<0.05) than control. Further, Feng *et al*.(2012) observed that the addition of gross saponin of *Tribulus terrestris* (GSTT) at 0.15, 0.30, 0.60 and 0.90 g/ litre of incubation medium significantly (P<0.05) reduced the protozoal population by 27.03, 37.03, 60.36 and 72.07 per cent respectively than control. One possible mechanism to explain the effect of saponins on protozoa is a change in cell membrane permeability (Klita *et al*., 1996) as they form complexes with cholesterol in protozoal cell membranes and result in cell lysis.

No significant difference of pH of fermented medium among the treatment groups in the present study was also agreed with the earlier reports by Hanim *et al*. (2009) who observed that the supplementation of saponin at 1, 2 and 3 per cent of substrate did not influence the pH of the fermented medium among the treatment groups. The addition of condensed tannin through

Medicago sativa and *Lotus pedunculatus* also did not influence the pH by *IVGPT* (Tavendale *et al*., 2005). The unaltered pH in the present study was due to the hydrogen accumulation during the inhibition of methanogens for methane reduction in which the carbohydrate fermenting bacteria utilize other mechanism of reducing equivalent particularly elimination of hydrogen ions and there by the pH is unaltered. (Kessel and Russel, 1996).

Table 4. Effect of ST + SS on total volatile fatty acid (mg/dl), acetic acid (per cent), propionic acid (per cent), butyric acid (per cent) and A/P ratio (Mean# ± S.E)

Treatment	Inclusion level of ST + SS (per cent of substrate)	TVFA (mg/dl) **	Acetic acid** (per cent)	Propionic acid * (per cent)	Butyric acid ** (per cent)	A/P ratio **
1	0 (Control)	65.91 ± 0.32 ^{a}	65.42 ± 0.20 ^{c}	23.18 ± 0.22 ^{a}	11.40 ± 0.28 ^{a}	2.83 ± 0.03 ^{c}
2	1.03 + 0.78	66.23 ± 0.08 ^{a}	63.83 ± 0.21 ^{ab}	23.85 ± 0.43 ^{ab}	12.32 ± 0.50 ^{ab}	2.69 ± 0.06 ^{bc}
3	2.06 + 1.56	67.92 ± 0.68 ^{b}	62.75 ± 0.17 ^{a}	23.93 ± 0.26 ^{ab}	13.32 ± 0.32 ^{b}	2.63 ± 0.03 ^{ab}
4	3.09 + 2.34	69.23 ± 0.29 ^{bc}	62.33 ± 0.54 ^{a}	24.57 ± 0.34 ^{b}	13.52 ± 0.56 ^{b}	2.53 ± 0.05 ^{a}
5	4.11 + 3.12	69.10 ± 0.50 ^{c}	62.08 ± 0.42 ^{a}	24.08 ± 0.35 ^{ab}	13.83 ± 0.54 ^{b}	2.59 ± 0.05 ^{ab}

Mean of six observations; Means bearing different superscripts in the same column differ significantly ($p<0.01$)**, ($p<0.05$)*

The TVFA, propionic acid and butyric acid was significantly increased in ST + SS added groups than control. The TVFA and butyric acid was significantly ($p<0.01$) increased by 2.96, 4.8 and 4.62 per cent and 14.41, 15.68 and 17.57 per cent respectively in treatment 3, treatment 4 and treatment 5 when compared to control. The propionic acid was significantly ($p<0.05$) increased by 5.66 per cent in 3.09 + 2.34 per cent ST + SS supplemented group than control.

Similar to the present study, Hess *et al*. (2006) also observed that the TVFA significantly ($P<0.05$) increased by supplementation with low tannin legume (*Cratylia argentea)* or in mixture with high tannin legume (*Calliandra calothyrsus) or* in high tannin legume (*Calliandra calothyrsus)* alone than grass (without tannin) in *RUSITEC*. But Sliwinski *et al*. (2002) observed that the addition of *Castanea sativa* wood extracts containing the hydrolysable tannin at 0.5 and 2.5 g per kg dry matter to the basal diet with grass silage, barley grain and grass hay did not influence TVFA, propionic acid and butyric acid among the treatment groups in *RUSITEC*. Castro –Montoya *et al*. (2011) also observed that the propionic acid was increased in purified condensed tannin (CT) like quebracho tannin at 0.5- 1.0 mg/dl by 28.6 - 32.2 per cent and mimosa tannin at 0.5- 1.0 mg/dl by 29.4 - 31.9 per cent than

control (22.7 per cent) by *in vitro*. They also observed that the purified hydrolysable (HT) tannin like sumach tannin at 0.5 - 1.0 mg/ml increased the propionic acid by 22.5 - 26.6 per cent than control. Further they studied the effect of purified saponin from quillaja saponin at 0.5- 1.25 mg/dl increased (P= 0.001) the propionic acid by 17.75 – 29.5 per cent than control where as in gypsophilla saponin the increase was only by 1.25 mg /dl (2.99 per cent) than control.

Similar to the present experiment, Guo *et al*. (2008) also observed that the addition of tea saponin at 0.4 mg per ml of rumen liquor increased the total VFA marginally than control and the molar proportion of propionate was significantly ($p<0.05$) increased by 21.5 per cent to 24.1 per cent than control. The saponin based surfactant at 5, 10 and 20 µl/g DM increased ($P = 0.005$) the propionic acid by 4.35, 13.48 and 8.33 per cent, respectively and increased ($P = 0.241$) the butyric acid by 1.08, 11.96 and 3.66 per cent, respectively in barley grain based diet when compared to control by *in vitro* (Wang *et al*., 2011). Further, the propionic acid was significantly ($P<0.05$) increased by 8.44, 9.72 per cent while the addition of gross saponin of *Tribulus terrestris* (GSTT) at 0.60 and 0.90 g/litre of incubation medium respectively than control (Feng *et al*., 2012).

Alexander *et al*. (2008) reported that the addition of *Moringa oleifera* aqueous methanol extract which contained 1.11 per cent of hydrolysable tannin (HT) and 4.09 per cent of saponin increased ($p<0.01$) the propionic acid and butyric acid production by 6.8 per cent and 16.16 per cent respectively than control and however the TVFA production was significantly ($P<0.05$) decreased than control. The acetic acid and acetate to propionate ratio were significantly ($p<0.01$) decreased in ST + SS treated groups than control. The decrease in acetic acid and A/P ratio was 4.08 -5.11 per cent and 7.07 – 10.6 per cent respectively in ST + SS treated groups when compared to control.

Similarly Alexander *et al*. (2008) reported that the addition of *Moringa oleifera* aqueous methanol extract which contained 1.11 per cent of HT and 4.09 per cent of saponin decreased the total acetic acid production and acetate to propionate ratio significantly ($P<0.05$) by 13.83 per cent and 19.64 per cent respectively than control. Getachew *et al*. (2008) also observed that the addition of purified quebracho tannin reduced the total acetic acids and acetate to propionate ratio significantly ($P<0.01$) at 100 g/kg DM by 47.35 per cent and 27.59 per cent than control. Pellikaan *et al*. (2011) reported that the acetic acid production reduced significantly ($P<0.05$) by the addition of CT and HT at 100g/kg substrate than control. Castro –Montoya *et al*. (2011) also observed that the acetic acid and acetate propionate ratio was significantly ($p<0.01$) decreased in purified CT (quebracho tannin and in mimosa tannin), purified HT (sumach tannin and chestnut tannin) and purified saponin from quillaja saponin by *in vitro*.

Tea saponin reduced the acetate to propionate ratio from 3 per cent to 2.6 per cent significantly ($P<0.05$) (Guo *et al*., 2008). Wang *et al*. (2011) reported that the saponin based surfactant at 5, 10 and 20 µl/g DM decreased ($P = 0.063$) the acetic acid

by 0.83, 5.78 and 2.64 per cent respectively in barley grain based diet when compared to control by *in vitro*. The addition of gross saponin of *Tribulus terrestris* (GSTT) supplementation 0.90 g/litre of incubation medium significantly (P<0.05) decreased the acetic acid level (Feng *et al*., 2012).

The decrease in acetic acid and increase in propionic acid in the present study suggesting that the nutrients were partitioned more towards microbial protein synthesis in the presence of tannins (Makkar *et al*., 1995). Further the decrease in acetic acid may also be due to the stronger inhibitory effect over acetate producing bacteria (*Ruminococcus albus, Butyrivibrio fibrisolvens*) than on others, either by directly inhibiting them or by inhibiting the production of their preferred substrate (Castro-Montoya *et al*., 2011). The saponin may support faster growth of certain bacteria leading to increased propionate production in the rumen (*Selenomonas ruminantium*, *Succinomonas amylolytica*) (Pen *et al*., 2006). The reduced acetic acid to propionic acid ratio might have been combined consequence of the significant reduction of acetic acid and increased propionic acid levels by tannin and saponins (Castro-Montoya *et al*., 2011). The ideal compound to inhibit the methanogenesis would be one that is effective in reducing methane production but which also increases propionic acid (Tavendale *et al*., 2005). Ruminal VFA and methane production strongly correlate with acetic acid to propionic acid ratio (Russel and Vansoest, 1984). The strong inverse relationship between the molar proportions of propionic acid and methane production can be predicted from knowledge of interactions among ruminal microbial populations and compounds like tannin and saponin that promote higher production of propionic acid in the rumen which may also decrease methane production (Tavendale *et al*., 2005). The above explanation confirms the changes in the acetic acid, propionic acid and A/P ratio observed in the present study.

CONCLUSION

It was concluded that the minimum concentration of 3.09 per cent ST + 2.34 per cent SS significantly reduced the methane, percentage of methane on total gas production and methane per 100 mg of truly digested substrate (p<0.01) by 38.02, 20.76 and 35.64 per cent respectively than control by *IVGPT.* The rumen ammonia nitrogen, *IVTDMD,* total bacteria and protozoa were significantly decreased in ST + SS treated groups than control. The TVFA, propionic acid and butyric acid were significantly increased and acetic acid and acetate to propionate ratio were significantly decreased in ST + SS treated groups. The decrease in methane emission recorded in this study was attributed to the suppression effects of tannin on rumen microbes especially on methanogen, protozoa and other bacteria which reduce the availability of hydrogen ions for methane production. Also the antiprotozoal activities of saponinn would decrease the methane production since a portion of methanogens attached to protozoa. Further the defaunation effect of saponin had synergistic with tannin justify the reduction of the methane emission in the present study without any adverse effect on rumen fermentation characteristics (Jayanegara *et al*., 2010). The energy saved

through decrease in methane emission can be used for sustainable animal production and may also curtail the global warming.

REFERENCES

Agarwal, N., Kamra, D.N., Chaudhary, L.C and Patra, A.K. (2006). Effect of *Sapindus mukorossi* extracts on *in vitro* methanogenesis and fermentation characteristics in buffalo rumen liquor. *Journal of Applied Animal Research,* **30:**1–4.

Alexander,G., Sing,B., Sahoo,A and.Bhat, T.K. (2008). *In Vitro* screening of plant extracts to enhance the efficiency of utilization of energy and nitrogen in ruminant diets. : *Animal Feed Science and Technology,* **145**: 229-244.

Animut, G.,.Goetsch, A.L.,.Puchala, R., Patra, A.K.,.Sahlu, T., Varel, V.H and Wells, J. (2008). Methane emission by goats consuming diets with different levels of condensed tannins from Lespedeza. *Animal Feed Science and Technology,* **144:**212-227.

Bharathidhasan, A., Viswanathan, K., Balakrishnan, V., Valli, C., Ramesh, S and Senthilkumar, T.M.A. (2013). Effects of purified saponin on rumen methanogenesis and rumen fermentation characteristics studied using *in vitro* gas production technique. *International Journal of Veterinary Science*, **2(2):**44-49

Bharathidhasan, A., Karunakaran, R., Pugazhenthi, T.R. and Ezhilvalavan, S. (2016). The effect of supplemental organic acid on methane reduction to decrease the global warming from dairy cattle. *Interational Journal of Advanced Chemical Science and Applications,* **3(4):**60-64

Bharathidhasan, A. (2018). Effect of standard tannin on *in vitro* rumen methane reduction and rumen fermentation characteristics. *Indian Journal of Veterinary and Animal Sciences Research*, **47(4):**1379-1391

Bhatta, R., Uyeno, Y., Tajima,K., Takenaka,A., Yabumoto,Y., Nonaka, I., Enishi, O and Kurihara, M. (2009). Difference in the nature of tannins on *in vitro* ruminal methane and volatile fatty acid production and on methanogenic archaea and protozoal populations. *Journal of Dairy Science,* **92:** 5512–5522

Castro-Montoya, J.M., Makkar, H.P.S and Becker, K. (2011). Chemical composition of rumen microbial fraction and fermentation parameters as affected by tannis and saponins using an *in vitro* rumen fermentation systems. *Canadian Journal of Animal Science,* **91**:433-448.

Chase LE. (1990). Analysis of fatty acids by packed column gas chromatography.G.C., Bulletin 856, Division of Rohand Has. Supelcom, pp: 1-12.

Cheeke, P.R. (1999). Actual and potential application of *Yucca schidigera* and *Quillaja saponaria* saponins in human and animal nutrition*, Proceedings of the American Society of Animal Science*, 1–10.

Feng, Z.H., Yu-Feng. CaO, Yan-Xia. Gao, Qiu-Feng. Li and Jian-Guo. Li, (2012). Effect of biological action of saponins in animal systems: a review. *British Journal of Nutrition,* **88** : 587-605.

Gall LS, Burroughs, W., Gerlaugh, P and Edgington, B.H. (1949). Special methods for rumen bacterial studies in the field. : *Journal of Animal Science,* **8:**433-440.

Getachew.G., Pittroff, W., Putnam, .D.H., Dandekar, A., Goyal, .S. and Depeters, E.J..(2008). The influence of addition of gallic acid, tannic acid or quebracho tannins to alfalfa hay on *in vitro* rumen fermentation and microbial protein synthesis, *Animal Feed Science and Technology,* **40:**444-461.

Goel G, Makkar, H.P.S. and Becker, K. (2008). Changes in microbial community structure, methanogenesis and rumen fermentation in response to saponin-rich fractions from different plant materials. *Journal of Applied Microbiology,* **105**: 770–777.

Goel, G and Makkar, H. P. S. (2012). Methane mitigation from ruminants using tannins and saponins. *Tropical Animal Health and Production*, **44**:729–739.

Guo.Y.Q., Liu, J.-X., Y.Lu , Zhu, W.Y., . Denman, S.E and Mcsweeney, C.S. (2008). Effect of tea saponin on methanogenesis, microbial community structure and expression of mcrA gene in cultures of rumen microorganisms. *Letters in Applied Microbiology*, **47:**421-426.

Hanim C, Yusiati, L.M. and Alimi, S. (2009). Effects of saponin as defauating agent on *in vitro* ruminal fermentation of forage and concentrate. *Journal of the Indonesian Tropical Animal Agriculture,* **34(4)**: 231-235.

Heins, Y., Tagari, H and Volcani, R. (1964). Effect of water extracts on carob pods, tannic acid and their derivatives on the morphology and growth of micro organusms. *Applied Microbiology,* **12:** 204-209.

Hess, H.D., Kreuzer,M., Diaz, T.E., Lascano, C.E., Carulla, J.E., Soliva, C.R. and Machmuller, A. (2003). Saponin rich tropical fruits affect fermentation and methanogenesis in faunated and defaunated fluid. *Animal Feed Science and Technology,* **109:** 79-94.

Hess.H.D, Tiemann, T.T., Noto, F., Carulla, J.E. and Kreuzer,M. (2006). Startegic use of tannins as means to limit methane emission from ruminant livestock. *International congress series*, **1293:**164-167.

Holtshausen L, Chaves, AV., Beauchemin, KA., McGinn, SM., McAllister, TA., Odongo, NE., Cheeke, PR and Benchaar, C. (2009). Feeding saponin-containing *Yucca schidigera* and Quillaja saponaria to decrease enteric methane production in dairy cows. *Journal of Dairy Science,* **92:** 2809–2821.

Hu W.L, Liu, J.X., Ye, J.A., Wu, Y.M. and Guo, Y.Q. (2005). Effect of tea saponin on rumen fermentation *in vitro*. *Animal Feed Science and Technology,* **120**: 333-339.

Istiqomah, L., Herdian, H., Febrisantosa, A.and Putra, D..(2011). Waru leaf (Hibiscus tillaceus) as saponin source on in vitro ruminal fermentation characteristic. *Journal of the Indonesian Tropical Animal Agriculture,* **36:** 43-49.

Jayanegara, A., Goel, G., Makkar, H.P.S and Becker, K. (2010). Reduction in Methane Emissions from Ruminants by Plant Secondary Metabolites: Effects of Polyphenols and Saponins. In. N.E. Odongo, M.Gracia and G.J.Viljoen (eds), 'Sustainable Improvement of Animal Production and Health. FAO, Rome, **2010:**151-157.

Jayanegara, A., Leiber, F. and Kreuzer, M. (2011). Meta-analysis of the

relationship between dietary tannin level and methane formation in ruminants from *in vivo* and *in vitro* experiments, *Journal of Animal physiology and Animal nutrition*, doi:10.1111/j.1439-0396.2011.01172.x

Johnson, K.A and Johnson, D.E. (1995). Methane emissions from cattle. *Journal of Animal Science,* **73:** 2483–2492.

Kessel, J.S.V and Russel, J.B. (1996). The Effect of pH on Ruminal Methanogenesis..U.S. Dairy Forage Research Center, Research Summaries, pp:90-92.

Klita, P.T., Mathison, G.W., Fenton, T.W and Hardin, R.T. (1996). Effects of alfalfa root saponins on digestive function in sheep. *Journal of Animal Science,* **74**: 1144–1156.

Lila, Z.A., Mohammed, N., Kanda, S., Kamada, T and Itabashi, H. (2003). Effects of sarsaponin on ruminal fermentation with particular reference to methane production *in vitro*. *Journal of Dairy Science,* **86**:3330-3336.

Makkar H.P.S., Blummel. M.and Becker, K.(1995). *In vitro* effects of and interactions between tannins and saponins and fate of tannins in the rumen. *Journal of the Science of Food and Agriculture,* **69**:481-493.

Makkar, H.P.S and Becker, K. (1996). Effect of *Quillaja saponaria* on *in vitro* rumen fermentation. *Advances in Experimental Medicine and Biology,* **405**:387-394

Makkar H.P.S., Blummel, S.S.and Becker, K.(1998). Effects of fractions containing saponins from *Yucca schidigera*, *Quillaja saponaria* and *Acacia auriculoformis* on rumen fermentation. *Journal of Agricultural and Food Chemistry,* **46**:4324-4328.

Menke, K.H. and Steingass, H. (1988). Estimation of the energetic feed value obtained from chemical analysis and *in vitro* gas production using rumen fluid. *Animal Research and Development,* **28:**7–55.

Moir RJ, (1951). The seasonal variation in the ruminal microorganism of grazing sheep. *Australian Journal of Agricultural Research,* **27:**322.

Moss, A.R., Jouany, J.P and Newbold, C.J. (2000). Methane production by ruminants: its contribution to global warming. *Annales de zootechnie,* **49**: 231–235.

Newbold, C.J., El Hassan, S.M., Wang, J., Ortega, M.E. and Wallace, R.J. (1997). Influence of foliage from African multipurpose trees on activity of rumen protozoa and bacteria. *British Journal of Nutrition,* **78:** 237–249.

Patra, A.K., Kamra, D.N. and Agarwal, N. (2006). Effect of plant extracts on *in vitro* methanogenesis, enzyme activities and fermentation of feed in rumen liquor of buffalo. *Animal Feed Science and Technology,* **128:** 276–291.

Patra, A.K and Saxena, J. (2010). A new perspective on the use of plant secondary metabolites to inhibit methanogenesis in the rumen. *Phytochemistry,* **71:**1198-1222.

Patra, A.K and Saxena, J. (2011). Exploitation of dietary tannins to improve rumen metabolism and ruminant nutrition. *Journal of the Science of Food and Agriculture,* **91:**24-37.

Pellikaan.W.F., Stringano, E., Leenaars, J., Bongers, D.J.G.M., Van schuppen, S.V.L.., Plant, J.and Harvey, I.M. (2011). Evaluating effects of tannins on extent and rate of *in vitro* gas and CH_4 production using an automated pressure evalution system (APES). *Animal Feed Science and Technology,* **166-167**: 377-390.

Pen, B., Sar, C., Mwenya, B., Kuwaki, M., Morikawa,R and Takahashi, J. (2006). Effects of *Yucca schidigera* and *Quillaja saponaria* extracts on *in vitro* ruminal fermentation and methane emission. *Animal Feed Science and Technology*, **129:**175–186.

Ramirez-Restrepo, C.A and Barry, T.N. (2005). Alternative temperate forages containing secondary compounds for improving sustainable productivity in grazing ruminants. *Animal Feed Science and Technology,* **120:**4179 – 4201.

Russell, J.B., and Van Soest, P.J. (1984). *In vitro* fermentation of organic acids common in forage, *Applied and Environmental Microbiology,* **47(1)**:155.

Santara, A., Saikia, A. and Baruah, K.K. (2012). Scope of rumen manipulation using medicinal plants to mitigate methane production, *Journal of Phamacognosy*, 3.

Sliwinski, B.J., Soliva, C.R., Machmuller, A.and Kreuzer, M..(2002). Efficacy of plant extracts rich in secondary constituents to modify rumen fermentation, *Animal Feed Science and Technology,* **101:**101-114.

Smith, A.H., Zoetendal, E.G.and Mackie, R.I. (2005). Bacterial mechanisms to overcome inhibitory effects of dietary tannins. *Microbial ecology,* **50**: 197–205.

Snedecor GW and Cochran, WC. (1989). Statistical Methods 8th edn. Iowa State University Press, Ames, Iowa.

Tagari,H., Heins, Y., Tamir, M and Volcani, R. (1965). Effect of carob pod extract on cellulolysis, proteolysis, deamination and protein biosynthesis in an artificial rumen. *Applied Microbiology,* **13:** 437-442.

Tavendale, M.H., Meagher, L.P.,.Pacheco, D., Walker, N., T.Attawood, G.and Sivakumaran, S. (2005). Methane production from *in vitro* rumen incubations with *Lotus pedunculatus* and *Medicago sativa* and effects of extractable condensed tannin fractions on methanogenesis. *Animal Feed Science and Technology,* **123-124**: 403-419.

Van Soest, PJ and Robertson. (1988). A Laboratory manual for animal science, 612, Ithaca Ny: Cornell University.

Vieira, S.C and Borba, A.E.S.(2011). Effects of condensed tannins from Quebracho extract on the kinetic of *in vitro* gas production on Trifolium repens, *Lotus corniculatus* and *Lolium perenne*. *Journal of Agriculture, Science and Technology,* B1: 982-988.

Wallace, R.J., Arthaud, C.J.L. and Newbold, C.J. (1994). Influence of Yucca schidigera extracts on ruminal ammonia concentration and ruminal microorganisms. *Applied and Environmental Microbiology,* **60**:1762-1767.

Wang, Y., Gibb, D., Greer, D. and McAllister, T.A. (2011). Effects of moisture and a saponin based surfactant during barley processing on growth performance and carcass quality of feed lot steers and on *in vitro* ruminal fermentation. *Asian-Australasian Journal of Animal Sciences,* **24(12)**:1690-1698.

Socio-economic and Demographic Factors influencing the Academic Performance of the Students of Veterinary Science and Animal Husbandry

S.Suganya[1], M.Thirunavukkarasu[2], A.Serma Saravana Pandian[3] and G.Senthilkumar[4]
Dept. of Animal Husbandry Statistics and Computer Applications,
Faculty of Basic Sciences, Madras Veterinary College Campus,
Tamil Nadu Veterinary and Animal Sciences University, Chennai – 600 007 (INDIA)

ABSTRACT

This study aimed to identify the socio-economic and demographic factors influencing the academic performance of students of veterinary science. Primary data collected from a sample of 280 students selected from four Veterinary Colleges during March - April, 2016 were analyzed. While most of the students were from rural (37.10%) and semi-rural areas (39.30%), about 44% of them were found to be the first graduates in their families. Age and gender had no significant association ($P > 0.05$) on academic performance. Community, medium of instruction, marks in qualifying examination, educational stream, location of school and board of education all had highly significant associations ($P \leq 0.01$) with academic performance. The type of school management also had a significant ($P \leq 0.05$) association with performance. While mothers' education was significantly associated with academic performance, father's education, his occupation, family's income and location of residence had no significant relationship with it.

Key Words: Students of Veterinary Science, Demographic and Socio-economic Factors, Academic Performance

INTRODUCTION

The students' academic performance plays a key role in producing the quality manpower, responsible for the country's socio-economic development (Ali *et al.,* 2009). Improvement of animal health and wealth depends on the intelligent, interested and enthusiastic professional graduates who can bring out adoptable new technologies suitable to the farmer clientele (Akila, 1997). Sinha *et al.* (2019) found many organizational, communicational, financial, psychological and technological constraints prevailing in Universities and recommended to address these issues for effective research-extension linkage. Thus, for imparting quality veterinary education, TamilNadu Veterinary and Animal Sciences University (TANUVAS) has been taking adequate steps through four of its constituent

Corresponding author Email Id: drthiruarasu@yahoo.com
Part of the unpublished MVSc thesis submitted to Tamil Nadu Veterinary and Animal Sciences University by first author
[1]MVSc scholar, [2] Professor and Head & corresponding author , [4] Assistant Professor
[3]Assistant Professor, Dept. of Animal Husbandry Economics, Madras Veterinary College, Chennai –600 007

veterinary colleges *viz.,* Madras Veterinary College (MVC) at Chennai, Veterinary Colleges and Research Institutes (VCRIs) at Namakkal, Orathanadu and Tirunelveli, to ensure better teaching – learning processes, so as to produce marketable and field compliant veterinary graduates.

However, despite excellent teaching and learning resources existing, some students perform better than others academically, while others fare dismally poor. In this context, the present study was aimed to explore and identify the socio-economic and demographic factors that influence the academic performance of students.

MATERIALS AND METHODS

Out of 851 students available in different professional years (second to fifth year) in the calendar year 2016, a total of 280 students from four Veterinary Colleges of TANUVAS were selected through stratified random sampling technique for data collection and analysis.

The sample size was determined using the following formula:

$$\text{Sample size } (S) = \frac{\chi^2 NP(1-P)}{d^2(N-1)+\chi^2 P(1-P)}$$

where N - Population size, P - Population proportion (assumed to be 0.50), d - Degree of accuracy (assumed to be 0.05), and table value of χ^2 for one degree of freedom relative to the desired level of confidence. The χ^2 value (3.481) is significant at 95 per cent confidence level. Based on the formula, the required sample size was determined to be S = 247.252. Average number of sample size per class was estimated to be required sample size divided by number of classes in colleges, which was equal to 247.252 / 14 = 17.6609 ≈ 18. As per sampling guide, minimum number of respondents to be selected was 18 per class at 95 per cent confidence interval. Hence, in this study, 13 - 24 students (on an average, 20 students) were selected per class and overall 280 students were selected from four colleges with greater than 95 per cent confidence interval.

Primary data were collected from the selected respondent students by personal interview method using structured, pre-tested interview schedules. For pre-testing, a pilot study was conducted among 30 students other than the sampled elements. The reliability of the interview schedule was assessed based on Cronbach alpha value, which was 0.697 (≈0.70). Secondary data (OGPA and marks scored by the students) were collected from Education Cells and Student Co-ordination Sections of the Colleges concerned. The period of data collection was March to April, 2016.

The collected data were tabulated and analyzed using the Statistical Package for Social Sciences (SPSS Version 17).

Descriptive statistics were used to obtain frequency counts and percentages of various coded responses. Chi-square (χ^2) test was used to assess whether socio-economic and demographic attributes are associated with academic performance of the sample students.

RESULTS AND DISCUSSION

The results of the descriptive statistics and the associations of socio-economic and demographic factors and the academic performance of sample students are described and discussed in this section. More than half of the students sampled (50.06 per cent) scored an OGPA of 7.00 - 7.99, followed by 31.96 per cent of students who scored the OGPA of 5.00 - 6.99 and 17.98 per cent of students scored higher OGPA of above 8.00. These secondary data about academic performance formed the basis for the sampling and selection of students.

The results of demographic features and particulars of schooling background of sample BVSc & AH students are presented in Table 1. Out of the total 280 sample student respondents, 54.29 per cent were males and the rest were females. The percentage of students belonging to different community categories is almost proportional to the community reservation followed in the State for admission to professional courses. While around 52 per cent studied in Tamil medium in their schooling, about 42 per cent studied in English medium.

More than 81 per cent of the students were found to have secured marks above 90 per cent in higher secondary education and 18.57 per cent students below 90 per cent. While more than half (55.71 per cent) studied in Tamil Nadu State Board schools, 40 per cent did their schooling Matriculation schools. An overwhelming majority of the students (95.00 per cent) were from the academic stream of education and rests were from vocational stream, which might be due to the reason that only a number of limited seats are reserved for those who studied vocational subjects in their qualifying examination. While more than 56 per cent of students studied in private schools, 43.57 per cent studied in Government and Government aided schools. Around 57 per cent of the students who joined the BVSc & AH course were from rural and semi rural areas, followed by 43.21 per cent who belonged to urban areas. It might be due to the phenomenal growth and development of livestock and the self employment potential available for the veterinary students in rural areas.

Table – 1. Demographic features and particulars of schooling background of sample students

(n=280)

Attributes	Category	Frequency	Percentage
Gender	Male	152	54.29
	Female	128	45.71
Community	OC	21	7.50
	BC	139	49.64
	MBC	59	21.07
	ST	6	2.14
	SC	40	14.29
	BCM	15	5.36
Medium of instruction	Tamil	145	51.78
	English	117	41.79
	Others	18	6.43
Higher secondary total marks	Below 90%	52	18.57
	Above 90%	228	81.43
Education board	State board	156	55.71
	Matriculation	112	40.00
	CBSE	12	4.29
Educational stream	General	266	95.00
	Vocational	14	5.00
School Management	Government	29	10.36
	Govt. aided	93	33.21
	Private	158	56.43
School location	Rural and Semirural	159	56.79
	Urban	121	43.21

Table 2 shows the socio-economic status of the parents and the financial support available to the sample students. Most of the students' fathers were illiterate (33.57 per cent), followed by 23.21 per cent having collegiate, 17.50 per cent having primary and 15.71 per cent having secondary education. An almost equal number of mothers of students' admitted had primary education (25.36 per cent), followed by having collegiate (24.29 per cent), illiterate (19.29 per cent), secondary (18.21 per cent) and higher secondary (18.21 per cent) education.

More than 56 per cent of sample students belonged to low income group with annual family income of less than Rs.2 lakhs, followed by 28.21 per cent to middle income (Rs.2 to 5 lakhs) and 15.71 per cent to high income (above Rs.6 lakhs) categories. Students from rural (37.10) and semi-rural areas (39.30) were more than that from urban areas (23.60 per cent). The rural background and the interest in livestock production and development might have influenced the students from the rural areas to select this course. The present finding concurs with the report of Akila (1997). About 44 per cent of sample students were observed to be the first graduates in their families, which indicated that students belonging to literate and illiterate family backgrounds equally performed in qualifying examinations and equally preferred the veterinary science course.

To the question to considering the effect of family income on their quality of education, 30.00 per cent of students strongly disagreed, followed by 27.86 per cent who disagreed, 19.64 per cent had no decision, 17.86 per cent did not agree, and 4.64 per cent strongly agreed. Since majority of the students (50.07 per cent) were from low income group, most of the students were willing to avail educational loan to pursue their studies.

Tables 3 portrays the association of demographic profile and schooling background of the students with their academic performance in veterinary education. There was no significant association (P > 0.05) between gender and OGPA, which was similar to the finding reported by Rajandran *et al*. (2015). Similarly the factors such as age, admission under special quota and participating in extra-curricular activities also did not have any significant association (P > 0.05) with academic performance of the students concerned. Non–significant effect of students' age on academic performance was already reported by Mlambo (2011). However, there was highly significant association between community and academic performance, which strongly underlines that fact that the students admitted under SC / ST require rigorous coaching, so as to improve their academic performance.

Table – 2. Socio-economic status of parents and financial support of sample students

(n=280)

Attributes	Category	Frequency	Percentage
Father's education	Primary	49	17.50
	Secondary	44	15.71
	HSc	28	10.00
	Collegiate	65	23.21
	Illiterate	94	33.57
Mothers' education	Primary	71	25.36
	Secondary	51	18.21
	HSc	31	11.07
	Collegiate	68	24.29
	Illiterate	54	19.29
Father's Occupation	Farmer	104	37.14
	Government employees	56	20.00
	Other occupation	120	42.86
Annual income (Rs. in lakh)	Low (< 2)	157	56.07
	Middle (2-5)	79	28.21
	Higher (>5)	44	15.71
Residence	Rural	104	37.1
	Semirural	110	39.3
	Urban	66	23.6
First graduate	Yes	123	43.93
	No	157	50.04
Family income might affect the quality of education	Strongly disagree	84	30.00
	Disagree	78	27.86
	Neutral	55	19.64
	Agree	50	17.86
	Strongly agree	13	4.64
Willing to avail education loan	Strongly disagree	89	31.79
	Disagree	71	25.36
	Neutral	68	24.29
	Agree	37	13.21
	Strongly agree	18	6.43

Table – 3. Association between demographic particulars and academic performance of students

Attribute	Category	OGPA		χ^2 value	p value
		5-6.99 (n = 77)	≥7 (n = 203)		
Gender	Male	46 (59.74)	106 (49.26)	2.46^{NS}	0.12
	Female	31 (40.26)	97 (50.74)		
Age	18-25 years	75 (97.40)	200 (98.52)	0.39^{NS}	0.53
	above 26 years	2 (2.60)	3 (1.48)		
Community	Other than SC/ST	53 (68.83)	181 (89.16)	16.81**	0.01
	SC/ST	24 (31.17)	22 (10.84)		
Special quota	No-Special quota	69 (89.61)	188 (92.61)	0.66^{NS}	0.46
	Special quota	8 (10.39)	15 (7.39)		
Extra curricular activities	Yes	66 (85.71)	167 (82.27)	0.475^{NS}	0.49
	No	11 (14.29)	36 (17.73)		

***Highly significant; ^{NS}Non-significant; Figures in parentheses indicate per cent to total*

As per the Table 4, medium of instruction marks in higher secondary education, educational stream, location of school and board of education had highly significant associations ($P \leq 0.01$) with the students' academic performance in BVSc & AH degree programme. Most of the students (87.68 per cent) who got above 90 per cent marks in their higher secondary education could score higher GPA of 7 - 10, which implied a significant association ($\chi^2 = 12.11$) of higher secondary marks with academic performance in veterinary degree course. Of the total students who secured more than 7.00 OGPA, only a small number of students (1.48 per cent) were from vocational stream in their schooling. Location of school too had a highly significant association with academic performance, with more than 70 per cent of the students could score only less GPA (5 – 6.99) The students from Matriculation and Central Board of Secondary Education (CBSE) performed better (52.71 per cent) than students from State Board (47.29 per cent) system. The type of school management *i.e*. Government and private had a significant ($P \leq 0.05$) association with academic performance in degree course.

Table – 4. Association between school background and academic performance of students

Attribute	Category	OGPA		χ^2 value	p value
		5-6.99 (n = 77)	7 and above (n = 203)		
Medium of Instruction	Tamil and others	62 (80.52)	101 (49.75)	21.72**	0.00
	English	15 (19.48)	102 (50.25)		
Higher secondary marks	< 90 per cent	27 (35.06)	25 (12.32)	12.11**	0.00
	> 90 per cent	50 (64.94)	178 (87.68)		
Educational Stream	General	66 (85.71)	200 (98.52)	21.91**	0.00
	Vocational	11 (14.29)	3 (1.48)		
School location	Rural	54 (70.13)	105 (51.72)	7.707**	0.01
	Urban	23 (29.87)	98 (48.28)		
Education board	State board	60 (77.92)	96 (47.29)	21.22**	0.00
	Others	17 (22.08)	107 (52.71)		
School management	Govt. / Govt. aided	42 (54.55)	80 (39.41)	5.20*	0.02
	Private	35 (45.45)	123 (60.59)		

***Highly significant; *Significant; Figures in parentheses indicate per cent to total*

From Table 5, it could be noted that mothers' secondary level education was significantly ($P \leq 0.05$) associated with the students' academic performance. This finding concurs with Hijazi and Naqvi (2006). However, the level of father's education, his occupation, family's income and location of residence had no significant association with the students' academic performance. As it could be seen from Table 6, there was no significant association of any of the financial support attributes with academic performance of the students, as indicated by the χ^2 values.

The study conducted to identify the socio-economic and demographic factors influencing the academic performance of students of BVSc & AH degree programme indicated that more than half of them studied in Tamil Nadu State Board schools, studied in private schools, belonged to rural and semi rural areas and low income group. About 44 per cent of the students were to be the first graduates in their families. The factors such as age and gender did not have any significant association with academic performance of the students. However, there was highly significant association between community and academic performance, which strongly underlines that fact that the students admitted under SC / ST category require rigorous coaching, so as to improve their academic performance.

Table – 5. Association between socio-economic status of parents and academic performance of sample students

Attribute	Category	OGPA		χ^2 value	p value
		5-6.99 (n = 77)	≥7 OGPA (n = 203)		
Father's education	Yes	35 (45.46)	108 (53.20)	0.25^{NS}	0.240
	No	42 (54.55)	95 (46.80)		
Mothers' education	Yes	30 (38.96)	120 (59.11)	9.12**	0.003
	No	47 (61.04)	83 (40.89)		
Father's occupation	Farmer	30 (38.96)	74 (36.45)	0.25^{NS}	0.920
	Govt. employee	15 (19.48)	41 (20.20)		
	Others	32 (41.56)	88 (43.35)		
Annual income	Low	47 (61.04)	110 (54.19)	1.35^{NS}	0.500
	Middle	18 (23.38)	61 (30.05)		
	Higher	12 (15.58)	32 (15.76)		
Residence	Rural	64 (83.12)	149 (73.4)	2.89^{NS}	0.890
	Urban	13 (16.88)	54 (26.6)		

*** Highly significant; [N]Non-significant; Figures in parentheses indicate per cent to total*

Table – 6. Association between financial support and academic performance of sample students

Attribute	Category	OGPA		χ^2 value	p value
		5-6.99 (n = 77)	≥7 (n = 203)		
Appropriate financial support	Agree	62 (80.52)	172 (80.52)	0.72^{NS}	0.39
	Disagree	15 (19.48)	32 (19.48)		
Willing to avail education loan	Agree	19 (24.68)	33 (24.68)	2.62^{NS}	0.11
	Disagree	58 (75.32)	19 (75.32)		
Family income might affect the quality of education	Agree	28 (36.36)	35 (17.24)	2.00^{NS}	0.16
	Disagree	49 (63.64)	168 (82.76)		

[NS]Non-significant; Figures in parentheses indicate per cent to total

Medium of instruction, marks in HSc, educational stream, location of school and board of education had highly significant associations ($P \leq 0.01$) with the students' academic performance in BVSc & AH degree programme. Most of the students (87.68 per cent) who got above 90 per cent marks in HSc could score higher GPA of 7 – 10. Location of school too had a highly significant association with academic performance. The type of school management *i.e*. Government and private had a significant ($P \leq 0.05$) association with academic performance in degree course. The study has unraveled various socio-economic and demographic attributes of students that influence the academic performance of BVSc & AH students in

terms of their Overall Grade Point Average (OGPA).

REFERENCES

Ali, N., Jusoff, K., Ali, S., Mokhtar N. and Salamat, A.S.A. (2009). The factors influencing students' performance at UniversitiTeknologi MARA Kedah, Malaysia. *Management Science and Engineering*, **3(4):** 81.

Akila, N. (1997). Factors influencing the choice of veterinary science by the students of Tamil Nadu Veterinary and Animal Sciences University. Unpublished M.V.Sc., thesis submitted to TANUVAS, Chennai.

Hijazi, S.T and Naqvi, S.M.M.R. (2006). Factors affecting students' performance, a case of private colleges. *Bangladesh e-Journal of Sociology*, 3(1): 1-10.

Mlambo, V. (2012). An analysis of some factors affecting student academic performance in an introductory biochemistry course at the University of the West Indies. *The Caribbean Teaching Scholar*, **1(2):**79-92.

Rajandran, K., Hee, T.C., Kanawarthy, S.,Soon, L.K., Kamaludin, H and Khezrimotlagh, D. (2015). Factors Affecting First Year Undergraduate Students Academic Performance. *Scholars Journal of Economics, Business and Management,* **2(1A):**54-60.

Sinha, S.S., Mahesh Chander and Kannadhasan, M.S. (2019). Strengthening Research-Extension Linkages in Veterinary Universities, *International Journal of Livestock Research*, **9(3):**263-272.

Influence of Personal, Psychological and Institutional Factors on Academic Performance of Students of Veterinary Science and Animal Husbandry

S.Suganya[1], M.Thirunavukkarasu[2], A.Serma Saravana Pandian[3] and C.Balan[4]

Dept. of Animal Husbandry Statistics and Computer Applications,
Faculty of Basic Sciences, Madras Veterinary College,
Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Chennai – 600 007

ABSTRACT

A study was conducted to explore and identify the personal and psychological characteristics towards study and institutional factors that influence the academic performance of students of veterinary science and animal husbandry from the data gathered through personal interview using structured pre-tested interview schedule from 280 students of TANUVAS selected using stratified random sampling procedure. Analysis of the data collected using χ^2 test revealed that there were significant ($P \leq 0.05$) associations between the time spent on studies after class hours, parental observation on studies, students' interest in pursuing higher studies, having personal textbooks and college of study, each with the academic performances of students of veterinary science and animal husbandry. Further, there was a highly significant ($P \leq 0.01$) association between the difficulty experienced in understanding topics and poor academic performance of the students. However, there was no significant ($P > 0.05$) association between the pressure of curriculum and students' perceptions on institutional facilities on academic performance.

Key Words: Students of veterinary science, Factors influencing, Academic performance

INTRODUCTION

Livestock sector plays a vital role in promoting and sustaining the rural economy in India, the growth of which largely depends on the quality of veterinary service provided by the veterinary professionals to the farmer clients. Quality of veterinary service provided in turn depends on the quality of veterinary education provided by veterinary institutions, for which the Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) has been taking formidable steps to ensure the marketability of its graduates in the rural setting. In TANUVAS, 320 students are admitted every year to get them qualified in veterinary science and animal husbandry through four of its constituent veterinary colleges *viz.,* Madras Veterinary College (MVC) at Chennai, Veterinary Colleges and Research Institutes (VCRIs) at Namakkal, Orathanadu and Tirunelveli.

In spite of its unstinted efforts, less than attainable grades obtained by a

Corresponding author Email Id: *drthiruarasu@yahoo.com*
Part of the unpublished MVSc thesis submitted to Tamil Nadu Veterinary and Animal Sciences University by the first author
[1]*MVSc scholar, 2 Professor and Head , 4 Assistant Professor*
[3]*Assistant Professor, Dept. of Animal Husbandry Economics, Madras Veterinary College, Chennai –600 007*

few of its students, despite the well-knit teaching and learning resources, have been a challenge to it. This problem among the students has wide ranging implications for national development (Osaikhiuwu, 2014). There are many factors which are believed to influence the academic performance of students, but not often well documented. Students perform poorly because the institutions have failed to create the environment that is conducive to their learning and educational needs (Hard and El-Shaawari, 2006).

In this context, the present study is aimed to explore the personal, psychological and institutional factors that could influence the academic performance of the students of veterinary science and animal husbandry (BVSc & AH) in TANUVAS in terms of their Overall Grade Point Average (OGPA).

MATERIALS AND METHODS

Out of 851 students available in different professional years (second to fifth year) in the calendar year 2016, a total of 280 students from four Veterinary Colleges of TANUVAS were selected through stratified random sampling technique for data collection and analysis.

The sample size was determined using the following formula:

$$\text{Sample size } (S) = \frac{\chi^2 NP(1-P)}{d^2(N-1)+\chi^2 P(1-P)}$$

where N - Population size, P - Population proportion (assumed to be 0.50), d - Degree of accuracy (assumed to be 0.05), and table value of χ^2 for one degree of freedom relative to the desired level of confidence. The χ^2 value (3.481) is significant at 95 per cent confidence level. Based on the formula, the required sample size was determined to be S = 247.252. Average number of sample size per class was estimated to be required sample size divided by number of classes in colleges, which was equal to 247.252 / 14 = 17.6609 ≈ 18. As per sampling guide, minimum number of respondents to be selected was 18 per class at 95 per cent confidence interval. Hence, in this study, 13 - 24 students (on an average, 20 students) were selected per class and overall 280 students were selected from four colleges with greater than 95 per cent confidence interval.

Data collection procedure

Primary data were collected from the selected respondent students by personal interview method using structured, pre-tested interview schedules. For pre-testing, a pilot study was conducted among 30 students other than the sampled elements. Secondary data (OGPA and marks scored by the students) were collected from Education Cells and Student Co-ordination Sections of the Colleges concerned. The period of data collection was March to April, 2016.

The collected data were tabulated and analyzed using the Statistical Package for Social Sciences (SPSS Version 17). Descriptive statistics were used to obtain frequency counts and percentages of various coded responses. Chi-square (χ^2) test was used to assess whether socio-economic and demographic attributes are associated with academic performance of the sample students.

RESULTS AND DISCUSSION

As it could be discerned from Table 1, majority of the students (70.13 per cent) in low GPA category of 5-6.99 reported that they did not study after the class hours. Despite an almost equal proportion of students studied / have not studied, the χ^2 value revealed that there was significant association between time spent on studies after class hours and academic performance, which was also reported by Salem *et al*. (2013). However, time spent on studies during weekends and time spent on activities other than studies by both the OGPA groups had no significant association with the academic performance of the students.

Table – 1. Association between time spent on studies and other activities and academic performance

Attribute	Category	OGPA		χ^2 value	p value
		5-6.99 (n = 77)	**≥7** (n = 203)		
Time spent on studies					
Studying after class hours	Agree	23 (29.87)	90 (44.33)	4.85*	0.03
	Disagree	54 (70.13)	113 (55.67)		
Studying in weekends	Agree	32 (41.56)	17 (8.37)	0.88^{NS}	0.41
	Disagree	45 (58.44)	131 (64.53)		
Time spent on activities other than studies					
≥ 2 hours in television / movies / internet	Agree	43 (55.84)	103 (55.84)	0.97^{NS}	0.33
	Disagree	34 (44.16)	100 (44.16)		
≥ 2 hours in social networking / Chatting	Agree	66 (85.71)	176 (85.71)	0.05^{NS}	0.84
	Disagree	11 (14.29)	27 (14.29)		
Sleeping hours/day	≤8 hours	61 (79.22)	172 (84.24)	2.38^{NS}	0.31
	>8 hours	16 (29.87)	32 (15.76)		

*Figures in parentheses are percentages to total; *Significant; ^{NS}Non-significant*

From Table 2, it could be found that there was highly significant association between the difficulty experienced in understanding topics and less academic performance (5-6.99 OGPA) of the students. However, there was no significant association between the pressure of curriculum on academic performance in both the OGPA groups.

Table – 2. Association between constraints perception and academic performance of sample students

Attribute	Category	OGPA		χ^2 value	p value
		5-6.99 (n = 77)	**≥7** (n = 203)		
Pressure of curriculum	Agree	31 (40.26)	90 (40.26)	0.39^{NS}	0.54
	Disagree	46 (59.74)	113 (59.74)		
Difficulty in understanding topics	Agree	29 (37.66)	80 (39.41)	11.83**	0.00
	Disagree	48 (62.34)	123 (60.59)		

*Figures in parentheses are percentages to total; **Highly significant; ^{NS}Non-significant*

The relationship between the personal and psychological characteristics of students with their academic performance is presented in Table 3. It can be observed that there was a significant association between parental observation on studies and academic performance of their wards. This could be because as majority of students (96.10 per cent), who secured 5-6.99 OGPA, reported that there was no observation by their parents in their studies, while a vast majority (84.73 per cent) of students scoring an OGPA of greater than or equal to 7.0 affirmed that their parents had a watch over their studies. Having personal text books by students themselves, which might have helped them to read even during late / odd hours, had also a highly significant association with their academic performance. Further, the students' interest in pursuing higher studies was found to be significantly associated with their academic performance.

Table – 3. Association between perception on personal and psychological characteristics and academic performance of sample students

Attribute	Category	OGPA		χ^2 value	p value
		5-6.99 (n = 77)	≥7 (n = 203)		
Motivation to score high marks	Agree	75 (97.40)	194 (97.4)	5.26 ^{NS}	0.48
	Disagree	2 (2.60)	9 (2.60)		
Parental observation on studies	Agree	3 (3.90)	172 (84.73)	6.78**	0.09
	Disagree	74 (96.10)	31 (15.27)		
Current interest in studies	Agree	75 (97.40)	194 (97.40)	5.26 ^{NS}	0.48
	Disagree	2 (2.60)	9 (2.60)		
Interest in pursuing higher studies	No	57 (74.03)	25 (28.08)	12.11*	0.05
	Yes	20 (25.97)	178 (87.68)		
Attending clinical training during vacation	Yes	34 (44.15)	123 (60.59)	0.38 ^{NS}	0.59
	No	43 (55.85)	81 (39.41)		
Having personal textbooks	Agree	36 (46.75)	143 (70.44)	7.33**	0.01
	Disagree	41 (53.25)	60 (29.56)		

*Figures in parentheses are percentages to total; **Highly significant; *Significant; ^{NS}Non-significant*

As could be perceived from Table 4, there were no significant associations between students' perceptions on institutional facilities (like library, laboratory, and lecture halls) and their academic performance, which is in agreement with that of Osaikhiuwu (2014). This indifference could be due to the fact that all the veterinary colleges of TANUVAS have been well equipped with all kinds of teaching and learning institutional facilities.

Table – 4. Association between perceptions on institutional facilities and academic performance

Attribute	Category	OGPA		χ^2 value	p Value
		5-6.99 (n = 77)	≥7 (n = 203)		
Adequate library facilities	Agree	22 (28.57)	55 (27.09)	1.93 NS	0.17
	Disagree	76 (71.43)	127 (72.91)		
Adequate laboratory facilities	Disagree	7 (9.09)	70 (9.09)	0.42NS	0.52
	Agree	70 (90.91)	179 (90.91)		
Adequate lecture hall facilities	Disagree	11 (15.71)	21 (10.35)	0.86 NS	0.36
	Agree	66 (84.29)	182 (89.65)		

Figures in parentheses are percentages to total; NSNon-significant

Association between the college of study and academic performance of students is shown in Table 5. Out of the total of 851 students considered among all the four colleges of TANUVAS, around 50 per cent of the students had secured an OGPA ranging from 7.00 to 7.99, while 32 and 18 per cent scored ≤ 6.99 and ≥ 8.00, respectively. However, when considering individual colleges, VCRI (Tirunelveli) topped with 28 per cent scoring an OGPA of ≥ 8.00, followed by VCRI (Namakkal), VCRI (Orathanadu) and MVC (Chennai) in that order. Because of this differing success rates and varying scoring patterns in different Colleges, the χ^2 analysis revealed a significant association between the college of study and academic performance of the students of veterinary science in TANUVAS.

Table – 5. Association between college of study and academic performance of students

Colleges	OGPA			Total	χ^2 value	p value
	5.00 - 6.99	7.00 - 7.99	≥ 8.00			
MVC, Chennai	163 (40.34)	193 (47.77)	48 (11.88)	404 (100)	38.76**	0.00
VCRI, Namakkal	69 (26.54)	131 (50.38)	60 (23.08)	260 (100)		
VCRI, Orathanadu	16 (17.98)	55 (61.80)	18 (20.22)	89 (100)		
VCRI, Tirunelveli	24 (24.49)	47 (47.96)	27 (27.55)	98 (100)		
Overall	**272 (31.96)**	**426 (50.06)**	**153 (17.98)**	**851 (100)**		

*Figures in parentheses are percentages to total; **Highly significant*

The results of the study conducted to explore and identify the associations between the personal, psychological and institutional factors that influence the academic performance of students of veterinary science and animal husbandry revealed that there were significant associations between the time spent on studies after class hours,

parental observation on studies, students' interest in pursuing higher studies, and college of study, each with the academic performances of students of veterinary science and animal husbandry. Further, there was a highly significant association between the difficulty experienced in understanding topics and poor academic performance of the students. Having personal text books by students themselves, which might have helped them to read even during late / odd hours, had also a highly significant association with their academic performance.

However, there was no significant association between the pressure of curriculum and students' perceptions on institutional facilities on academic performance. The indifference in performance among colleges could be due to the fact that all institutions have been well equipped with adequate teaching and learning facilities. These findings underline the needs to / for encourage consistent reading habits outside class hours, arranging additional coaching for difficult topics / lessons, better parental watch and making available textbooks round the clock especially in hostels, to ensure desirable improvement in academic performances of students of veterinary and animal husbandry.

REFERENCES

Salem, R.O., Al-Mously, N., Nabil, N.M., Al-Zalabani, A.H., Al-Dhawi, A.F and Al-Hamdan,N. (2013). Academic and socio-demographic factors influencing students' performance in a new Saudi medical school. *Medical Teacher*, **35(1)**: S83-S89.

Hard, N and A.El-Shaarawi (2006). Factors affecting students' performance. Munich personal Repec Archive paper No. 13621.

Osaikhiuwu, O.C. (2014). Institutional factors affecting the academic performance of public administration students in a Nigerian University. *Public Administration Research*, **3(2)**:171-177.

Prevalence of *Buxtonella sulcata* Infection in Bovines of Southern Haryana

S Jinu Manoj[1] and Manoj Kumar Singh[2]
Lala Lajpat Rai University of Veterinary and Animal Sciences, Haryana

ABSTRACT

Buxtonella sulcata is considered as an opportunistic ciliate protozoan inhabiting the large intestine especially the colon of bovines. In this study, the prevalence of B. sulcata in bovines of southern Haryana is reported according to season, age and health status of animals. Coprological examination of faecal samples from cattle and buffaloes for B. sulcata revealed a prevalence rate of 25.69% and 34.65%, respectively. It was found that the highest prevalence was among heifers (52.90% and 33.84%), followed by calves (29.28% and 25.71%) and adults (8.69% and 13.63%) in both the species. The prevalence of this protozoan infection among diarrhoeic buffaloes and cattle were found as 38.18% and 31.57%, respectively with a statistical significance ($p<0.05$) when compared to non-diarrhoeic bovines. The seasonal prevalence study revealed highest incidence of B. sulcata infection in rainy season (45.13% and 35.84%) followed by winter season (37.96% and 28.57%) in both buffaloes and cattles of the study area. B. sulcata was considered as non pathogenic or commensal protozoa till recently, but its increased association with diarrhoea among animals suggests the need of further studies regarding its pathogenecity capacity.

Key Words: Buffaloes, *Buxtonella sulcata*, Cattle, Haryana, Prevalence

INTRODUCTION

Buxtonella sulcata is considered as an opportunistic ciliate protozoan inhabiting the large intestine especially the colon of bovines (El-Ashram *et al*., 2019). *Buxtonella sulcata* possess a dorsal ridge running in a sweeping curve from one end to the other end of body with a groove running down the middle. Outside the organism, they can survive in the form of a cyst, which is an endosporic form, but invasive in nature. The roundish oval cyst of this protozoan varies with a size of 80-100 µm in length by 60-80µm in width and is covered by a two layered capsule (Omeragic and Crnkic, 2015; Tomczuk *et al*., 2005). The consumption of fodder and water which is contaminated by cysts may lead to infection and the trophozoites are released from the cysts in the distal area of small intestine. In young and immunocompromised animals, it can become virulent and intensify the diarrhoeic symptoms, resulting in the reduction of the performance of animals and may leads to life threatening situation (Goz *et al*., 2006; Hasheminasab *et al*., 2015; Dianso *et al*., 2018). *Buxtonella sulcata* in bovines is often misdiagnosed as *Balantidium coli*, another pathogenic ciliate

Corresponding author EmailId: drjinumanoj@gmail.com
[1]Assistant Disease Investigation Officer, College Central Laboratory, College of Veterinary Sciences.
[2]Department of Livestock Production Management S.V.P.University of Agriculture and Technology, Meerut

for animals and man. The present study was conducted to know the prevalence of *B. sulcata* in bovines of southern Haryana and to analyze the association of this parasite with regard to health status and age of animals and season of the locality.

MATERIALS AND METHODS

A total of 548 faecal samples brought routinely to the Disease investigation Laboratory, Mahendragarh, Lala Lajpat Rai University of Veterinary and Animal Sciences, Haryana were examined for the presence of *Buxtonella sulcata* from a period of June 2018 to May 2019. Among these, 144 and 404 faecal samples were from cattle and buffaloes, respectively. The animals were categorized into three age groups, viz. calves (under 1 year of age), heifers (1-3 years) and adults (above 3 years). The health status of the animals were recorded into two categories *viz*., diarrhoeic and non-diarrhoeic. The whole year study period was divided into four seasons *viz*., summer, winter, spring/autumn and rainy. All the faecal samples were processed by floatation and sedimentation methods (Soulsby, 1982). The data obtained were compiled and tabulated for finding out the prevalence of the parasite as per their age, health status and climatic seasons. The data was analyzed using chi-squared ($\chi 2$) test with a p value of <0.05 for calculating the statistical significance.

RESULTS AND DISCUSSION

Buxtonella sulcata cysts were identified based on the morphological features (Fig.1). The cysts of *B. sulcata* are round or oval shaped, slight yellowish coloured and have macronucleus, contractile vacuoles surrounded by a two layered capsule. The cysts are the resting stage of ciliated protozoan inhabiting the caecum and colon of bovines. Coprological examination revealed the presence of *B. sulcata* in 37 (25.69%) and 140 (34.65%) faecal samples from cattle and buffaloes, respectively in the current study. Studies from different parts of world also reported a wide range with regard to prevalence of *B. sulcata* infection. Al-Saffar *et al*. (2010) reported 24.5% prevalence of *B. sulcata* from Iraq, while Adhikari et *al.* (2013) reported 27% prevalence in cattle from Nepal. Ganai *et al*. (2015) reported 23.6% and 18.5% of *B. sulcata* infection from Jammu in cattle and buffaloes, respectively. Maharana *et al*. (2016) found an incidence of 4.57% and 15.79% of *B. sulcata* in cattle and buffaloes of Gujarat, respectively. They further reported that the highest incidence rate was of *B. sulcata* among all age groups, breed, sex and seasons when compared to all other gastrointestinal parasites undertaken in the study. Kumar *et al*. (2017) reported an incidence of 35% from buffaloes of Gujarat. Edith *et al*. (2018) reported an incidence rate of 35.48% and 54.48% in organized and unorganized dairy farms in Tamilnadu. The incidence rate as high as 87.9% was also reported from Poland in diarrhoeic cattle (Tomczuk *et al*., 2005). These differences in prevalence of infection from all over the world could be due to many different factors such as animal health status, farm management, environmental conditions and stress factors.

Fig. 1. Cysts of *Buxtonella sulcata* (10X)

Statistical analysis showed significant differences between age groups with the highest prevalence among heifers (52.9% and 33.84%) animals when compared to calves (29.28% and 25.71%) and adults (8.69% and 13.63%) (Table 1). Al-Saffar *et al*. (2010) reported significant differences of *B. sulcata* infection between various age groups of cattle in their study, with highest prevalence in young animals. Ganai *et al*. (2015) reported significantly higher infection rate in young bovines (33.1%) than the adults (13.9%). Das and Dekha (2017) reported lowest prevalence of *B. sulcata* in Assam as of 0.74%, 0.78% and 0.85% among calves, heifers and adult cattle, respectively.

Table-1. Age-wise prevalence of *B. sulcata* infection in bovines of Southern Haryana

Species	Age of animals	Samples examined	Samples positive	Prevalence (%)
Buffalo	< 1 year	140	41	29.28[b]
	1-3 year	172	91	52.90[a]
	> 3 year	92	8	08.69[c]
Cattle	< 1 year	35	9	25.71[b]
	1-3 year	65	22	33.84[a]
	> 3 year	44	6	13.63[c]

Groups with different superscripts differ significantly (p <0.05)

The current study documented a high incidence rate of *B. sulcata* infection in animals with diarrhoea. The prevalence of this protozoan infection among diarrhoeic buffaloes and cattle were found as 38.18% and 31.57%, respectively with a statistical significance when compared to non-diarrhoeic bovines (18.91% and 14.28%). High intensity of *B. sulcata* was associated with diarrhoea in animals (El-Ashram *et al*., 2019). Similar reports were documented by various researchers (Goz *et al*., 2006; Al-Saffar *et al*., 2010; Ganai *et al*., 2015; Hasheminasab *et al*., 2015; Kumar *et al*., 2017) and all of them found a significantly higher infection rate in diarrhoeic animals than the bovines with normal faeces. The presence of *B. sulcata* cysts in the faecal samples of diarrhoeic animals clearly indicates its close association with the enhancement of motility of digestive tract contents (Edith *et al*., 2018). *Buxtonella sulcata* can lead to pH changes of intestinal content of animals and multiplication of this protozoa causes a cytotoxic effect, resulting in lesions of intestinal mucosa followed by secondary bacterial infections (Das and Deka, 2017).

The seasonal prevalence study revealed highest incidence of *B. sulcata* infection in rainy season (45.13% and 35.84%) followed by winter season (37.96% and 28.57%) in both buffaloes and cattles of the study

area (Table 2). Maharana *et al*, (2016) also reported highest prevalence in monsoon in both cattle and buffaloes, followed by winter and summer in buffaloes and summer and winter in cattle, even though their data didn't differ significantly. Edith *et al*. (2018) also reported higher prevalence in unorganized dairy farms due to the poor hygiene and managemental practices followed. The seasonal variations in the prevalence of infection were reported by Fox and Jacobs (1986) also. The epidemiology of any infection varies according to the climatic conditions and managemental practices followed in that particular area. The humidity or moisture content along with optimum temperature during monsoon favours the growth and survival of parasitic infections. The lower and lowest prevalence in winter and summer respectively may be accorded due to the lack of moisture and optimum temperature during cold and hot climatic conditions (Laha *et al*., 2013; Maharana *et al*., 2018).

Table-2. Season-wise prevalence of *B. sulcata* infection in bovines of Southern Haryana

Season*	Species	Samples Examined	Samples Positive	Prevalence (%)
Rainy	Buffalo	113	51	45.13
	Cattle	53	19	35.84
Spring/Autumn	Buffalo	85	26	30.58
	Cattle	34	08	23.52
Winter	Buffalo	108	41	37.96
	Cattle	21	06	28.57
Summer	Buffalo	98	22	22.44
	Cattle	36	04	11.11

*__Season__ 1. Rainy-July, August, September. 2. Spring/Autumn-October, November, March. 3. Winter-December, January, February. 4. Summer-April, May, June.

CONCLUSION

Buxtonella sulcata may be considered to be a factor for persistent diarrhoea in animals. In the current study also, no clinical sign reported other than diarrhoea among the animals and no other gastrointestinal parasites were also diagnosed. The *B. sulcata* infection associated with diarrhoeal symptoms affected the optimal growth and cause reduction in productivity of bovines in the study area. *Buxtonella sulcata* was considered as non pathogenic or commensal protozoa till recently, but its increased association with diarrhoea among animals suggests the need of further studies regarding its pathogenic capacity.

REFERENCES

Adhikari, B.B., Rana, H.B., Sultan, K.M.I., Devkota, B., Nakao, T., Kobayashi, K., Sato H and Dhakal, I.P (2013). Prevalence of *Buxtonella sulcata* in water buffaloes and cows in Chitwan valley, Southern Nepal. *Japenese Journal of Veterinary Parasitology*, **11**(2): 55-60.

Al-Saffar, T.M., Suliman, E.G and Al-Bakri, H.S. (2010). Prevalence of intestinal ciliate *Buxtonella sulcata* in cattle in Mosul. *Iraqi Journal of Veterinary Science*, **24**(1): 27-30.

Das M and Deka D.K. (2017). Preliminary report on prevalence of intestinal ciliate (*Buxtonella sulcata*) in cattle of Assam. *Indian Journal of Hill Farming*. Special Issue. 64-67.

Dianso, J.A., Garcia, G.G., Belotindos, L.P and Mingala C.N. (2018). Molecular identification of *Buxtonella sulcata* from associated-diarrhea in water buffaloes (*Bubalus bubalis*) in the Philippines. *Annals of Parasitology,* **64**(2): 93–100.

Edith, R., Balagangatharathilagar, M., Gomathinayagam, S and Roy P. (2018). Incidence of *Buxtonella sulcata* infection in cattle from organized and unorganized dairy farms in Tamilnadu. *International Journal of Science, Environment and Technology,* **7**(1): 133 -137.

El-Ashram, S., Aboelhadid, S.M., Kamel, A.A., Mahrous, L.N and Abdelwahab, K.H. (2019). Diversity of parasitic diarrhea associated with *Buxtonella sulcata* in cattle and bualo calves with control of buxtonellosis. *Animals* **9**:259.

Fox, M.T and Jacobs, D.E. (1986). Pattern of infection with *Buxtonella sulcata* in British cattle. *Research in Veterinary Science*, **41**: 90-92.

Ganai, A., Parveen, S., Kaur, D., Katoch, R., Yadav, A., Godara, R and Ahamed, I. (2015). Incidence of *Buxtonella sulcata* in bovines in RS Pura, Jammu. *Journal of Parasitic Diseases*, **39**(3): 446-447.

Goz, Y., Altug, N., Yuksek, N and Ozkan, C. (2006). Parasite detected in neonatal and young calves with diarrhea. *Bulletin of the Veterinary Institute in Pulawy,* **5**: 345-348.

Hasheminasab, S.S., Moradi, P., Talvar, H.M., Wright, I and Darbandi, M.S. (2015). *Buxtonella* spp. like infection in cattle in Sanandaj province, Iran. *Annals of Parasitology,* **61**(4): 247–251.

Kumar, B., Maharana, B.R., Prashad, A., Joseph, J.P and Patel, B.R. (2017). Incidence of *Buxtonella sulcata* in Jaffrabadi buffaloes of south-western Gujarat, India. *Buffalo Bulletin,* **36**(4): 623-628.

Laha, R., Das, M and Goswami, A. (2013). Gastrointestinal parasitic infections in organized cattle farms of Meghalaya. *Veterinary World*. **6**(2):109–112.

Maharana, B.R., Kumar, B., Sudhakar, N.R., Behera, S.K and Patbandha, T.K. (2016). Prevalence of gastrointestinal parasites in bovines in and around Junagadh (Gujarat). *Journal of Parasitic Diseases,* **40**(4): 1174-1178.

Omeragic, J and Crnkic, C. (2015). Diarrhoea in cattle caused by *Buxtonella sulcata* in Sarajevo area. *Veterinaria*, **64**(2): 50-54.

Soulsby, E.J.L. (1982). Helminths, arthropods and protozoa of domesticated animals, 7th ed. ELBS and Bailliere Tindal, London.

Tomczuk, K., Kurek, L., Stec, A., Studzinska, M and Mochol, J. (2005). Incidence and clinical aspects of colon ciliate *Buxtonella sulcata* infection in cattle. *Bulletin of the Veterinary Institute in Pulawy,* **49**(1): 29-33.

PREPLANTING SETT TREATMENTS ON SPROUTING AND PERFORMANCE OF BAJRA NAPIER HYBRID GRASS CO (BN) 5

S. V. Varshini[1] and C. Jayanthi[2]
Agricultural College and Research Institute
Tamil Nadu Agricultural University, Coimbatore

ABSTRACT

A field experiment was conducted in TNAU, Coimbatore during 2017 - 2018 to 2018 - 2019 to evaluate the effect of sett treatments on the growth, fodder yield, quality and economics of BN hybrid grass. The variety taken was CO (BN) 5 as a single bud in a RBD with 13 sett treatments and two replications. The result showed that higher sprouting, establishment percentage, growth attributes with higher number of tillers, green fodder (58.6 t/ha/cut) and dry fodder yield (12.6 t/ha/cut) were recorded with water soaking for 12 hours and 24 hours incubation (T_1). Quality parameter viz., crude protein, crude fibre, crude fat and total ash content (%) showed non significant difference. Higher gross return (Rs.117222) and net return (Rs.79428) were recorded with water soaking for 12 hours and 24 hours incubation (T_1). The lower cost of cultivation (Rs. 37794) was observed with water soaking for 12 hours and 24 hours incubation (T_1).

Key Words: Bajra napier, Singlebudded setts, Sett treatment, Sprouting percentage, Fodder quality and yield.

INTRODUCTION

Livestock holds a major position in the economy of rural India by providing employment and supplementary family income through balanced and nutritional food in the form of milk, meat and egg to the millions of people. The population of livestock that the country currently house's is about 535.78 million which is an increase of 4.6% over the livestock census-2012.The business of livestock and related sectors alone contributes approximately 4.5% of national GDP and 27.6% of the agriculture GDP. Recent surveys about livestock in India shows that the country has about 15% of world cattle population and due to ever increasing population pressure of human, most of the arable land is mainly used for food and cash crops, thus there is little chance of having good quality arable land available for fodder production. Until milk production becomes remunerative to the farmers as compared to other field crops there will be the scope for fodder cultivation in arable lands.(Meena and Singh 2014).

India's forage resources are mainly derived from crop residues, cultivated forages and grazing from pastures and grasslands. India is currently facing a mesh shortfall of around 64 per cent feeds, 61.1 per cent green fodder and 21.9 per cent dry crop residues (Datta, 2013).Chronic shortage of feeds and forages together with

[1] Ph.D Scholar, Agricultural College and Research Institute
Email: varshuagri08@gmail.com
[2] Professor, Dept. of Agronomy
Email: jayanthichins@hotmail.com

poor nutritive value of available feeds has lowered the productive capacity and fertility of Indian livestock. This gap in requirement and availability would further aggravate due to increase in livestock population. One of the main impediments in the way of improvement of livestock production is quantitative and qualitative insufficiency of fodder (Pathan *et al.,* 2012). Bajra naipar is believed to be the perfect crop to meet these demands.

Bajra Napier hybrid grass CO (BN) 5 is an interspecific hybrid between fodder Cumbu IP 20594 (*Pennisetum glaucum*) and Napier grass FD 437 (*P. Purpureum Schumach*). It is widely distributed in tropical and sub-tropical regions of Asia, Africa, southern Europe and India (Kadam *et al.,* 2017). But the issue with bajra napier is that it behaves more like sugarcane with somewhat similar planting method and resource requirements. The planting materials are not cost effective and need to be transported which adds additional cost. The large quantity of planting material required in normal planting system also leads to problems with logistics, storage, and loss of bud viability. (Moraes *et al.,*2018).

The availability of quality setts in huge quantity is also a major problem (Tudu *et al*., 2007). Further the current method of planting double budded setts not only increases the cost but also consume resources. Nalawade *et al*. (2018) concluded that the single budded setts also match the germination of double budded setts if protected with sett treatment. Planting single budded sett not only reduces the material requirement but also has a huge economic benefits. With the deficit of fodder increasing fodder requirement every year, it is essential to develop efficient crop establishment method on growth & yield of bajra napier grass. By keeping these factors as an objective this study was conducted to evaluate the best sett treatment for good establishment and to improve the growth, yield and economics of bajranapier hybrid grass.

MATERIALS AND METHOD

A field experiment to evaluate the effect of sett treatments on the performance of bajranapier hybrid grass CO (BN) 5 was conducted during 2017-18 and 2018-19 at the Eastern block of Department of Agronomy, Tamil Nadu Agricultural University – Coimbatore. The soil of experimental field was sandy clay loam in texture. The chemical composition of the soil comprised of pH 8.49, EC 0.55 dS/m, organic carbon 0.57%, available nitrogen 204 kg/ha, available phosphorus 32 kg/ha and available potassium 769 kg/ha.

The experimental field was laid out in a randomized block design (RBD) with thirteen treatments and two replications. The treatment comprised with thirteen sett treatments viz, water soaking for 12 hours and 24 hours incubation(T_1), water soaking for 30 minutes (T_2), hot water soaking at 40°C for 20 minutes (T_3), cowdung slurry (1:1) soaking for 30 minutes (T_4), panchagavya (3%) soaking for 30 minutes (T_5), panchagavya (5%) soaking for 30 minutes (T_6), beejamruth (soaking concentrated solution for 30 minutes) (T_7), beejamruth (50% dilution) soaking for 30 minutes (T_8), GA3 (5 ppm) soaking for 15 minutes (T_9), GA3 (10 ppm) soaking for 15

minutes (T_{10}), ethrel (50 ppm) soaking for 15 minutes (T_{11}), ethrel (100 ppm) soaking for 15 minutes (T_{12}), control (without sett treatment) (T_{13}). The field was thoroughly ploughed and applied with recommended dose of NPK 75:50:40 kg/ha as basaland subsequently 75 kg/ha of nitrogen was applied at 30 DAP.

The single budded setts were treated as per treatment schedule and planted vertically in their respective plots with a spacing of 60X50 cm. First irrigation was given at the time of planting and life irrigation was provided on 3 DAP. Subsequent irrigations were given at 10 days interval. Hand weeding was done on 20 DAP. Observations were taken on sprouting at at10, 15, 20 DAP and establishment at 30 DAP, plant height (cm), number of tillers, number of leaves per clump, tussock perimeter (cm), leaf area index, leaf stem ratio, green fodder and dry fodder yields (t/ha/cut) at the time of harvest. The standard analytical methods were used for plant analysis viz., crude protein and crude fibre, crude fat and total ash content (%) by A.O.A.C., (2005). The prevailing market prices were taken out in order to work out the economics of different treatments.

RESULTS AND DISCUSSION

Mean of two years results on sprouting, establishment, growth, yield, quality and economics of sett treatment are presented.

Sprouting and establishment

Sprouting percentage on 10, 15 and 20 DAP showed a significant difference among the sett treatment (Table 1). Higher sprouting percentage were observed with water soaking for 12 hours and 24 hours incubation (T_1) 60 %, 61% and 70 % respectively on 10,15 and 20 DAP and this was onpar with beejamruth (soaking concentrated solution for 30 minutes) (T_7). This is mainly because of the improved metabolic activity from the water soaking. The high water content on setts will promote conversion of carbohydrates into reducing sugars, the higher concentration of reducing sugars might be the reason for the high sprouting percentage observed in water soaking for 12 hours and 24 hours incubation (T_1), since hydrolysis of sugar from complex into simple form helps to readily utilize in the synthesis of auxins and proteins (Sabongari and Ailero, 2004). The auxins thus produced helps to soften cell walls which in turn facilitate the growth and readily utilize the proteins for the production of new tissues. Another possible reason is that it may also leach germination inhibitors from setts and fastening metabolic events in the treated setts. These positive effects are probably due to the stimulatory effects of sett treatment on the early stages of germination process by mediation of cell division in germinating setts (Golezani *et al.,* 2010). Lower sprouting percentage was observed with T_{13} control (without sett treatment) 28 %, 46% and 51% respectively on 10,15 and 20 DAP.

Table 1: Effect of preplanting sett treatments on sprouting and establishment percentage (%) of B. N. hybrid grass.[mean of two years (2017-18 & 2018-19)]

Treatments	10 DAP	15 DAP	20 DAP	30 DAP
T_1	60 (93)	61 (95)	70 (100)	70 (100)
T_2	46 (25)	54 (53)	67 (65)	65 (65)
T_3	41 (50)	54 (75)	63 (85)	60 (83)
T_4	55 (55)	62 (65)	68 (85)	68 (85)
T_5	42 (40)	54 (65)	62 (80)	62 (75)
T_6	35 (45)	51 (65)	55 (80)	55 (75)
T_7	53 (70)	60 (80)	68 (88)	68 (88)
T_8	36 (63)	54 (75)	60 (85)	61 (85)
T_9	44 (40)	57 (60)	65 (60)	64 (75)
T_{10}	49 (50)	59 (70)	68 (80)	66 (80)
T_{11}	45 (35)	55 (60)	64 (70)	64 (70)
T_{12}	41 (30)	54 (60)	60 (65)	60 (65)
T_{13}	28 (20)	46 (45)	51 (55)	49 (53)
S.Ed	3.6	3.2	4.3	3.8
CD(P=0.05)	7.9	7.1	9.4	8.4

Figures in parenthesis are orginal values – arcsine transformation was carried out

Establishment percentage was higher with water soaking for 12 hours and 24 hours incubation (T_1) (70%) this was comparable with beejamruth (soaking concentrated solution for 30 minutes) (T_7). This is mainly because when a sett has a surplus or an adequate amount of water, the cells will not offer any resistance or minimal resistance to the water movement towards bud and root primordial, which can facilitates the build-up of requisite water content in the bud and root primordia, thus improving the establishment percentage of setts soaked in water. Sett treatment may improve germination by accelerating imbibitions, which in turn would facilitate

the emergence phase and the multiplication of radicle cells (McDonald, 2004).The lower establishment percentage was observed with T_{13} control (without sett treatment) 49%.

Growth parameters

The growth parameters observed were number of tillers per clump, numbers of leaves per clump, tussock perimeter (cm), leaf area index showed significant difference between treatments (Table 2). But there is no significant difference were observed with plant height and leaf stem ratio.

The treatment water soaking for 12 hours and 24 hours incubation (T_1) recorded higher number of tillers per clump (27.0), numbers of leaves per clump (316), tussock perimeter (160.5cm) and leaf area index (24.4). This might be due to the increased shoot production associated with water soaking, which in turn increases the production of photosynthate for the developing roots, efficient roots leads to better nutrient uptake thus improves the overall all growth parameters (Basra *et al.,*2005).

The lower values were observed with T_{13} control (without sett treatment) for number of tillers per clump (19.6), numbers of leaves per clump (230), tussock perimeter (118.5cm) and leaf area index (12.9).

Table 2: Effect of preplanting sett treatments on growth of B. N. hybrid grass. [mean of two years (2017-18 & 2018-19]

Treatments	Plant height (cm)	Number of tillers/clump	Number of leaves/clump	LAI	Tussock perimeter (cm)	Leaf stem ratio
T_1	245.9	27.0	316	24.4	160.5	0.45
T_2	196.4	20.3	235	13.8	121.2	0.41
T_3	218.4	24.3	275	21.7	149.8	0.43
T_4	218.6	24.9	286	22.7	153.0	0.44
T_5	212.0	22.0	256	17.2	136.0	0.42
T_6	215.5	23.8	263	18.7	138.9	0.43
T_7	240.6	25.9	307	23.8	156.9	0.45
T_8	224.1	25.3	301	23.0	155.7	0.45
T_9	210.2	21.6	252	16.9	132.5	0.42
T_{10}	217.0	24.1	270	20.2	146.8	0.43
T_{11}	207.3	21.0	242	15.8	127.8	0.42
T_{12}	200.1	20.4	244	14.8	122.8	0.41
T_{13}	193.0	19.6	230	12.9	118.5	0.40
S.Ed	**NS**	**1.0**	**13.2**	**1.0**	**6.7**	**NS**
CD(P=0.05)		**2.1**	**28.8**	**2.2**	**14.5**	

Table 3: Effect of preplanting sett treatments on fodder yield and economics of B. N. hybrid grass. [mean of two years (2017-18 & 2018-19)]

Treatments	Green fodder yield (t/ha/ cut)	Dry fodder yield (t/ha/cut)	Cost of cultivation Rs./ha/cut	Gross return Rs./ha/cut	Net return Rs./ha/cut
T_1	58.6	12.9	37794	117222	79428
T_2	29.4	6.7	37794	58712	20917
T_3	46.2	9.7	37794	92369	54575
T_4	50.3	10.7	38494	100580	62086
T_5	38.1	8.5	47694	76052	28358
T_6	40.2	8.9	54394	80388	25994
T_7	55.9	12.4	50289	111807	61518
T_8	53.7	11.7	46124	107228	61104
T_9	36.4	8.2	39074	72738	33664
T_{10}	43.8	9.2	40434	87656	47222
T_{11}	33.6	7.8	44184	67141	22957
T_{12}	31.3	7.3	50589	62631	12042
T_{13}	27.0	6.1	37794	53917	16123
S.Ed	**3.5**	**0.7**			
CD(P=0.05)	**7.7**	**1.5**			

Green and dry fodder yields

Green fodder and dry fodder yields showed significant difference among the sett treatments (Table 3). Mean results showed that higher green (58.6 t/ha/cut) and dry fodder yield (12.9 t/ha/cut) were observed with water soaking for 12 hours and 24 hours incubation (T_1) this was onpar with treatment beejamruth (soaking concentrated solution for 30 minutes) (T_7), beejamruth (50% dilution) soaking for 30 minutes (T_8).

The higher green and dry fodder yields associated with the treatment water soaking for 12 hours and 24 hours incubation (T_1) might be due to the reason that, soaking the setts in water increased the growth promoting effect as well as rapid and regulated production of emergent metabolites on the plant at the initial and later developmental stages contributes to the increased number of tillers per clump, number of leaves per clump, leaf area index, tussock perimeter, number of nodes per tiller. This inturn produces higher green and dry fodder yield. Lower green (27.0 t/ha/cut) and dry fodder yield (6.1 t/ha/cut) were recorded with control (without sett treatment) (T_{13}).

Table 4: Effect of preplanting sett treatments on quality of B. N. hybrid grass. [mean of two years (2017-18 & 2018-19)]

Treatments	Crude protein content (%)	Crude protein yield (t/ha)	Crude fibre content (%)	Crude fat content (%)	Total ash content (%)
T_1	14.51	1.86	30.43	5.18	12.08
T_2	13.50	0.90	29.86	4.72	10.53
T_3	14.06	1.36	30.32	4.90	11.25
T_4	14.11	1.50	30.34	4.96	11.41
T_5	13.71	1.17	30.21	4.76	10.71
T_6	13.82	1.22	30.25	4.80	10.96
T_7	14.47	1.79	30.41	5.14	11.95
T_8	14.23	1.66	30.36	5.02	11.72
T_9	13.62	1.11	30.18	4.74	10.62
T_{10}	13.94	1.28	30.26	4.82	11.03
T_{11}	13.53	1.06	29.92	4.75	10.57
T_{12}	13.47	0.98	29.75	4.70	10.45
T_{13}	13.39	0.81	29.44	4.67	10.38
S.Ed	**NS**	**0.09**	**NS**	**NS**	**NS**
CD(P=0.05)		**0.20**			

Quality parameters

Quality parameters of bajra napier hybrid grass showed non significant difference on crude protein, crude fibre, crude fat and total ash content (%) (Table 4). Whereas, crude protein yield showed significant difference on sett treatment. Sett treatment with water soaking for 12 hours and 24 hours incubation (T_1) recorded higher crude protein yield (1.86 t/ha). This was due to increased bud germination with adequate plant population which would inturn produced more dry matter production leading to higher crude protein yield (Singh *et al.,* 2016). This was also found to be on par with the treatment beejamruth (soaking concentrated solution for 30 minutes) (T_7) which recorded 1.79 t/ha of crude protein yield. Lower crude protein yield of 0.81 t/ha was recorded in control T_{13} (without sett treatment).

Economics

Economics of the study showed that, higher cost of cultivation (Table 3) was recorded with panchagavya (5 %) soaking for 30 minutes (T_6) (Rs.54394). This might be due to increased cost of panchagavya preparation. Higher gross return (Rs.117222), net return (Rs. 79428) and lower cost of cultivation was observed with water soaking for 12 hours and 24 hours incubation (T_1). The reduced cost of cultivation is mainly due to less preparation

cost in treatment (T_1). Lower gross return (Rs.53917) and net returns (Rs.16123) was observed with control T_{13} (without sett treatment).

Conclusion

It can be concluded from the present study that single budded setts with water soaking for 12 hours and 24 hours incubation is the best treatment to achieve higher sprouting (60, 61, and 70 % on 10, 15 and 20 DAP respectively), establishment percentage (70%), growth, green fodder yield (58.6 t/ha/cut), dry fodder yield (12.9 t/ha/cut), crude protein yield (1.86 t/ha) and net return (Rs. 79428/ ha/cut) of bajra napier hybrid grass CO (BN) 5. Further it is also proven that single budded setts with water soaking for 12 hours and 24 hours incubation can provide considerable economic benefits for the farmers.

REFERENCES

AOAC (Association of official Agricultural Chemist), 1970. Method of analysis, Washington, D.C (U.S.A).

Basra, S.M.A., Farooq, M. and Tabassum. R. (2005). Physiological and biochemical aspects of seed vigour enhancement treatments in fine rice *(Oryza sativa* L.). *Seed Science and Technology.* **33**:623–628.

Datta, D. (2013). Indian fodder management towards 2030: A case of vision or myopia. *International Journal of Management and Social Science Reserach*, **2(2):** 33-41.

Golezani, G. K., Jeddi, A.C., Nasrollahzadeh, S. and Moghaddam, M. (2010). Effect of hydropriming duration on seedling vigour and growing yield of Pinto bean cultivars. *Notulae. Botanicae. Horti Agrobotanici Cluj-Napoca,* **38 (1):** 109-113.

Kadam, S. S., Kumar, A., and Arif, M. (2017). Hybrid Napier for round the year quality fodder supply to the dairy industry-A review. *International Journal of Current Microbiology and Applied Science*, ***6*(10):** 4778-4783.

McDonald, M.B. (2004). Seed deterioration: physiology, repair and assessment. *Seed Science and Technology,* **27:** 177-237.

Meena, M. S., & Singh, K. M. (2014). Fodder Production Scenario and Strategies for Revitalizing Fodder Production Technologies.

Moraes, M. C. D., Ribeiro Guimarães, A. C., Perecin, D., & Sainz, M. B. (2018). Effect of Planting Material Type on Experimental Trial Quality and Performance Ranking of Sugarcane Genotypes. *International Journal of Agronomy*, *2018*.

Nalawade1, S.M., Mehta, A. K. and Sharma. A.K. (2018). Sugarcane planting techniques: a review. Contemporary Research in India. 2231-2137.

Pathan, S. H., Tumbare, A. D., & Kamble, A. B. (2012). Impact of planting

material, cutting management and fertilizer levels on nutritional quality of bajra x napier hybrid. *Forage Research*, **38(2):**74-79.

Sabongari, S. and Aliero, B. L. (2004). Effects of soaking duration on germination and seedling growth of tomato (*Lycopersicum esculentum* Mill). *African Journal of Biotechnology,* **3(1):** 47-51.

Singh, A. K., Lal, M., Singh, S., Pathak, A., & Singh, E. (2016). Effect of planting methods on growth, yield and quality of sugarcane in subtropical India. *Indian Journal of Sugarcane Technology*, **31(02):** 55-60.

Tudu, S., D. Mandal and G.C. De. (2007). Studies on sprouting and rooting of single budded sugarcane setts in seedbed. *Agricultural Science Digest,***27 (3):** 222 – 224.

Short Communication

Twin Follicular Cysts in a Crossbred Cow: a Case Report

S. Satheshkumar*, A. Ganesan[1], Chhavi Gupta[2], M.Murugan[3], J. Jayalakshmi [4] and A. Palanisammi [5]

Department of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute, Tamilnadu Veterinary and Animal Sciences University, Tirunelveli – 627 358, Tamil Nadu

Follicular cyst is an important ovarian dysfunction and a major cause of reproductive failure in dairy cattle which has an economic impact on dairy industry. With the advent of imaging diagnostics follicular cyst has been defined as follicle like structures, with a minimum diameter of 17 mm and persisting for more than 6 days in the absence of a corpus luteum (Silvia *et al*., 2002). Calder *et al*. (2001) has explained the different natures of follicular cysts in cattle. This paper places on record the co-existence of two types of follicular cysts and therapeutic approach in a crossbred cow

CASE HISTORY AND OBSERVATION

A Jersey crossbred cow (3 calvings) was brought to the Large animal Gynaecology Unit of Veterinary Clinical Complex, Veterinary College and Research Institute, Tirunelveli with the history of persistent oestrus signs for the past 10 days. On enquiry it was found that the animal had calved four months back and exhibited the first post partum oestrus by 90 days after calving.

On external examination, the animal had edematous vulva and pale vaginal mucous membrane. Clear copious vaginal discharge was noticed. Gynaeco-clinical examination revealed dilated cervix with uterine tonicity simulating the oestrus characteristics. The right ovary was enlarged in size with palpable fluctuating areas resembling that of follicular cyst. Left ovary was normal. No corpus luteum could be palpated in both the ovaries.

On ultrasonographic examination, it was found that the right ovary had two large anechoic structures (F1 and F2, each 23.0 mm diameter) (Fig.1). Left ovary had small sized follicles. No luteal tissue could be observed in both the ovaries. The case was tentatively diagnosed as a 'Twin Follicular cyst'

Corresponding author Email Id: drsatheshkumar6@rediffmail.com; Mobile: 9840885192

[1] Assistant Professor, Department of Veterinary Gynaecology and Obstetrics,

[2] Assistant Professor, Veterinary Clinical Complex,

[3] Undergraduate Scholar,

[4] Dean, Veterinary College and Research Institute, Tamilnadu Veterinary and Animal Sciences University, Tirunelveli – 627 358, Tamil Nadu, India

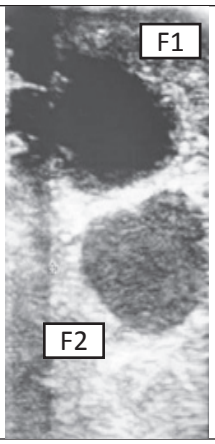

Fig.1. 'Twin follicular cysts' in the right ovary (day of LH administration)

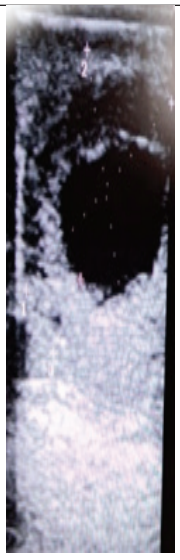

Fig.2a. Day7 post LH – Luteinized cyst (F1)

Fig.2b. Day7 post LH -Unresponsive cyst (F2)

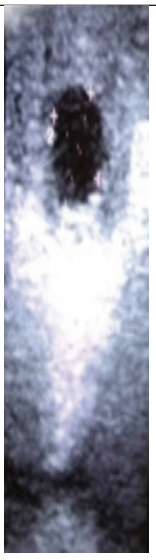

Fig.2c. Day7 post LH- DF in left ovary

TREATMENT AND DISCUSSION

A modified Cosynch protocol was followed by initiating the treatment with Luteinizing hormone (Inj. Human Chorionic gonadotrophin; 3000 IU; i.v.). After 7 days we found that F1 in the right ovary responded with luteinization (8mm luteinized tissue), while the other follicle (F2) persisted with a thin lining of luteinized tissue (3mm). Left ovary possessed a dominant follicle (DF) of 10 mm diameter (Fig.2 a,b,c). Prostaglandin (Inj. Cloprostenol: 500 µg; i.m.) was administered on that day. The animal exhibited oestrus 48 h post PG. Ultrasonographic examination revealed the lysis of luteinized follicle (F1), but the F2 follicle still persisted. On the left ovary, the

DF increased in diameter (13.5 mm). The animal was inseminated for two subsequent days, with GnRH administration (Inj. Buserelin acetate; 10 µg; i.m.) during the first day AI. Ultrasonographic examination on the third day of the cycle revealed the ovulation of the DF in the left ovary. Based on the therapeutic response, it could be concluded that among the two follicular cysts, one was a dominant responsive cyst and the other one was a non-responsive cyst as described by Calder *et al.* (2001). The interesting feature of this case was the co-existence of both responsive and non-responsive follicular cysts in the same ovary.

Cattle are usually mono-ovular species, but multiple ovulations do occur occasionally. During the follicular turnover only one follicle will deviate and attain the dominance while the rest of the recruited follicles will undergo atresia. Co-dominance might occur when more than one follicle could deviate at the same time, which increases the chance of multiple ovulations (Macmillan *et al*., 2018). In the present clinical case, such phenomena of co-dominance would have occurred, but the twin follicles persisted as cysts instead of ovulation. Calder *et al*. (2001) suggested that low serum progesterone and high basal LH concentrations are characteristic of cows with cysts. Thus modified Cosynch protocol followed in this case was found to have corrected the endocrine imbalance resulting in culmination of cystic degeneration and return to normal cyclicity.

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REFERENCES

Calder, M.D., Manikkam, M., Salfen, B.E., Youngquist, R.S., Lubahn, D.B., Lamberson, W.R and Garverick, H.A. (2001). Dominant bovine ovarian follicular cysts express increased levels of messenger rnas for luteinizing hormone receptor and 3β-hydroxysteroid dehydrogenase δ^4,δ^5 isomerase compared to normal dominant follicles. *Biology of Reproduction,* **65**:471-76.

Macmillan, K., Kastelic, J.P and Colazo, M.G. (2018). Update on Multiple Ovulations in Dairy Cattle. *Animals*, **8**:1-12

Silvia, W.J., Hatler, T.B., Nugent, A.M and Laranja da Fonseca, L.F. (2002). Ovarian follicular cysts in dairy cows: an abnormality in folliculogenesis. *Domestic Animal Endocrinology,* **23:**167–177.

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