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A study on comparative evaluation of supplementing Asparagus racemosus root powder with vitamin E and selenium on growth performance and oxidative stress biomarkers in early weaned Malabari goat kids[#]

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Abstract

An experiment was conducted to evaluate and compare the effect of Asparagus racemosus root powder and Vitamin E–Selenium supplementation on growth performance and oxidative stress biomarkers in early weaned Malabari goat kids. Twenty-four kids (45 days old) were randomly allotted into four groups (T1–T4) and reared upto 90 days. T1 served as control (basal ration), T2 received 50 mg Vitamin E + 0.3 mg selenium/kg ration, while T3 and T4 were supplemented with Asparagus racemosus root powder at 50 mg/kg and 100 mg/kg body weight, respectively. Final body weight (kg) was significantly (P<0.05) higher in T2 (11.96) and T4 (11.78) compared to T3 (10.77) and T1 (9.95). Significantly higher (P<0.05) average daily gain (ADG) values were recorded in T2 (91.10 g/day) and T4 (89.30 g/day) versus T1 (72.08 g/day). Antioxidant indices revealed significantly increased (P<0.05) catalase and superoxide dismutase (SOD) activities, and reduced malondialdehyde (MDA) levels in T2 (717.33 µmole H_2O_2 utilized/min, 113.46 U/ml, 2.19 nmol/ml) and T4 groups (714.83 µmole H_2O_2 utilized/min, 114.77 U/ml, 2.31 nmol/ml) when compared to T1 control group (553.33 µmole H_2O_2 utilized/min, 99.67 U/ml, 3.30 nmol/ml). The results indicate that Asparagus racemosus at 100 mg/kg BW was comparable with Vitamin E–Selenium supplementation on enhancing growth performance and antioxidant status in Malabari kids under early weaning stress.

Keywords: *Asparagus racemosus, Vitamin E, Selenium, antioxidants, Malabari kids*

Goat farming is an important part of the livestock sector in many countries. Goats provide meat, milk, fibre, manure and are widely reared by small and marginal farmers due to their ability to survive in different climatic conditions. Compared to other livestock species, goats require lower investment and are easy to manage (Devendra, 2013). Their

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fast reproductive rate and resilience to diseases make them suitable for both small-scale and commercial farming systems (FAO, 2012).

India has one of the largest goat populations in the world, with about 148.88 million goats as per the 20th Livestock Census. Goat farming plays a major role in the rural economy by supporting landless labourers and small landholding farmers (Kumar et al., 2021). Goats are often called the "poor man's cow" because of their economic importance and ability to provide multiple products like milk, meat, fibre, skin, and manure.

Herbal feed additives, also called phytogenic feed additives, are gaining attention in livestock production. They help in improving digestion, appetite, and immune response and also in reducing the effects of stress in animals. According to the World Health Organization, around 80 per cent of the global population still uses traditional medicinal plants because they are affordable, safe, and effective (Devi, 2020). In animals, herbal supplements can support rumen function, enhance nutrient absorption, and promote growth. Weaning is the process of separating young animals from their mothers and shifting them from milk to solid feed. In commercial goat farms, early weaning is used to boost milk output and speed up the breeding cycle. This practice lowers infant mortality, reduces labour, feed costs and promotes early rumen development in kids. However, early weaning can cause stress in kids, leading to lower feed intake, increased susceptibility to diseases, behavioural changes such as increased vocalisation and restlessness, digestive problems, slower growth, and reduced immunity. The stress of weaning may also cause oxidative damage in the body, which can affect overall health. Therefore, proper nutritional support is essential to reduce weaning stress and ensure better performance in goat kids.

The use of anti-stress supplements represents a viable approach to alleviate weaning stress in kids. Hence, it is essential to supplement the feed with suitable anti-stress formulations. Shatavari (*Asparagus racemosus*) is a well-known medicinal plant in Ayurveda, traditionally used as a health tonic and rejuvenator. It grows widely in India, Southeast Asia, and tropical Africa. These compounds help improve antioxidant activity, boost immunity, and promote growth in animals (Madhavan et al., 2010). Shatavari supplementation has shown positive results in different species. In goat kids and calves, it helped improve average daily gain and feed efficiency (Singla et al., 2017; Bhinda et al., 2022). It has also been found to improve antioxidant enzyme levels and reduce stress in rats and poultry (Sharma et al., 2012; Kumari et al., 2012). Hence, it can be considered a useful natural feed additive in goat farming.

This study was conducted to evaluate the effects of *Asparagus racemosus* (Shatavari) root powder, a phytogenic feed additive known for its adaptogenic, antioxidant, and immunomodulatory properties. Shatavari is a plant-based, easily available and cost-effective alternative to synthetic additives. However, its potential as an anti-stress supplement in the diet of early-weaned kids has not been explored. Therefore, this study aimed to assess the effects of Shatavari root powder on oxidative stress biomarkers and growth performance in early-weaned Malabari kids, in comparison with the known antioxidants vitamin E and selenium.

Materials and methods

The present study was conducted at the University Goat and Sheep Farm, KVASU, Mannuthy, Thrissur, Kerala over a period of 90 days. The trial was carried out from December 2024 to March 2025 and all kids were maintained under uniform feeding and managemental conditions. A total of 24 apparently healthy Malabari goat kids, each early weaned at 45-55 days of age and clinically normal, were selected for the study and the animals were allotted into four treatment groups (Table

Table 1. Treatment groups of the experimental early weaned Malabari kids

Treatment	Ration
T1	Basal ration without supplementation
T2	Basal ration + 50 mg α tocopherol acetate + 0.3mg selenium /kg of ration
T3	Basal ration + *Asparagus racemosus* root powder 50 mg/kg body weight
T4	Basal ration + *Asparagus racemosus* root powder100 mg/kg body weight

Table 2. Composition of components fed to experimental kids on dry matter basis

Sl. No.	Component	Total solids (%)	Moisture (%)	Crude protein (%)	Crude fibre (%)	Ether extract (%)	Total ash (%)	Solids-not-fat (SNF) (%)
1	Milk	13.27 ±0.36	–	3.59 ± 0.24	–	3.48 ± 0.59	0.72 ± 0.02	11.20 ± 0.17
2	Kid starter	–	8.83	23.74	7.28	4.54	9.33	–
3	Hybrid Napier grass	–	76.44	8.70	40.82	2.07	10.96	–
4	*Asparagus racemosus* root powder	–	9.23	5.77	15.26	0.80	3.97	–

1) following a completely randomized design (CRD). Each group consisted of six animals.

Experimental feed, supplementation and feeding design

The *Asparagus racemosus* roots used for the study were sourced from a local Ayurvedic farmer in Thrissur, Kerala. The roots were shade-dried first, followed by sun drying, and then ground into a fine powder using a local milling unit. A sample of the powder was sent to the Department of Animal Nutrition, College of Veterinary and Animal Sciences, Mannuthy, for proximate analysis using AOAC (2016) standards. Vitamin E and Selenium premix was procured from a licensed veterinary pharmaceutical distributor in Thrissur.

All the animals were fed by following ICAR feeding standards (ICAR, 2013). The kid starter with crude protein (23%) procured from the Feed Mill, School of Animal Nutrition and Feed Technology, Mannuthy was used. Kid starter and fresh hybrid napier grass was fed twice daily based on the body weight and requirements of the animals in each group. To ensure full intake of supplements, the required quantity of *Asparagus* root powder and the Vitamin E + Selenium premix was mixed with water and given orally based on individual requirement. Individual body weights were recorded fortnightly. The feed and supplement quantities were adjusted weekly according to body weight. The offered feed and leftover (refusals) were recorded separately for morning and afternoon sessions to calculate actual daily feed intake.

Growth performance

The growth performance of the kids was assessed by recording their body weight fortnightly using a digital weighing balance. The body weight of each kid was taken in the morning before feeding and was recorded on two consecutive days using an electronic weighing balance to obtain an accurate average weight and to ensure consistency. The data obtained were used to calculate growth parameters such as Total body weight gain (kg) and Average Daily Gain (ADG, g/day).

Blood collection and laboratory analysis

Blood samples were collected at 8:00 AM from each kid on day 0 and day 90 of the experimental period. A total of 3 mL of blood was withdrawn from the jugular vein into EDTA tubes for oxidative stress biomarker assays. Lipid peroxidation was estimated by determining the concentration of malondialdehyde (MDA) in plasma using the Thio barbituric acid reactive substances (TBARS) assay, as described by Rehman (1984). Catalase (CAT) activity in the haemolysate was estimated using the method of Aebi (1984), based on the enzymatic decomposition of hydrogen peroxide (H_2O_2), monitored as a decrease in absorbance at 240 nm. The estimation of SOD was done by the reduction of MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) using microtiter plate assay as reported by Madesh and Balasubramanian (1998). The extent of reduction of MTT indicates the amount of superoxide generation. Autoxidation of hydroxylamine hydrochloride produces superoxide which reduces the

Table 3. Fortnightly average body weight of experimental kids (Kg)

Day	T1	T2	T3	T4	P value
0	3.58 ± 0.20	3.67 ± 0.21	3.75 ± 0.11	3.77 ± 0.21	0.76 ns
15	4.63 ± 0.16	4.88 ± 0.25	4.97 ± 0.19	4.90 ± 0.20	0.68 ns
30	5.65 ± 0.25	6.23 ± 0.28	6.10 ± 0.22	6.35 ± 0.23	0.22 ns
45	6.95 ± 0.32	7.60 ± 0.31	7.37 ± 0.27	7.70 ± 0.32	0.33 ns
60	7.88^b ± 0.22	9.20^a ± 0.30	8.63^b ± 0.35	9.10^a ± 0.41	0.03
75	8.80^b ± 0.23	10.68^a ±0.27	9.63^b ± 0.33	10.60^a ±0.42	0.001
90	9.95^b ± 0.27	11.96^a ±0.23	10.77^b ± 0.41	11.78^a±0.47	0.001

Mean values of six replicates with SE, $^{a-b}$ Mean of different treatment having different alphabets as superscripts within a row differ significantly (*- P<0.05), ns-non significant (P>0.05)

Table 4. Summarised data on body weight, final body weight, total body weight gain and average daily gain of experimental kids

Parameter	T1	T2	T3	T4	P value
Initial body weight (kg)	3.58 ± 0.20	3.67 ± 0.21	3.75 ± 0.11	3.77 ± 0.21	0.76^{ns}
Final body weight (kg)	9.95^b ± 0.27	11.96^a±0.23	10.77^b±0.41	11.78^a±0.47	0.01*
Total body weight gain (kg)	6.55^b ± 0.33	8.21^a ± 0.31	7.02^b ± 0.42	8.01^a ± 0.51	0.02*
ADG (g/day)	72.08^b ±3.80	91.10^a±3.42	78.47^b±4.73	89.30^a ±5.45	0.02*

Mean values of six replicates with SE, $^{a-b}$ Mean of different treatment having different alphabets as superscripts within a row differ significantly (*- P<0.05), ns-non significant (P>0.05).

Table 5. Oxidative stress parameters of experimental kids (at 0 day)

Parameter	T1	T2	T3	T4	P value
Catalase (µmole H_2O_2 utilized/min)	370.67±18.68	378.83±40.03	365.50±32.54	378.33±21.59	0.98 ns
Superoxide dismutase (U/mL)	89.61±3.23	95.31 ± 3.58	90.73 ± 4.02	88.86 ±4.67	0.65ns
Malondialdehyde (nmol/mL)	3.80 ± 0.28	4.16 ± 0.43	4.74 ± 0.36	4.20 ± 0.52	0.46 ns

Mean values of six replicates with SE ns-non-significant difference (p > 0.05).

Table 6. Oxidative stress parameters of experimental kids (at 90 day)

Parameter	T1	T2	T3	T4	P value
Catalase (µmole H_2O_2 utilized/min)	553.33^b±51.18	717.33^a±38.76	670.0^{ab}±11.28	714.83^a±42.36	0.02*
Superoxide dismutase (U/mL)	99.67^b±3.90	113.46^a±1.85	95.67^b ±3.05	114.77^a±3.34	0.04*
Malondialdehyde (nmol/mL)	3.30^a ± 0.20	2.19^b ± 0.16	3.64^a ± 0.30	2.31^b ± 0.20	0.02*

$^{a-b}$ Mean of different treatment having different alphabets as superscripts within a row differ significantly (*-P<0.05) ns-non-significant difference (p > 0.05).

MTT, a tetrazolium dye to coloured formazan which gives absorbance at 595 nm.

Statistical Analysis

All the recorded data were statistically analysed using SPSS software version 24.0.

Results and discussion

Proximate principles of feed, fodder and Asparagus racemosus root power

The proximate analysis of milk, kid starter, green fodder and *Asparagus racemosus* root power was done according to AOAC (2016). The chemical composition of milk, kid starter, green fodder and *Asparagus racemosus* root powder fed to experimental kids are given in table 2, 3, 4 and 5. *Asparagus racemosus* root powder contained 9.23 per cent moisture, 5.77 per cent crude protein, 15.26 per cent crude fibre, 0.80 per cent ether extract and 3.97 per cent total ash. These values were similar with findings of Chavan et al*.* (2021), Jat et al*.* (2021) and Rajini et al. (2023).

Growth performance

Higher final body weight and ADG values were recorded in the T2 group (11.96 ± 0.23 kg and 91.10 ± 3.42 g/day), and T4 (11.78 ± 0.47 kg and 89.30 ± 5.45 g/day), followed by T3, compared to the control group (9.95±0.27kg and 72.08 ± 3.80 g/day). The results in T2 group are in agreement with the observations of Mahmood et al*.* (2020) who reported that administering vitamin E (1000 mg/kg body weight) and selenium (3mg/kg body weight) through parenteral route promoted survival rate (100%), daily weight gain and total weight gain of the kids under treatment group. Similarly, Dhari et al. (2019) and Yue et al. (2009) documented that Awassi lambs supplemented with (0.4 mg selenium + 100 mg vitamin E) per kg dietary dry matter for 90 days had significantly higher average daily gain of 191 g/day and final live body weight of 41.75 kg in treatment groups. Similar results in T4 group are in agreement with the observations of Boopathi et al. (2023) who supplemented Murrah buffalo heifers with Shatavari root powder at 100mg/kg body weight for a period of six months and observed significantly higher average daily weight gain as 516.02±21.61 g/day for the treatment group when compared to control group with 485.66±22.09 g/day. Verma et al*.* (2023) reported that broiler chickens supplemented with one percent Shatavari root powder resulted in an increase weight gain from 186.35g to 2547.76g over first to sixth week in treatment groups, compared to 185.30g to 2423.0g in the control group.

Oxidative stress parameters

Oxidative stress biomarkers catalase (CAT), superoxide dismutase (SOD), and malondialdehyde (MDA) were evaluated on day 0 and day 90 to assess the antioxidant status of goat kids under different treatments and presented in Table 5 and 6. No significant differences (P > 0.05) were observed at day 0. At day 90, significant differences (P < 0.05) were observed in all three parameters. Catalase activity (µmol H_2O_2 utilized / min) was significantly higher in T2 (717.33 ± 38.76) and T4 (714.83 ± 42.36) compared to T1 (553.33 ± 51.18), while SOD activity also showed a similar pattern, with the highest values in T4 (114.77 ± 3.34 U/mL) and T2 (113.46 ± 1.85 U/mL). Conversely, MDA concentration, a marker of lipid peroxidation, was significantly lower in T2 (2.19 ± 0.16 nmol/mL) and T4 (2.31 ± 0.20 nmol/mL) compared to T1 (3.30 ± 0.20 nmol/mL), indicating reduced oxidative stress in the supplemented groups. The elevated levels of CAT and SOD in T2 confirm the well-established role of Vitamin E and Selenium in enhancing the antioxidant defence system. Chauhan et al. (2015) also reported similar increases in CAT and SOD, along with decreased MDA levels, in small ruminants receiving Vitamin E and Selenium supplementation. The T4 group, which received 100 mg/kg BW of *A. racemosus*, showed antioxidant responses comparable to the T2 group.

This is consistent with the findings of Oviya (2023) who demonstrated the antioxidant potential of *A. racemosus* in improving enzymatic activity and lowering oxidative markers in goats. Similarly, Govindarajan et al. (2004) found that supplementation of *A. racemosus* at 100 and 250 mg/kg BW in diabetic rats reduced LPO and elevated the values of CAT and SOD. Supplementation of *A. racemosus* at 100 mg/kg BW significantly increased SOD, CAT and LDH activity and decreased malondialdehyde activity in rats under stress (Vimal et al*.,* 2010).

Conclusion

Based on the findings, it can be concluded from the present study that that supplementing the basal ration with *Asparagus racemosus* root powder (100 mg/kg.BW) in early weaned Malabari kids significantly enhanced growth performance, and improved antioxidant status which were comparable to supplementing a combination of α-tocopherol acetate (50 mg/Kg ration) and selenium (0.3 mg/Kg ration).

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