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Impact of incorporating *Asparagus racemosus* (Shatavari) into the diet on the growth performance of Murrah buffalo heifers (*Bubalus bubalis*)

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Abstract
The current research aimed to assess the impact of *Asparagus racemosus* (shatavari) root powder on the growth performance of Murrah buffalo heifers. Twelve Murrah heifers, with an average age of 18.5±0.77 months and an average body weight of (220.05±7.11 Kg), were randomly allocated into two groups. Six Murrah heifers comprised the control group, while the remaining six served as the treatment group, receiving shatavari root powder supplementation at a dosage of 100 mg/kg live body weight once daily in the morning for a six-month period. The body weight gain in the treatment group was significantly higher (p<0.01) compared to the control group heifers. Additionally, the average daily weight gain in the treatment group was statistically higher (p<0.05) than the untreated control group. However, dry matter intake as a percentage of live body weight exhibited no statistically significant difference (p>0.05) between the treatment and control groups. In conclusion, the supplementation of shatavari significantly enhanced the body weight of Murrah buffalo.

Keywords: Buffalo heifers, Shatavari, dry matter intake (DMI), body weight

Introduction
The buffalo holds the distinction of being the world's second most crucial milch animal, contributing to over 95% of the milk production in South Asia (Javaid *et al*., 2009) [7]. With a continuously growing global buffalo population, estimates surpass 188.33 million, and more than 95% (178.91 million) of this population is concentrated in Asia (FAO STAT, 2019) [4]. In India, the current buffalo population stands at 105.34 million, securing its position as the foremost buffalo-holding country globally. Renowned as the primary dairy animal in India, buffalo makes a substantial contribution, accounting for approximately 56% of the total milk production in the country (GOI-BHAS, 2021) [5]. Within India, the Murrah breed stands out as a significant milk-producing buffalo breed, emphasizing the critical need for genetic advancements in Murrah buffalo growth within the country's extensive ruminant industry. Recognizing the importance of growth rate as a pivotal trait, its enhancement in Murrah buffaloes becomes paramount. Growth rate not only influences the age at which an animal attains puberty and conceives but also directly impacts the age at first calving, ultimately shaping the lifetime productivity of the animal (Lawrence and Fowler, 1997) [12]. Extensive research endeavours have concentrated on the utilization of growth promoters and feed additives to enhance growth performance, yet these often pose economic challenges for small and marginal farmers in India. In contrast, phytobiotics, derived from herbs, spices, or aromatic plants, offer a promising alternative. These compounds exhibit antimicrobial, antifungal, and antioxidant properties, along with potential sedative effects. India's ancient history is rich in herbal medicine, boasting one of the world's oldest and enduring health care systems, Ayurveda. Recognizing the economic constraints and the desire for safe, locally available substitutes to improve growth performance, the spotlight turns to herbal solutions. Ayurveda, rooted in natural remedies and herbal-based approaches, stands out for its ability to minimize side effects, maximize benefits, and reduce health hazards. The incorporation of herbs into livestock management, as highlighted by Chandra S, *et al*. (2017) [4], presents an

avenue for effective growth, reproductive management, and successful animal.

The Asparagaceae family is commonly found in low-altitude areas, thriving in shade and tropical climates across Asia, Australia, and Africa. Among the various asparagus species in India, *Asparagus racemosus* (Shatavari) holds significance as a crucial herbal medicinal plant in tropical and sub-tropical regions. Its medicinal importance is attributed to the presence of steroidal saponins, sapogenins, and phytochemicals (Karmakar, 2012) [8]. Traditional practices involve the use of Shatavari root powder for treating ailments related to productivity, reproduction, and udder health in livestock across several regions in India (Pandey SK *et al*., 2005; Kumar R and Bharathi A B, 2012; Nigam G and Sharma N K, 2010; Behara BC *et al*., 2013) [18, 10, 16, 1]. Despite the longstanding use of herbal preparations like Shatavari in local and tribal communities, scientific validation of their medicinal properties remains limited. This study aims to address this gap by investigating the impact of Shatavari root powder supplementation on the growth performance of Murrah buffalo heifers, recognizing the potential benefits observed in traditional practices and emphasizing the need for scientific scrutiny in modern farm animal treatment strategies.

Materials and methodology

Asparagus racemosus (Shatavari) root powder

Asparagus racemosus, a medicinal plant, is part of the diverse Asparagus species found both in India and globally. With approximately 300 species distributed worldwide, India alone records 22 species of Asparagus, with *Asparagus racemosus* being prominently featured in traditional medicine (Bopana and Saxena, 2007) [3]. This woody climber, reaching a height of 1-2 meters, was botanically described in 1799. The versatile nature of *Asparagus racemosus* has led to a growing demand for its utilization. The plant features pine needle-like leaves that are small and uniform, while its white flowers present small spikes. Remarkably, every part of *Asparagus racemosus* be it the stem, root, or leaves finds application in disease prevention for both humans and dairy animals, underlining its significance in traditional medicinal practices.

Location and experimental design

The current research was carried out at the National Dairy Research Institute Farm located in Karnal, situated in the northern region of Haryana state, India. Twelve Murrah buffalo heifers were randomly selected from the farm, ensuring they were free from any anatomical, physiological, or infectious disorders. These animals were then categorized into two groups, namely the treatment and control groups, each comprising six animals. The basis for grouping was the similarity in body weight, with the treatment group at 220.5±4.9 kg and the control group at 221.7±6.0 kg, as well as age, with the treatment group at 18.5±0.9 months and the control group at 18.9±1.0 months. This careful selection ensured that there were no significant differences (p>0.10) in the mean body weight and mean age between the two groups at the commencement of the experiment. The ethical aspects of the study were overseen and approved by the Ethical Committee for Animal Experiments (ECAE) at the National Dairy Research Institute. The approval encompassed the animal use protocol, management practices, and the overall experimental design employed for the study.

Management of experimental animals

The heifers under study were individually housed in well-ventilated pens featuring brick flooring and asbestos roofing, equipped with courtyards to facilitate free movement. These settings allowed exposure to natural photoperiod and ambient temperature conditions. Each heifer received an individualized diet, comprising a concentrate mixture with a protein content of 20% (C.P.) and total digestible nutrients of 70% (T.D.N.). The concentrate mixture included 30% maize, 10% wheat, 5% oats, 17% groundnut cake, 10% mustard cake, 15% wheat bran, 10% rice bran, 1% common salt, 2% vitamin-mineral mixture, and daily provision of green fodder (oats, maize, or jowar, depending on farm availability). The feeding regimen aimed to achieve an approximate daily body weight gain of 0.4 kg per animal, following the standards outlined in the National Research Council guidelines of 2001 (NRC, 2001) [16]. Fresh and clean water was made available to each animal throughout the day on a free-choice basis. Additionally, all animals underwent deworming at three-month intervals throughout the entire experimental period. To ensure their health, the experimental animals received timely vaccinations against Hemorrhagic septicemia (HS), foot-and-mouth disease, and black quarters.

Body weight and dry matter intake

The experimental animals were weighed using an electronic balance on two consecutive days at 15-day intervals before the initiation of any feed offerings. This meticulous process ensured that each recorded body weight was an average of two observations. The individual feed requirements for each animal were determined based on their respective body weights. The dry matter intake of each group was documented at fortnightly intervals over three consecutive days. During this period, weighed amounts of concentrate mixture, green fodder, and dry roughages were offered daily, and residues were weighed with subsequent determination of dry matter content. To ascertain the dry matter content of both fresh and leftover fodder, samples were subjected to drying in an electronic oven at 100±1 ºC for 24 hours. Additionally, the fortnightly body weight of each animal was recorded consecutively for two days using a high-precision electronic balance platform. Importantly, these observations on body weight were the average of two measurements, and this protocol was followed before providing the animals with any feedstuff or water.

Herbal treatment

For the herbal treatment, *Asparagus racemosus* (Shatavari) root powder was incorporated into the concentrate feed at a dosage of 100 mg per kilogram of body weight (BW). This herbal mixture was administered to all the heifers in the treatment group over a span of six months. In contrast, heifers in the control group received only the concentrate mixture in accordance with the National Research Council guidelines of 2001 (NRC, 2001) [16] and were designated as the untreated control group. The administration of Shatavari root powder aimed to assess its potential impact on the growth performance of the heifers over the course of the study period.

Statistical analysis

The experimental data underwent analysis of variance (ANOVA) using a completely randomized design through SAS version 7.0 programs. The analysis employed a linear equation model with interaction components. The focus of the analysis was on assessing differences in the observed parameters among the comparable groups. This statistical approach allowed for a comprehensive examination of the

data, evaluating the significance of variations and interactions within the experimental design.

Results and Discussions

Dry matter intake (DMI)

The overall fortnightly mean ± S.E of dry matter intake (DMI) per 100 Kg body weight was observed to be 2.55±0.01 in the control group and 2.64±0.01 in the treatment group. Notably, the DMI as a percentage of live body weight exhibited a statistically significant difference (p>0.05) between the treatment and control groups (Fig.1). Shatavari, being rich in tannins, serves as a bypass protein. Tannins bind with available protein in the rumen, converting it from Rumen Degradable Protein (RDP) to Rumen Undegradable Protein (RUP), which is then absorbed in the intestines. Additionally, Shatavari contains saponins, glycoside amphipathic compounds acting as surfactants that alter the permeability of the gut membrane. This, in turn, enhances the absorption capacity of the gut, contributing to increase DMI in animals, as highlighted by Jamra (2012) [7].

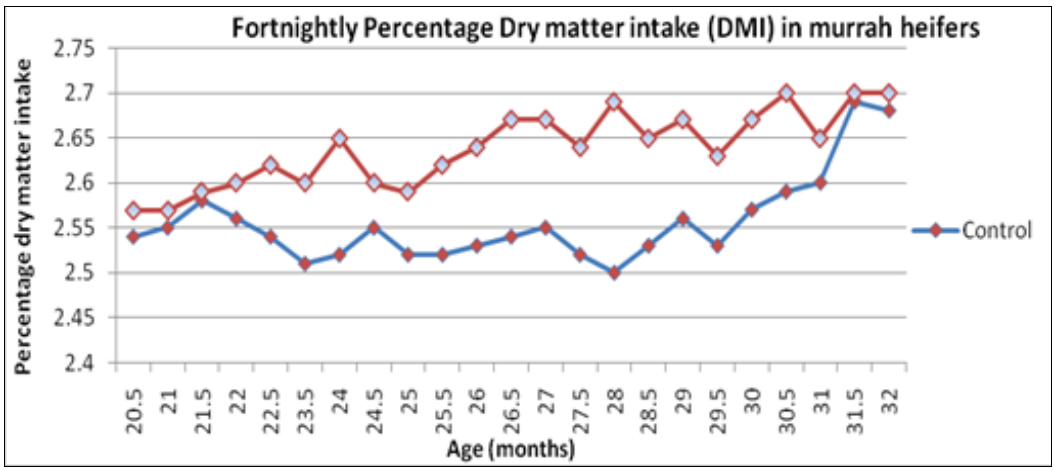

Fig 1: Fortnightly Percentage Dry matter intake (DMI) in Murrah buffao heifers

In the present experiment, the heightened DMI during the pre-pubertal period in the Shatavari-supplemented group is attributed to the anabolic effect of A. racemosus, supported by findings in studies by Sharma *et al*. (1986) [20], Panigrahi *et al*. (2005) [19], and Kumar S. *et al*. (2014) [11]. The incorporation of herbal formulations containing 25% Shatavari demonstrated a significant 10.97% increase in dry matter intake (DMI) in buffaloes (Mahantra *et al*., 2003) [14] and in cows at a rate of 100g on alternate days (Berhane *et al*., 2002) [2].

Average body weight gain

The cumulative disparity in body weight gain from the initiation to the conclusion of the experiment was observed to be 177.03 kg for the control group and 203.0 kg for the treatment group. The body weight gain in the treatment group was found to be significantly higher (p<0.01) than that in the control group, as illustrated in Figure 2. Specifically, the body weight gain in the shatavari-supplemented group exhibited a marked increase compared to the control group, demonstrating a significant difference (p<0.01).

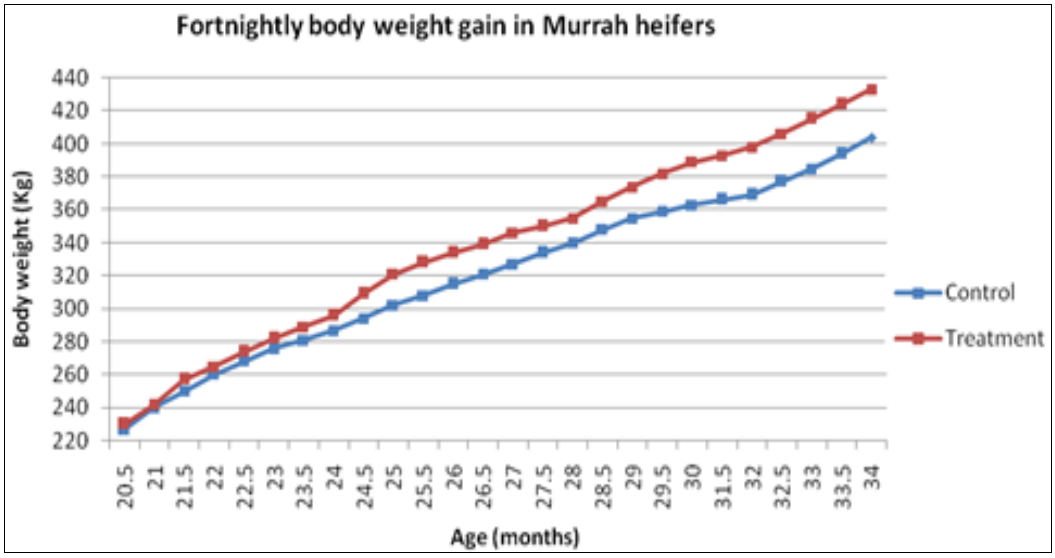

Fig 2: Fortnightly body weight gain (Kg) in Murrah buffalo heifers

These outcomes align with prior research indicating that A. racemosus supplementation positively influences growth performance, attributing this effect to the adaptogenic properties of A. racemosus, as noted by Sharma *et al*. (1986) [20]. Additionally, Sharma *et al*. (1986) [20] reported that A. racemosus supplementation promotes digestibility and dry matter intake without disrupting rumen protozoa in both healthy and problematic animals, reinforcing the findings of the present study.

The overall mean± S.E of average daily weight gain (ADWG)

was 485.66±22.09 g/day for the control group and 516.02±21.61 g/day for the treatment group. Significantly (p<0.05), the average daily weight gain in the treatment group surpassed that of the untreated control group. This growth-promoting effect is indicative of the anabolic impact of the adaptogenic substances present in A. racemosus, as suggested by Sharma *et al*. (1986) [20]. These findings further corroborate and support the conclusions drawn in our study.

Weight at puberty

The least squares mean± S.E of body weight at puberty in the control and treatment groups of Murrah heifers were determined to be 321.55±15.96 kg and 337.96±17.81 kg, respectively. However, there was no statistically significant difference observed in mean body weight between the control and treatment groups. Research suggests that heifers exhibiting faster growth, shorter prepubertal periods, and calving at a younger age tend to have greater lifetime productive efficiency and higher fecundity compared to those with slower growth rates, longer prepubertal periods, and calving at an older age, as reported by Berhane M. B. and Singh V. P. (2002) [2].Shatavari, known for its general tonic and female reproductive tonic properties, contains 9,10-dihydrophenanthrene, which has been found to interact with androgen receptors. This interaction may potentially inhibit androgen-dependent prostatic growth, as documented by Short RE and Bellows RA. (1971) [21].

Weight at sexual maturity

The mean average body weight at sexual maturity was recorded as 354.75±18.44 kg for the control group and 375.35±16.55 kg for the treatment group. Despite the lack of statistical significance in the body weight difference between the groups, the treatment group exhibited a higher average body weight. Notably, it is observed that age at sexual maturity is more closely associated with body weight than chronological age, a trend consistent with the findings of the present study. The early attainment of sexual maturity is deemed economically advantageous, considering that, from birth to the calving date, animals produce relatively little of value compared to the cost of maintenance. This characteristic is of paramount importance for economic efficiency. Nanda *et al*. (2003) [15] noted that improved nutrition can reduce the age of maturity in buffalo heifers. Furthermore, Shatavari (*Asparagus racemosus*) emerges as a potential feed supplement for promoting growth in dairy animals. Its inclusion in the diet is supported by its anti-stress properties, as highlighted by Kumar *et al*. (2008) [12].

Conclusion

In conclusion, the supplementation of *Asparagus racemosus*, specifically in the form of shatavari root powder, has been found to significantly enhance the body weight of buffalo heifers. This positive impact is attributed to an increase in dry matter intake associated with the supplementation. The results suggest that *Asparagus racemosus* could be a valuable dietary addition for promoting growth and overall well-being in buffalo heifers.

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