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Maryam Harsini Shakarami , [Bhaskar Ganguly](#) ^{*} , Simin Kazemi , Javad Raeisipour , [Akbar Taghizadeh](#)

Posted Date: 26 January 2026

doi: 10.20944/preprints202601.1808.v1

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Article

The Effects of a Polyherbal Digestive Tonic, Ruchamax®, on Feed Intake, Apparent Digestibility, Cecal Digestion, and Fermentation in Arabian Horses

Maryam Harsini Shakarami ^{1,†}, Bhaskar Ganguly ^{2,*}, Simin Kazemi ¹, Javad Raeisipour ³ and Akbar Taghizadeh ⁴

¹ Department of Animal Science, Faculty of Animal Science and Food Technology, Khuzestan Agricultural Sciences and Natural Resources University, Iran

² Research and Development Division, Ayurved Limited, India

³ Research and Development Division, Gohar Shimi Khebreh Company, Iran

⁴ Department of Animal Sciences, University of Tabriz, Iran

* Correspondence: vetbhaskar@gmail.com; present affiliation: Indian Immunologicals Limited, India.

† Equal contribution.

Abstract

The results of a trial aimed at studying the effects of a commercial polyherbal digestive tonic, Ruchamax®, on the feed intake, apparent digestibility, fermentation and microbial digestion of lucerne and wheat straw in Arabian horses are reported. Six Arabian mares, aged three to four years and weighing about 400 kg, received a diet containing 65% forage, consisting of lucerne and wheat straw, and 35% concentrate for two phases of ten days; the first phase without any digestive supplement and the next phase with an additional 15 grams of Ruchamax® per animal per day. Feed intakes were measured daily, and apparent digestibility, cecal digestion, and fermentation were assessed at the end of each phase. In vitro gas production was assessed to determine the fermentation and gas production of lucerne and wheat straw. Digestibility of dry matter and neutral detergent fiber was also determined for each phase. Ruchamax® increased ($p < 0.05$) feed intake; apparent digestibility of dry matter, crude protein, neutral detergent fiber, and acid detergent fiber; the potential of gas production; and microbial biomass efficiency for both forages. However, Ruchamax® did not affect cell wall degradability, partitioning factor, microbial biomass, amount and ratio of volatile fatty acids, and in vitro digestibility of dry matter, crude protein, neutral detergent fiber, and acid detergent fiber. Besides establishing the positive effects of Ruchamax® supplementation on cecal digestion and fermentation in horses, our findings also uphold the functional equivalence of the equine hindgut to the ruminant forestomach.

Keywords: herbal; horse; Ruchamax®; digestive tonic; digestibility; hindgut; feed intake

Introduction

Various kinds of feed additives are used to improve the growth, production, and overall health of animals. Feed additives could be nutrient or non-nutrient compounds and help to improve feed efficiency, thereby reducing feeding costs. The use of herbal feed additives is gaining particular traction in animal-based production systems due to restrictions on the use of certain antibiotics, concerns over chemical residues in the products, and their cost-effectiveness as additives. Herbal additives exert their initial activity as a flavor and stimulate appetite and the secretion of digestive juices. Some phytochemicals selectively modulate the microbiota. The antioxidant activity of herbal additives, attributable to the presence of phenolic compounds, flavonoids, and terpenoids, helps to protect food, tissues, and cellular components from oxidative damage (Upadhaya and Kim, 2017).

Ruchamax®, a polyherbal appetite stimulant and digestive tonic for livestock, contains many different herbs such as *Allium sativum* (garlic), *Azadirachta indica* (neem), *Phyllanthus emblica*, *Terminalia chebula*, *Zingiber officinale* (ginger), etc. and has been shown to improve feed intake and alimentary functions in both ruminants and non-ruminants alike, resulting in their better growth (Al-Amery, 2013; Lipinski et al., 2014; Kowalik et al., 2015; Roopa et al., 2017; Lavanya et al., 2023). Neem had a positive effect on reducing methane, carbon monoxide, and hydrogen sulphide production in horses with no deleterious effect on fecal fermentation activities (Alvarado et al., 2022). Garlic and ginger have been shown to improve feed intake and find common use as in-feed herbs and functional foods in horses (Kothari et al., 2019). Similarly, extracts of *Phyllanthus emblica* and *Terminalia chebula* have also been shown to exert microflora-balancing activity and promote digestion in horses (Schell, n.d.).

Previously, the microbial populations in equine hindgut and cecum have been reported to be similar to those found in the rumen (Elghandour et al., 2023). Hence, it was hypothesised that the beneficial effects of Ruchamax® observed in ruminants due to its eubiotic properties may also be achieved in horses and, thus, the present study was undertaken to evaluate the effects of Ruchamax® on the feed intake, apparent nutrient digestibility, and cecal digestion and fermentation in Arabian horses.

Materials and Methods

Animals and Diets

In this experiment, six Arabian mares, three to four years of age and weighing about 400 kg, were selected and fed in two periods of ten days; the first ten days without any supplements, and the next ten days with an additional 15 grams of Ruchamax® per day. The basal diet, consisting of 35% commercial concentrate and 65% forage (lucerne and wheat straw), was offered as total mixed ration twice daily. The animals had *ad libitum* access to fresh drinking water.

Feed Intake and Apparent Digestibility

The leftover feed was weighed daily to measure feed intake. Dung was collected in the last three days of each period to measure apparent digestibility. Samples were dried in an oven at 60 °C. Dry matter (DM), ash, and nitrogen (N) contents were analysed following the AOAC (1990) procedures 930.15, 924.05, and 984.13, respectively. Neutral detergent fiber (NDF) was determined without sodium sulphite and expressed exclusive of residual ash (Van Soest et al., 1991). Acid detergent fiber (ADF) was determined and expressed exclusive of residual ash following the AOAC (1990) procedure 973.18.

In Vitro Experiments

On the last day, approximately 100 g of fresh dung, collected before morning feeding from each mare, was mixed with three volumes (*w/v*) of McDuggal buffer, filtered through four layers of cheesecloth and transported to the laboratory in pre-warmed thermos flasks flushed with carbon dioxide. Gas production, fermentation, and in vitro digestibility of samples were determined using buffered fecal solution in six replicates per treatment as described previously (Mohammadabadi et al., 2018). The experimental substrate included lucerne and wheat straw. The cumulative gas production data were fitted to the exponential equation (Ørskov and McDonald, 1979):

$Y = b(1 - e^{-ct})$;
where Y = gas volume at time t (mL), b = potential of gas production (mL), t = time (h) and c = fractional rate of gas production (mL/h). The fermentation parameters (Makkar and Becker, 1998) were estimated as follows:

$$\text{Partitioning factor (mg/mL)} = \frac{\text{Digested organic matter (mg)}}{\text{Gas production (mL)}}$$

$$\text{Microbial biomass (mg)} = \text{Digested organic matter (mg)} - (\text{Gas production} \times 2.2)$$

$$\text{Microbial biomass efficiency (\%)} = \frac{\text{Microbial biomass (mg)}}{\text{Digested organic matter (mg)}} \times 100$$

Statistical Analysis

A completely randomized design was used to determine the effect of Ruchamax® on the various parameters. All data were analysed using generalized linear model in SAS (2001) based on the statistical model: $Y_{ij} = \mu + T_i + e_{ij}$; where Y_{ij} is the observation, μ is the general mean, T_i is the effect of treatment on the observed parameters, and e_{ij} is the standard error of the term. Means were compared by the Duncan multiple comparison test at $p < 0.05$.

Results and Discussion

No morbidity or mortality was observed during the experimental period. Any changes in physical activity and demeanour of the animals were also not apparent, suggesting the safety of Ruchamax® in horses. Herbal supplements should not be assumed to be safe merely due to their natural origin, especially so in equines that are more sensitive as a species (Poppenga et al., 2001) and where the composition of the basal ration itself can strongly influence the outcomes (Vervuert and Stratton-Phelps, 2021). At 15 g of Ruchamax® per day, the daily amount of garlic supplementation was also well-within tolerable limits for horses; daily garlic intake of 200 mg/kg body weight has been shown to incite oxidative damage and Heinz body anemia in horses (Behling-Kelly and Newman, 2022).

Our findings indicated that Ruchamax® improved ($p < 0.05$) feed intake, body weight gain, and apparent digestibilities of DM, CP, NDF and ADF (Tables 1 and 2). As was observed for both forages, the use of Ruchamax® increased ($p < 0.05$) the potential of gas production and microbial biomass efficiency. However, Ruchamax® did not affect cell wall degradability, partitioning factor, or microbial biomass. Ruchamax® decreased ($p < 0.05$) the rate of gas production from lucerne but had very little effect with wheat straw (Tables 3 and 4). No significant differences were observed in the concentrations of VFAs between the control and Ruchamax®-supplemented phases (Tables 5 and 6). Further, the in vitro digestibilities of DM, CP, NDF, and ADF were not affected for either forage by Ruchamax® supplementation (Tables 7 and 8).

Table 1. Effect of Ruchamax® on feed intake and weight gain (g) of Arabian horses.

Treatments	Feed intake	Weight gain
Control	6301.00 ^b	166.66 ^b
Ruchamax®	7431.00 ^a	383.33 ^a
SEM	275.60	27.80
p-value	0.02	0.00

SEM: Standard error of mean; ^a, ^b: Means with identical superscript(s) within each column do not differ significantly ($p > 0.05$).

Table 2. Effect of Ruchamax® on digestibilities (%) of DM, CP, NDF and ADF.

Treatments	DM	CP	NDF	ADF
Control	74.68 ^b	79.52 ^b	49.96 ^b	41.26 ^b
Ruchamax®	80.13 ^a	86.98 ^a	59.55 ^a	48.91 ^a
SEM	0.79	1.12	1.70	2.20
p-value	0.00	0.00	0.00	0.03

SEM: Standard error of mean; ^a, ^b: Means with identical superscript (s) within each column do not differ significantly ($p > 0.05$).

Table 3. Effect of Ruchamax® on gas production parameters of Wheat straw.

Treatments	Potential of gas production (mL)	Gas production rate (mL/h)	Cell wall degradation (mg)	Partitioning factor (mg/mL)	Microbial biomass (mg)	Microbial biomass efficiency (%)
Control	24.52 ^b	0.05	150.08	11.90	123.70	0.82 ^b
Ruchamax®	28.52 ^a	0.03	147.33	10.50	124.20	0.84 ^a
SEM	1.08	0.01	7.82	0.83	6.18	0.01
<i>p</i> -value	0.03	0.15	0.81	0.24	0.96	0.03

SEM: Standard error of mean; ^a, ^b: Means with identical superscript(s) within each column do not differ significantly (*p* > 0.05).

Table 4. Effect of Ruchamax® on gas production parameters of Lucerne.

Treatments	Potential of gas production (mL)	Gas production rate (mL/h)	Cell wall degradation (mg)	Partitioning factor (mg/mL)	Microbial biomass (mg)	Microbial biomass efficiency (%)
Control	31.17 ^b	0.05 ^a	166.30	10.44	143.30	0.86 ^b
Ruchamax®	36.89 ^a	0.03 ^b	171.70	9.36	151.10	0.88 ^a
SEM	1.21	0.01	8.80	0.57	7.82	0.00
<i>p</i> -value	0.01	0.05	0.67	0.21	0.50	0.02

SEM: Standard error of mean; ^a, ^b: Means with identical superscript(s) within each column do not differ significantly (*p* > 0.05).

Table 5. Effect of Ruchamax® on VFAs of Wheat straw (mmol/L).

Treatments	Acetate	Propionate	Butyrate	Isobutyrate	Valerate	Isovalerate	Acetate : Propionate	Total VFAs
Control	52.30	18.75	8.14	2.39	1.11	4.59	2.80	87.20
Ruchamax®	50.95	19.21	7.90	2.21	1.18	4.67	2.66	86.10
SEM	0.76	0.49	0.31	0.10	0.08	0.13	0.06	0.67
<i>p</i> -value	0.24	0.51	0.58	0.23	0.65	0.65	0.30	0.25

SEM: Standard error of mean.

Table 6. Effect of Ruchamax® on VFAs of Lucerne (mmol/L).

Treatments	Acetate	Propionate	Butyrate	Isobutyrate	Valerate	Isovalerate	Acetate : Propionate	Total VFAs
Control	49.43	21.53	8.26	2.36	1.04	4.56	2.30	87.20
Ruchamax®	48.32	22.04	8.04	2.51	1.29	5.36	2.19	87.58
SEM	0.81	0.53	0.28	0.12	0.10	0.50	0.08	1.00

<i>p</i> -value	0.36	0.51	0.59	0.40	0.11	0.29	0.36	0.80
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SEM: Standard error of mean.

Table 7. Effects of Ruchamax® on dry matter and NDF digestibility (%) of Wheat straw.

Treatments	Time (h)											
	24				48				72			
	DM	CP	NDF	ADF	DM	CP	NDF	ADF	DM	CP	NCF	ADF
Control	23.70	39.40	15.50	11.30	30.50	47.50	32.70	19.80	47.40	53.70	37.60	27.00
Ruchamax®	23.60	40.00	15.40	11.50	30.60	47.80	30.70	18.50	46.90	54.10	38.90	26.50
SEM	0.55	0.90	0.75	0.49	0.46	1.04	0.87	0.83	1.07	1.40	1.01	0.93
<i>p</i> -value	0.91	0.61	0.91	0.76	0.80	0.82	0.13	0.32	0.67	0.84	0.38	0.70

SEM: Standard error of mean.

Table 8. Effects of Ruchamax® on dry matter and NDF digestibility (%) of Lucerne.

Treatments	Time (h)											
	24				48				72			
	DM	CP	NDF	ADF	DM	CP	NDF	ADF	DM	CP	NCF	ADF
Control	30.20	52.20	18.00	13.70	35.50	63.30	34.70	23.50	54.50	66.70	41.60	36.50
Ruchamax®	30.60	53.00	18.90	12.70	35.50	62.90	35.00	24.50	52.90	67.10	42.60	35.50
SEM	1.39	0.84	0.84	0.72	1.11	0.80	0.69	0.92	0.92	0.78	1.06	1.06
<i>p</i> -value	0.87	0.53	0.47	0.35	0.99	0.75	0.79	0.33	0.26	0.71	0.53	0.50

SEM: Standard error of mean.

Ruchamax® is a commercial, polyherbal preparation of plants such as *Allium sativum*, *Andrographis paniculata*, *Azadirachta indica*, *Curcuma longa*, *Piper longum*, *Trachyspermum ammi*, *Zingiber officinale*, etc., indicated for use as an appetite stimulant and digestive tonic in ruminants, equines, and other species like camels and pigs. In the present study, the use of Ruchamax® increased feed intake, digestibility of nutrients, and improved weight gain in Arabian horses. Feed additives have been used to enhance animal productivity by increasing growth rate, production, and enhancing animal health (Pandey et al., 2019). Natural feed additives help in improving the efficiency of feed utilization and reducing the high cost of feed. The use of phytogenic feed additives in livestock feed is gaining popularity because of their beneficial effects on animal health and productivity (Placha et al., 2022). Despite the extensive availability and use of plant extracts as feed additives in various livestock species, peer-reviewed and scientific evidence of their usage in horses is low (Elghandour et al., 2018).

Generally, the beneficial effects of herbs or botanicals in farm animals may arise from activation of feed intake and secretion of digestive juices, immune stimulation, anti-bacterial, coccidiostatic, anthelmintic, antiviral or anti-inflammatory activity, and antioxidant properties (Kumar et al., 2014). The fermentation system of the large intestine of the horse is similar to the rumen. The size and diversity of the microbial population in the horse digestive tract enabled it to adapt to fibrous feeds (Tisserand, 1989). These microorganisms can break down fibers (Shakarami et al., 2019) and play an important role in providing the energy needed by animals (O'Connor-Robison et al., 2007). The findings of the current experiment indicated that the in vitro digestibilities of DM, CP, NDF and ADF were not affected by Ruchamax® in both forages, but Ruchamax® altered in vitro fermentation so that it increased the gas production potential and microbial biomass efficiency in both forages, but had no significant effect on the absolute and relative concentration (ratio) of volatile fatty acids.

Increased feed intake may be attributed to the presence of garlic in the formulation, which is known to improve palatability in horses (Horton et al., 1991). Large herbivores typically assimilate only about 40-60% of the nutrients in feed and the rest is wasted through dung, urine, and gases (Getachew et al., 2004; Springer et al., 2025). Increased gas production at a slower rate observed in

our study may be responsible for lower losses and better assimilation, which was also apparent as a higher microbial biomass efficiency. Consequently, this may have resulted in better apparent digestibilities of fiber and dry matter, and greater body weight gains. Higher assimilation of nutrients and lower emissions also have critical bearings for sustainability in equine feeding practices (Kaya Karasu, 2024).

Generally, it has been shown that essential oils can reduce the acetate-propionate ratio, amino acid deamination and methanogenesis (Benchaar et al., 2007; Benchaar et al., 2008; Klevenhusen et al., 2011). Nassar (2020) reported that total VFA concentration (TVFA, mEq/100 mL) was affected by both ginger powder or oil additives and decreased in groups fed either ginger powder or oil as compared to the control group. These results are in agreement with those reported by Zhang et al. (2011), where total VFA concentration was decreased by the addition of ginger powder, suggesting that the doses of ginger powder used modified the fermentability of the diet. The use of ginger powder, having potent antimicrobial activity, can increase the stability of feed and beneficially influence the gastrointestinal ecosystem through the inhibition of pathogenic microorganisms to reduce fermentability (Srinivasan, 2003). Some researchers have also reported medicinal herbs like garlic to have the ability to change the rumen fermentation pattern, such as reducing the ratio of acetate and increasing the ratio of propionate and butyrate and limiting methane production (Busquet et al., 2005). Here, it is important to consider that in vitro assays may not always be able to represent changes in digestibility due to the action of feed additives (Rowe et al., 2001). For example, herbal constituents may afford local histological improvements (Ferreira et al., 2023) that can improve digestibility and feed assimilation without influencing microbial fermentation. Ancient Indian texts reveal extensive usage of the constituent herbs of Ruchamax® like ginger, garlic, turmeric, black pepper, long pepper, *etc.* for promoting general wellbeing and digestive health of horses (Kolhe et al., 2025).

Conclusion

Our study observed that Ruchamax® increased feed consumption and nutrient digestibility and improved the body weight of the horses. This additive did not change the digestibility in the laboratory, but it changed the fermentation to some extent, so that it increased the potential of gas production and the efficiency of microbial biomass in both wheat straw and lucerne. Therefore, the findings of the study suggest that Ruchamax® can be useful as a feed additive in horses.

Acknowledgments: The authors acknowledge the financial assistance received from M/s Zenex Ayurved Limited, India, towards the conduct of this study.

Conflicts of Interest: The study was conceived by BG and was funded by M/s Ayurved Limited. At the time of the conduct of the study, BG was a full-time employee of M/s Ayurved Limited. BG also participated in the design of the study, and the drafting and finalization of the manuscript. At the time of preparation of the manuscript or its finalization, BG ceases to be employed by M/s Ayurved Limited. Neither BG nor M/s Ayurved Limited influenced the conduct of the trial or the interpretation of the results of the study in any manner that may present a potential conflict of interest. CRediT statement: MHS designed and performed the study and revised the manuscript. BG conceived the study and prepared the manuscript. SK and JR assisted with the conduct of the study. AT participated in the designing of the study and supervised the study. All authors approved the final manuscript.

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