

Original Research Article

Impact of Turmeric Powder-Supplemented Diets on Growth Performance and Feeding Economics in Konkan Kanyal Kids

Abstract

The study was undertaken to evaluate the effect of turmeric (*Curcuma longa* L.) powder supplementation on growth performance, body measurements and economics in Konkan Kanyal kids. Twenty weaned kids were randomly allotted to five dietary treatments (T₁: basal diet only, T₂: basal diet + 3 g turmeric/day, T₃: basal diet + 6 g/day, T₄: basal diet + 9 g/day and T₅: basal diet + 12 g/day) and reared for 90 days. The basal diet consisted of Sampoorna grass, Jowar kadbi and compounded goat pellets. Growth traits including body weight, body length, height at withers and chest girth were recorded, along with economic parameters. Supplementation at 9 g/day (T₄) significantly ($p < 0.05$) improved body length (8.55 cm), height (8.40 cm) and chest girth (7.13 cm) gains compared to the control. T₄ also achieved the highest average daily gain (71.94 g/day) and final body weight (15.70 kg). Economic evaluation revealed the lowest cost per kg gain (₹905.53), highest net profit (₹1777.16) and most favorable B:C ratio (1.30) under T₄. It is concluded that turmeric supplementation at 9 g/day, along with a basal diet of Sampoorna grass, Jowar kadbi and goat pellets, optimizes growth performance and profitability in Konkan Kanyal kids under Konkan conditions.

Keywords: Turmeric powder, growth performance, economic efficiency, herbal feed additive, Konkan Kanyal goats, indigenous, ruminants.

Introduction

Goat farming plays a crucial role in sustaining the livelihoods of rural communities in India, particularly in the Konkan region of Maharashtra, where the indigenous Konkan Kanyal breed is traditionally reared for meat production. According to the 20th Livestock Census (Anonymous, 2019), India has a goat population exceeding 148.88 million, contributing significantly to the rural economy through the production of meat, milk and manure. Enhancing the growth performance and profitability of native breeds like the Konkan Kanyal through strategic nutritional interventions is essential for improving productivity and supporting farmer incomes. In recent years, the use of phytogetic feed additives natural products derived from herbs and plants

has gained considerable interest as a sustainable and safer alternative to synthetic growth promoters in livestock nutrition.

Turmeric (*Curcuma longa L.*), rich in bioactive compounds like curcumin, is known for its antioxidant, antimicrobial and growth-promoting properties. Oderinwale et al. (2017) reported improved body weight gain in kids from three goat breeds when turmeric was supplemented at graded levels, confirming its growth-promoting effects. Bansal et al. (2002) and Mane et al. (2018) attributed these benefits to turmeric's active compound, curcumin, which possesses antioxidant, anti-inflammatory and digestive stimulant properties. Additionally, Ashraf et al. (2020) demonstrated turmeric's antiparasitic efficacy in goats, which may indirectly support better growth. Its potential economic benefits, due to improved feed efficiency and overall animal health, make it an attractive additive in small ruminant nutrition.

Previous studies have shown that turmeric supplementation can significantly enhance growth performance and reduce production costs in goats. Adebisi et al. (2022) observed an average daily gain of 55 g/day in goats fed 10 g of turmeric powder over a 56-day period. Similarly, Habeeb and Tarabany (2012) reported improved weight gain in curcumin-supplemented Zaraibi kids, particularly under heat stress conditions. Supporting these findings, Pingale (2022) demonstrated that inclusion of 0.6% turmeric powder in the concentrate feed of Osmanabadi kids reduced the cost per kilogram of weight gain to ₹313.08, compared to ₹418.05 in the supplemented control group.

However, despite the promising results of turmeric supplementation in various goat breeds, there is a lack of scientific data specifically focused on its application in indigenous breeds like the Konkan Kanyal, which are uniquely adapted to the coastal humid conditions of the Konkan region. These goats hold significant genetic, economic and cultural value but often suffer from suboptimal growth rates due to traditional feeding practices and limited nutritional inputs. Given turmeric's known bioactive properties such as enhancing nutrient absorption, improving gut health and reducing oxidative stress its inclusion in the diet may offer a natural and effective strategy to boost growth and feed efficiency in this breed. Therefore, this study was undertaken to evaluate the effects of graded levels of turmeric powder supplementation on growth performance and economic returns in weaned Konkan Kanyal kids under controlled feeding conditions, with the goal of developing a cost-effective and sustainable feeding strategy for smallholder farmers.

II. Materials And Methods

The present study was conducted to evaluate the effect of turmeric (*Curcuma longa* L.) powder supplementation on the growth performance of Konkan Kanyal kids. The 90-day feeding trial was carried out at the Goat Unit, Livestock Research Station, Nileli, Sindhudurg District, Maharashtra, India. Turmeric powder was procured from the College of Forestry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli.

1. Management of experimental animals:

The experimental kids were housed in a clean, well-ventilated shed, dewormed with Fendikind Plus and the shed was disinfected with Deltamethrin 19 (1.25%) a week before the trial. Each kid was provided with individual feeders and tied with nylon ropes. Clean drinking water was supplied twice daily and its intake was recorded. General management practices such as vaccination, deworming (Fendikind Plus @ 3 g/10 kg body weight), grooming, tagging and routine care were followed throughout the 13-week experiment.

2. Experimental layout and treatment details:

A Randomized Block Design (RBD) was used with 5 treatments and 4 replications per treatment, involving a total of 20 weaned Konkan Kanyal kids of similar average body weight. The experimental animals were randomly allotted to five dietary treatment groups, each comprising four Konkan Kanyal kids with similar average body weight. All animals were fed a basal diet consisting of green Sampoorna grass, Jowar kadabi and goat pellets. The control group (T₁) received only the basal diet without any supplementation. The treatment groups T₂, T₃, T₄ and T₅ were supplemented with turmeric powder at levels of 3 g, 6 g, 9 g and 12 g per animal per day, respectively. The turmeric powder was thoroughly mixed with the concentrate portion (goat pellets) and offered along with the basal diet throughout the 90-day trial period.

3. Chemical composition of experimental feed

The quality of livestock feed is determined by its chemical composition, which reflects its capacity to meet animal nutrient requirements. For the experimental rations, locally available feed resources were utilized to ensure both nutritional adequacy and regional relevance (Kearl, 1982). The proximate composition of green Sampoorna grass, Jowar kadabi, compounded goat pellets and turmeric (*Curcuma longa* L.) powder was analyzed to establish their nutrient profile.

Table 1. Proximate analysis of experimental feed ingredients (% DM basis)

Sr. No	Attributes (%)	Feed ingredients			
		Turmeric Powder	Jowar kadabi	Sampoorna grass	Goat pellet
1	DM	91.15	89.10	23.50	86.65
2	CP	9.95	3.25	9.90	19.40
3	CF	12.11	35.80	23.70	10.90
4	EE	2.46	1.62	5.80	3.80
5	Ash	6.82	6.80	8.90	10.50
6	NFE	68.66	52.53	52.00	55.40

Turmeric powder was mixed with the concentrate portion (goat pellets) of the diet. Feed cost was calculated at the end of the 13th week using prevailing market prices. Economic analysis was done using:

- Total Cost = Fixed Cost + Variable Cost
- Net Profit = Total Revenue – Total Cost
- Benefit Cost Ratio = Total Revenue / Total Cost

Statistical analysis was performed using ANOVA as per Rangaswamy (2000), considering replication, treatment and sampling error.

III. Results and Discussion

3.1 Growth performance of experimental kids

The initial body weight, weekly body weights, weekly weight gain and total weight gain of goats fed the experimental diets in treatments T₁, T₂, T₃, T₄ and T₅ are presented in Table 1, Table 2 and Table 3.

Table 1 presents the goats' average weekly body weight gain throughout the trial. In this study, treatment T₄ showed the highest increase in body weight, followed by T₅, T₃, T₂ and T₁. Specifically, the weight gain in T₄ (fed with 9 g of turmeric powder) was greater than that observed in T₅, T₃, T₂ and T₁.

TABLE 1. Average weekly body weight in kids during experimental period (kg/week)

Week	T ₁	T ₂	T ₃	T ₄	T ₅
1	9.20	9.23	9.15	9.23	9.10
2	9.53	9.54	9.50	9.61	9.45
3	9.84	9.90	9.91	10.04	9.86
4	10.18	10.33	10.32	10.48	10.30
5	10.59	10.77	10.76	10.94	10.78
6	11.05	11.20	11.21	11.44	11.28
7	11.54	11.66	11.70	11.99	11.82
8	12.03	12.14	12.19	12.54	12.36
9	12.54	12.66	12.71	13.11	12.92
10	13.05	13.18	13.24	13.71	13.46
11	13.57	13.73	13.78	14.35	14.03
12	14.09	14.30	14.35	15.03	14.60
13	14.63	14.88	14.93	15.70	15.20

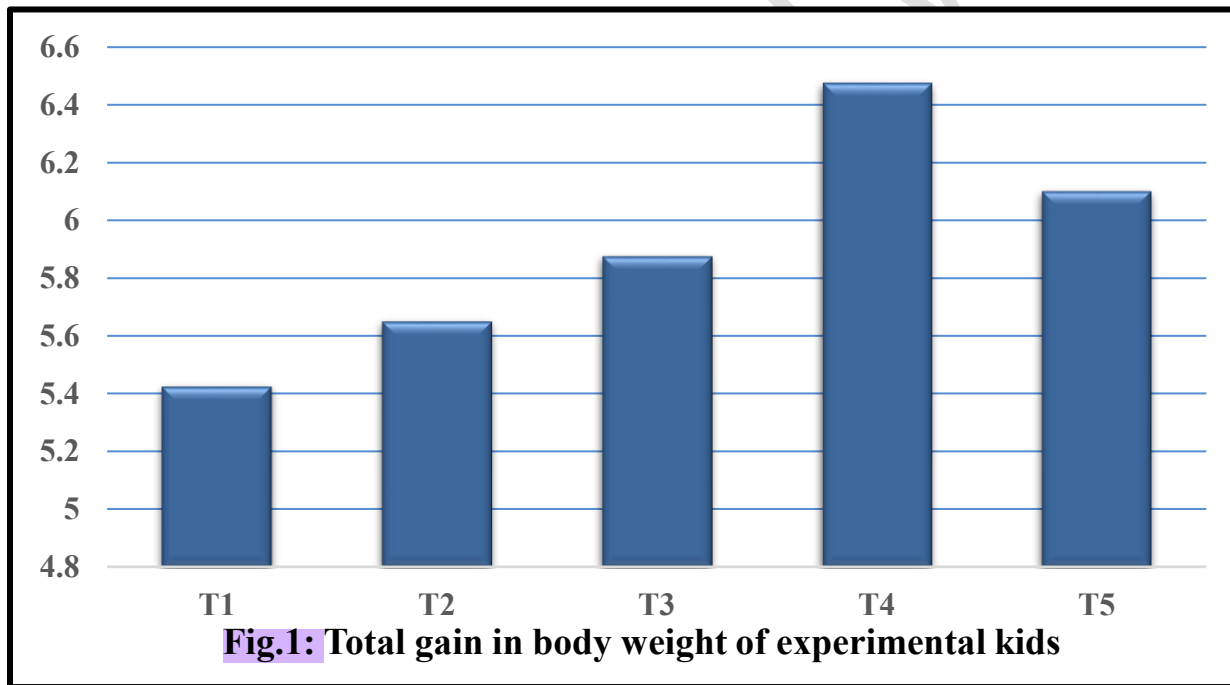
The weekly body weight data show a consistent increase across all treatments over 13 weeks. Starting around 9.10 – 9.23 kg in week 1, goats in T₄ (9 g turmeric) reached the highest final weight at 15.70 kg by week 13, followed by T₅ (15.20 kg), T₃ (14.93 kg), T₂ (14.88 kg) and T₁ (14.63 kg). Throughout the trial, T₄ consistently recorded higher weights, particularly after week 6, indicating that 9 g turmeric supplementation most effectively boosted growth performance compared to the other groups.

Table 2. Average weekly body weight gain in kids during experimental period (kg/week)

Week	T ₁	T ₂	T ₃	T ₄	T ₅
1	0.32	0.31	0.35	0.39	0.35
2	0.32	0.36	0.41	0.42	0.41
3	0.34	0.43	0.41	0.44	0.44
4	0.41	0.44	0.44	0.45	0.48
5	0.46	0.44	0.45	0.50	0.49
6	0.49	0.46	0.49	0.55	0.54
7	0.50	0.48	0.49	0.55	0.55
8	0.51	0.52	0.52	0.57	0.55
9	0.51	0.52	0.53	0.60	0.55
10	0.52	0.55	0.54	0.64	0.56
11	0.52	0.57	0.57	0.67	0.57
12	0.53	0.58	0.58	0.68	0.60
13	0.54	0.60	0.64	0.70	0.66

Table 3. Total gain in body weight of experimental kids

Treatments	Initial BW (kg)	Final BW (kg)	Gain in total BW (kg)	Av. Gain in BW
				(g/day)
T ₁	9.20	14.63	5.43	60.28
T ₂	9.23	14.73	5.65	62.78
T ₃	9.15	14.80	5.88	65.28
T ₄	9.23	15.70	6.48	71.94
T ₅	9.10	15.20	6.10	67.78
SE ±	0.32	0.32	0.10	1.08
CD (5%)	NS	NS	0.30	3.33



The initial body weights of goats across treatments were similar, ranging from 9.10 to 9.23 kg. After the trial, final body weights increased in all groups, with T₄ showing the highest final weight of 15.70 kg, followed by T₅ (15.20 kg), T₃ (14.80 kg), T₂ (14.73 kg) and T₁ (14.63 kg). Total weight gain was greatest in T₄ (6.48 kg), with T₅ at 6.10 kg, T₃ at 5.88 kg, T₂ at 5.65 kg and T₁ at 5.43 kg. Average daily weight gain followed the same pattern, peaking at 71.94 g/day in T₄ and lowest in T₁ at 60.28 g/day.

Adebisi et al. (2022) observed a 3.08 kg gain over 56 days (55 g/day) with 10 g turmeric in goats, while the control gained 2.90 kg. Amosu et al. (2020) reported higher maternal weight gains in **KalaWAD** (6.92 kg; 74.93 g/day) and WAD does (3.85 kg; 60.82 g/day), further enhanced by turmeric. Similarly, Habeeb and Tarabany (2012) found that curcumin supplementation in Zaraibi kids led to a 4.80 kg gain and 54.2 g/day under heat stress, supporting turmeric's role in improving growth.

4.9.1 Body measurements of experimental kids

The assessment of physical biometric parameters can serve as an indicator of the animal's nutritional status. Therefore, live body weight and external measurements including body length, height and chest girth were recorded weekly throughout the feeding trial.

TABLE 4. Effect of different treatments on average initial and final height, body length, and chest girth of animals, along with total gains.

Treatment s	Avg. Initial Height (cm)	Avg. Final Height (cm)	Total Gain in Height (cm)	Avg. Initial Body Length (cm)	Avg. Final Body Length (cm)	Total Gain in Body Length (cm)	Avg. Initial Chest Girth (cm)	Avg. Final Chest Girth (cm)	Total Gain in Chest Girth (cm)
T1	49.30	56.35	7.05 ^c	48.60	54.03	5.43 ^d	51.08	56.76	5.69 ^c
T2	48.93	56.30	7.38 ^{bc}	50.35	57.13	6.78 ^{bc}	51.50	57.58	6.08 ^{bc}
T3	49.00	56.85	7.85 ^b	50.98	58.40	7.43 ^b	50.60	57.10	6.50 ^b
T4	49.33	57.73	8.40 ^a	49.80	58.35	8.55 ^a	51.10	56.25	7.13 ^a
T5	50.39	58.64	8.25 ^a	50.05	58.25	8.20 ^{ab}	50.45	57.13	6.70 ^a
SE ±	0.69	0.87	0.31	0.76	1.00	0.34	1.06	1.72	0.28

CD (5%)	NS	NS	0.95	NS	3.07	1.06	NS	NS	0.87
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The initial body length across treatments T₁ to T₅ ranged from 48.60 to 50.98 cm, with no significant variation. By the end of the trial, the final body length increased to 54.03, 57.13, 58.40, 58.35 and 58.25 cm for T₁, T₂, T₃, T₄ and T₅, respectively. The total gain in body length was significantly higher in T₄ (8.55 cm), followed by T₅ (8.20 cm), T₃ (7.43 cm) and T₂ (6.78 cm), while the lowest gain was observed in T₁ (5.43 cm). Similar but comparatively lower gains were reported by Kore (2023) in Konkan Kanyal goats supplemented with Spirulina, where the total gain ranged between 5.15 and 8.15 cm across treatments.

The initial height at withers varied from 48.93 to 50.39 cm across treatments, with final values ranging between 56.30 and 58.64 cm. Although initial and final values were comparable, the total gain in height showed significant differences. The highest gain was recorded in T₄ (8.40 cm), followed by T₅ (8.25 cm) and T₃ (7.85 cm), which were statistically superior to T₁ (7.05 cm). The results indicate that supplementation of turmeric at higher levels improved height gain in kids. Comparable results were reported by Sawant (2024), who observed gains ranging from 6.55 to 7.58 cm with ginger powder supplementation in Konkan Kanyal goats.

For chest girth, the initial measurements were comparable (50.45–51.50 cm). By the end of the study, the final values increased to 56.25–57.58 cm across treatments. The gain in chest girth was significantly highest in T₄ (7.13 cm), followed by T₅ (6.70 cm) and T₃ (6.50 cm), while the lowest gain was observed in T₁ (5.69 cm). These findings are in agreement with Pingale (2022), who also reported a significant improvement in chest girth with turmeric supplementation in goat kids.

Overall, turmeric supplementation, particularly at 9 g/day (T₄), produced the most notable improvements in body length, height and chest girth, indicating enhanced growth performance in Konkan Kanyal kids.

Estimation of feeding cost of turmeric (*Curcuma longa* L.) powder

The cost-benefit analysis of feeding Konkan Kanyal kids with and without turmeric powder supplementation is presented [Table 5](#). The analysis includes the average total cost (covering both

fixed and variable expenses), average weight gain per treatment and the overall economic evaluation of incorporating turmeric powder into the basal diet.

At the beginning of the trial, average body weights were comparable across all groups, ranging from 9.10 kg in T₅ to 9.23 kg in T₂ and T₄. The lowest total body weight gain was observed in the control group (T₁) at 5.43 kg, while the highest gain was recorded in T₄ (6.48 kg), indicating enhanced growth performance with a 9 g turmeric supplement. Final body weights reflected these gains, with T₄ reaching the highest value (16.40 kg), followed by T₅ (15.86 kg), whereas T₁ concluded at 15.16 kg.

Dry matter intake was relatively uniform across treatments, ranging from 104.54 kg in T₅ to 108.50 kg in T₂. The cost per kilogram of body weight gain was highest in T₁ (₹1037.14) and gradually decreased with higher turmeric inclusion, reaching the lowest in T₄ (₹905.53), suggesting better feed efficiency with turmeric supplementation.

Fixed costs (comprising housing and initial animal purchase) varied slightly, from ₹4172.50 in T₃ to ₹4208.50 in T₂ and T₄. Feed costs increased proportionally with turmeric levels, starting from ₹1422.14 in T₁ to ₹1714.46 in T₅. When combined with other variable costs such as equipment, depreciation and miscellaneous items total variable expenses ranged from ₹1436.67 in T₁ to ₹1728.99 in T₅. Accordingly, total costs (fixed + variable) were lowest in T₁ (₹5631.67) and highest in T₅ (₹5878.99).

TABLE 5. Economics of feeding Turmeric powder (Rs.) during experimental period

Sr. No.	Particulars	T ₁	T ₂	T ₃	T ₄	T ₅
1	Initial average body weight (kg)	9.20	9.23	9.15	9.23	9.10
2	Total body weight gain (kg/goat)	5.43	5.65	5.88	6.48	6.10
3	Final average body weight (kg)	15.16	15.48	15.58	16.40	15.86
4	Total feed intake DM (kg/goat)	106.13	108.50	106.72	105.10	104.54
5	Initial cost @ 450 Rs./kg live weight	4140.00	4153.50	4117.50	4153.50	4095.00
6	Cost per kg body weight gain (Rs./kg)	1037.14	1019.17	982.51	905.53	963.77
7	Final cost @ 450 Rs./kg live weight	6822.00	6966.00	7011.00	7380.00	7137.00
A Fixed cost (Capital Cost)						
8	House rent charges	55	55	55	55	55
9	Initial cost of kids @ 450/kg live weight	4140.00	4153.50	4117.50	4153.50	4095.00

	Total	4195.00	4208.50	4172.50	4208.50	4150.00
A. Variable cost						
10	Feed Cost (Sampoorna grass + Jowar kadbi + goat pellet)	13.4	13.4	13.4	13.4	13.4
11	Cost of Turmeric powder	0	0.75	1.5	2.25	3
12	Total cost of feed (11+12)	13.4	14.15	14.9	15.65	16.4
13	Total cost of feed (Rs. for 90 days)	1422.14	1535.28	1590.13	1644.82	1714.46
14	Average equipment cost (bucket, feed trays, roaps) (Rs.)	0.94	0.94	0.94	0.94	0.94
15	Depreciation cost of equipment's (bucket, feed trays, roaps) (Rs.)	0.09	0.09	0.09	0.09	0.09
16	Misc. expenditure (Drug, water, labour etc.) (Rs.)	13.5	13.5	13.5	13.5	13.5
	Total variable cost 13+14+15+16	1436.67	1549.81	1604.66	1659.35	1728.99
	C Total cost (A+B)	5631.67	5758.31	5777.16	5867.85	5878.99
D Returns after sale						
17	Final weight	15.16	15.48	15.58	16.40	15.86
18	Final cost of kids @450/kg live weight	6822	6966	7011	7380	7137
19	Average total manure obtained (kg/kid)	38	42	48	53	56
20	Total price of manure(5 Rs/kg)	190	210	240	265	280
	Total return	7012	7176	7251	7645	7417
	Net profit per kid (D-C)	1380.33	1417.70	1473.84	1777.16	1538.01
	B:C Ratio (D/C)	1.25	1.25	1.26	1.30	1.26

Revenue from final body weight (valued at ₹450/kg) was greatest in T₄ (₹7380) and lowest in T₁ (₹6822). Additional income from manure (₹5/kg) ranged between ₹190 (T₁) and ₹280 (T₅). Overall returns increased from ₹7012 in T₁ to ₹7645 in T₄. Net profit per kid was highest in T₄ (₹1777.16), followed by T₅ (₹1538.01), T₃ (₹1473.84), T₂ (₹1417.70) and lowest in T₁ (₹1380.33). The benefit-cost ratio (BCR) was also most favourable in T₄ at 1.30, compared to 1.25 in T₁ and T₂ and 1.26 in T₃ and T₅. These findings demonstrate that supplementing the basal ration with 9 g of turmeric powder (T₄) leads to the most economically advantageous results, improving growth performance, feed efficiency and profitability in Konkan Kanyal kids.

Pingale (2022) reported that supplementing Osmanabadi kids with 0.6% turmeric powder (T₄) resulted in the lowest cost per kg live weight gain (₹313.08), compared to the control group (T₁) at ₹418.05, indicating improved economic efficiency with turmeric inclusion.

Conclusion

The present study demonstrated that turmeric powder supplementation had a positive effect on the growth performance and body measurements of Konkan Kanyal kids. Significant improvements were observed in body length, height and chest girth, with the highest gains recorded in T₄ (8.55 cm, 8.40 cm and 7.13 cm, respectively), followed by T₅, while the lowest gains were in T₁. Turmeric supplementation at 9 g/day (T₄) also recorded the highest average daily gain (71.94 g/day) and final body weight (15.70 kg). From an economic perspective, T₄ achieved the lowest cost per kg gain (₹905.53), the highest net profit (₹1777.16) and the best B:C ratio (1.30). These findings suggest that turmeric supplementation at 9 g/day can be recommended as an effective, economical and natural feed additive for improving growth, body conformation and profitability of Konkan Kanyal kids under Konkan conditions.

Ethics

All procedures involving animals in this study were carried out following ethical standards and welfare guidelines. Prior approval was obtained from the Institutional Animal Ethics Committee (IAEC), Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. The animals were handled humanely, with due care taken to minimize discomfort and ensure well-being throughout the research period.

Disclaimer (Artificial intelligence)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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