



ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2026): 4.97
IJAFS 2026; 8(9): 359-361
www.agriculturaljournals.com
Received: 12-07-2026
Accepted: 16-08-2026

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Effect of different levels of annatto (*Bixa Orellana*) seed extract on sensory quality and cost of flavoured Cow milk

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DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i9e.1894>

Abstract

The present study evaluated annatto seed extract as a natural colouring agent in flavoured cow milk. The experiment was conducted during 2025-26 at the Department of Animal Husbandry and Dairy Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Five treatments were used: T₁ (0%), T₂ (3%), T₃ (5%), T₄ (7%) and T₅ (9%) annatto seed extract, with 8 per cent sugar constant. The experiment was conducted in Completely Randomized Design with four replications. Sensory evaluation was carried out using a 9-point hedonic scale. Treatment T₄ (7%) recorded the highest scores for flavour (8.41), colour and appearance (8.48), body and texture (8.32), taste (8.42) and overall acceptability (8.42). The cost of production increased with increasing extract level. Treatment T₄ was found to be the most suitable based on sensory quality and cost. The study indicated that annatto seed extract can be successfully used to prepare naturally coloured and acceptable flavoured cow milk.

Keywords: Annatto, Flavoured milk, Natural colour, Sensory quality

Introduction

Milk is an important food because it provides valuable nutrients and is widely consumed in India. Flavoured milk is a value-added dairy beverage prepared by adding ingredients to improve taste and sensory appeal. Li and Drake (2015) ^[1] reported that flavoured milk combines the nutritional benefits of milk with improved taste and consumer appeal. Sarkar (2015) ^[2] also highlighted the importance of value-added dairy products for better utilization of milk and development of new dairy products. The demand for naturally derived food ingredients has increased interest in natural colouring materials. Annatto obtained from the seeds of *Bixa orellana* has been used as a natural colourant in different food products. Levy and Rivadeneira (2000) ^[3] reported that annatto provides attractive yellow to orange-red shades and has applications in food products including dairy foods. Scotter (2009) ^[4] reviewed the chemistry and use of annatto as a food colouring material and reported its wide application in food products. Hirko and Getu (2022) ^[5] also discussed annatto as an important natural colour source and described its food applications. Flavoured milk prepared with natural ingredients has been studied by several workers. Aneja *et al.* (2002) ^[6] described the use of good-quality milk, sugar, flavouring and colouring ingredients in the preparation of flavoured milk. Hingne *et al.* (2020) ^[7] reported good sensory quality in herbal flavoured milk prepared using Tulsi and Aloe vera juices. Bhilawekar (2021) ^[8] observed that suitable incorporation of cardamom improved the sensory quality of flavoured milk. Lad *et al.* (2024) ^[9] also reported good sensory acceptance of flavoured milk prepared using extracted natural colour from turmeric. However, limited work has been carried out on the use of annatto seed extract in flavoured cow milk. Therefore, the present study was undertaken to evaluate annatto seed extract for the preparation of flavoured cow milk and to identify a suitable level based on sensory quality and cost of production.

Materials and Methods

The investigation was conducted during 2025-26 at the Department of Animal Husbandry and Dairy Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. Fresh and clean cow milk was collected from the Livestock Instructional Farm of the department.

Annatto seeds were procured from the local market at Akola. Cane sugar was used at 8 per cent in all treatments was kept constant.

Preparation of flavoured cow milk

Fresh cow milk containing approximately 4.0 per cent fat was pre-heated to 35-40°C and filtered through a clean muslin cloth. Sugar was added at 8 per cent and mixed properly until completely dissolved. The milk was then blended thoroughly and pasteurized at 72°C for 15 seconds. After pasteurization, the milk was cooled to room temperature. Annatto seed extract was then added according to the treatment level and mixed properly for uniform distribution. Five treatments were used: T₁ - control, T₂ - 3 per cent annatto seed extract, T₃-5 per cent, T₄-7 per cent and T₅-9 per cent annatto seed extract. The sugar level was kept constant at 8 per cent in all treatments. The prepared flavoured milk was filled into 200 ml bottles, sealed and stored under refrigerated conditions.

Sensory evaluation

The prepared flavoured milk samples were evaluated by a panel of five semi-trained judges. Sensory evaluation was carried out using a 9-point hedonic scale as described in IS:6273 Part II (1972) ^[10]. The samples were evaluated for

flavour, colour and appearance, body and texture, taste and overall acceptability. Nelson and Trout (1964) ^[11] were followed for evaluation of overall acceptability.

Statistical analysis

The experiment consisted of five treatments with four replications and was conducted in Completely Randomized Design (CRD). The data were statistically analysed using analysis of variance as described by Panse and Sukhatme (1978) ^[12]. The treatment means were compared at the 5 per cent level of significance.

Cost of production

The cost of production was calculated for one litre of flavoured milk based on the prevailing prices of cow milk, sugar, annatto seed extract and other expenses during 2025-26. Electricity, gas and labour expenses were included under miscellaneous cost. The cost was calculated per litre, 200 ml and 100 ml.

Results and Discussion

Sensory evaluation of flavoured cow milk

The sensory scores of flavoured cow milk prepared with different levels of annatto seed extract are presented in Table 1.

Table 1: Sensory evaluation of flavoured cow milk as affected by different levels of annatto seed extract

Treatments	flavour	colour & appearance	body & texture	taste	Mean
T ₁	8.35	8.35	8.21	8.31	8.32
T ₂	8.11	8.02	8.09	8.02	8.06
T ₃	8.23	8.08	8.12	8.23	8.16
T ₄	8.41	8.48	8.32	8.42	8.42
T ₅	8.14	8.06	8.04	8.11	8.08

SE (m) ±: Flavour 0.0137; Colour and appearance 0.0129; Body and texture 0.0120; Taste 0.0128; Overall acceptability 0.0308

CD at 5%: Flavour 0.0412; Colour and appearance 0.0389; Body and texture 0.0361; Taste 0.0387; Overall acceptability 0.0927. The flavour scores were 8.35, 8.11, 8.23, 8.41 and 8.14 for T₁ to T₅ respectively. The highest score was recorded in T₄ containing 7 per cent annatto seed extract. The score decreased slightly at 9 per cent. Similar improvement in sensory quality at an optimum level of natural ingredients was reported by Dhande *et al.* (2016) ^[13], Hingne *et al.* (2020) ^[7], Bhilawekar (2021) ^[8] and Lad *et al.* (2024) ^[9]. The colour and appearance scores were 8.35, 8.02, 8.08, 8.48 and 8.06 respectively. T₄ recorded the highest score of 8.48. The attractive colour obtained at the 7 per cent level improved the visual appeal of the flavoured milk. A slight decrease was observed at 9 per cent. Similar improvement in colour and appearance at an optimum level of natural ingredients was reported by Dhande *et al.* (2016) ^[13], Hingne *et al.* (2020) ^[7] and Lad *et al.* (2024) ^[9]. The body and texture scores ranged from 8.04 to 8.32. The highest score was recorded for T₄ (8.32), followed by T₁ (8.21). The score increased up to 7 per cent annatto seed extract and decreased slightly at 9 per cent. Bhilawekar

(2021) ^[8] also reported better consistency and body characteristics at the optimum level of cardamom powder in flavoured milk. The taste scores were 8.31, 8.02, 8.23, 8.42 and 8.11 for T₁ to T₅ respectively. T₄ recorded the highest taste score of 8.42, while T₂ recorded the lowest score of 8.02. The taste score increased up to 7 per cent and decreased slightly at 9 per cent. This indicates that 7 per cent annatto seed extract provided a more preferred product. The overall acceptability scores were 8.32, 8.06, 8.16, 8.42 and 8.08 for T₁ to T₅ respectively. The highest overall acceptability score of 8.42 was recorded for T₄ containing 7 per cent annatto seed extract. The higher acceptability of T₄ may be due to its better colour and appearance, flavour, body and texture and taste. Similar findings were reported by Hingne *et al.* (2020) ^[7], who found that an optimized level of herbal ingredients improved the acceptability of flavoured milk. Thus, among all treatments, T₄ containing 7 per cent annatto seed extract was found to be the most acceptable treatment.

Cost of production

The cost of production of flavoured milk prepared with different levels of annatto seed extract is presented in Table 2.

Table 2: Cost structure of flavoured cow milk prepared with different levels of annatto seed extract (1 litre)

Particulars	T ₁	T ₂	T ₃	T ₄	T ₅
Cow milk @ Rs. 60/kg	60.00	58.20	57.00	55.80	54.60
Sugar @ 8% @ Rs. 56/kg	4.48	4.48	4.48	4.48	4.48
Annatto seed extract @ Rs. 215/L	—	6.45	10.75	15.05	19.35
Miscellaneous cost (electricity, labour, gas)	20.00	20.00	20.00	20.00	20.00
Total cost of production (Rs. /L)	84.48	89.13	92.23	95.33	98.43
Cost/200 ml (Rs.)	16.90	17.83	18.45	19.07	19.69
Cost/100 ml (Rs.)	8.45	8.91	9.22	9.53	9.84

The cost of production increased gradually with an increase in the level of annatto seed extract. The lowest cost was recorded for T₁ (Rs. 84.48/L), while the highest cost was recorded for T₅ (Rs. 98.43/L). The cost of the selected best treatment, T₄ containing 7 per cent annatto seed extract, was Rs. 95.33 per litre or Rs. 9.53 per 100 ml. The increase in cost was mainly due to the additional quantity of annatto seed extract used in the higher-level treatments. Similar increases in cost with increasing levels of natural ingredients were reported by Deore (2013) ^[14], Shirke *et al.* (2015) ^[15], Tayde *et al.* (2018) ^[16] and Hingne *et al.* (2020) ^[7].

Conclusion

The present study showed that annatto seed extract can be successfully used for the preparation of naturally coloured flavoured cow milk. Among the treatments, T₄ containing 7 per cent annatto seed extract recorded the highest scores for flavour (8.41), colour and appearance (8.48), body and texture (8.32), taste (8.42) and overall acceptability (8.42). The cost of production increased with increasing level of annatto seed extract. Considering sensory quality and cost of production, 7 per cent annatto seed extract was found to be the most suitable level for preparation of flavoured cow milk under the conditions of the present study.

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