The Pharma Innovation Journal 2023; 12(10): 1775-1778

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(10): 1775-1778

www.thepharmajournal.com
Received: 01-07-2023
Accepted: 04-08-2023

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Organoleptic evaluation and consumer acceptability of ready to eat products developed from turmeric

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Abstract
In cultivation of turmeric, *Curcuma longa* rhizomes are harvested and processed for producing turmeric powder which is used as a spice and a colouring agent in food. It has been recognized for pharmaceutical uses of which India is the largest producer supplying 90% of world's demand. Since the use of turmeric is limited only to daily meals, therefore products were developed to incorporate it in the daily diet. Two products were developed using turmeric as an ingredient to incorporate it in food other than the daily meals. Orange based turmeric spread was developed so that it can be relished even by the children. In this, three substitutions of turmeric *viz*. 10%, 20% and 30% were used. Turmeric candy was also developed with 5%, 10% and 15% turmeric substitution. In candy, honey was used as a sweetening agent. Pepper was also used in the candy to facilitate the absorption of curcumin as proven in various studies. These products were subjected to organoleptic evaluation using 9-point Hedonic scale and consumer acceptability using 5-point Hedonic scale. The acceptability score of turmeric spread and candy was 7.8 which indicates very good acceptability.

Keywords: Curcuma longa, pharmaceutical, spread, candy, organoleptic

Introduction
Turmeric, a product of the plant, *Curcuma longa*, is member of the *Zingiberaceae* family. It is popularly known as the solid Indian gold and has been harnessed for a variety of purposes since ages. Curcumin, the primary ingredient derived from the rhizome is used as a spice in the countries of the Indian subcontinent (Reema, *et al.* 2006) [1]. Apart from enhancing the colour and taste of the food, it also increases the shelf life by preventing it from deterioration and by inhibiting contamination by food borne pathogens. Various products have been developed using turmeric as the prime component and were found acceptable among the judges in sensory evaluation. Wannee (2020) [2] conducted a study to evaluate the sensory characteristics of beef stick product with 3 levels of turmeric powder. These incorporations were 0 percent, 1 percent and 2 percent. Each treatment was evaluated by a panel of 58 untrained participants for the acceptability of appearance, colour, flavour, taste, texture and overall liking. The beef stick product with one percent turmeric powder was found to be most acceptable in case of overall liking with a score of 7.13.
In a study conducted by Pande *et al.* (2020) [3] in Bali, on 900 respondents regarding the use of turmeric, it was found that, 36.8 percent people use turmeric as medicine. Other usage was mostly in the form of loloh, a traditional drink.
The physicochemical, microbiological and sensory characteristics of snack prepared from broken rice grains and turmeric powder was investigated by Oliveria *et al.* (2020) [4]. Turmeric was incorporated into broken rice grains as 0 percent, 2 percent, 4 percent, 8 percent, and 10 percent. The prepared snack was subjected to sensory evaluation and the most accepted substitution turned out to be with 6 percent substitution.
Mane *et al.* (2018) [5] developed a formulation of orange ready to serve beverage by mixing it with fresh turmeric rhizome juice in various proportions. Turmeric juice was substituted with orange juice in ratios of 90:10, 80:20 and 70:30 and were named as T_1, T_2 and T_3 respectively. Organoleptic evaluation of turmeric-based orange RTS beverage for colour and appearance, flavour, after taste and overall acceptability was also carried out.
Prajakta *et al.* (2018) [6] worked upon the development of phytochemical free turmeric based sweetened condensed milk. The phytochemicals were removed from turmeric using ethanol. The obtained powder was then incorporated in cow's milk at different level of substitution *viz* (0.1, 0.2, 0.4, 0.8 and 1.6 percent) and subjected to heating until a turmeric based condensed milk was obtained. The prepared condensed milk samples were then subjected for sensory analysis and, 0.4 percent substitution obtained maximum acceptability.

Park *et al.* (2012) [7] evaluated the antioxidant, rheological, physical and sensorial properties of wheat flour dough cake containing turmeric powder. Wheat flour was substituted with 0 percent, 2 percent, 4 percent, 6 percent, and 8 percent turmeric powder. Different levels of substitution showed different properties. The highest curcumin (203 mg/kg) and RSA DPPH activity (45 percent) was found in cake with 8 percent substitution. However, this was not accepted in sensory evaluation. The cake with 6 percent substitution of wheat flour with turmeric showed acceptable sensory score.
Dash *et al.* (2014) [8] carried out an investigation on the physicochemical properties and product development from turmeric germplasm available in south western region of Bangladesh. Products were also developed from the rhizomes. Turmeric laddu were prepared by using 400 g sugar with 100 g variation in three treatments without changing other ingredients. Turmeric nimky was prepared by using 400 g flour containing treatment consisting 300-500 g of flour with 100 g variation of flour in three treatments without changing other ingredients.

Material and Methods

Development of ready to eat turmeric based products

Products were developed by incorporating turmeric in the product so that turmeric-based products can be included in the diet of people apart from its general use in food. Two products, *Orange-turmeric spread* and *Turmeric candy* were decided to be developed so that it can be relished even by younger children.

Orange-turmeric spread

Sweet orange (*Citrus sinensis* L.) is a deciduous fruit belonging to the family *Rutaceae.* Sweet orange is widely cultivated in tropical and sub-tropical climate. The fruit is eaten either whole or it is processed to extract juice, and preserved as beverage, jams, jellies, spreads etc.
Therefore, for the development of orange turmeric spread, the materials were orange, sugar and turmeric powder. The raw materials, 5 kgs of Oranges and 5 kgs of sugar were procured from local Pusa market. The turmeric powder that was processed in the lab was used. The spread was prepared in different proportions of orange and turmeric. Control (A0) was made without adding turmeric. The treatments A1, A2 and A3 were prepared by 10%, 20% and 30% substitution of turmeric. Organoleptic evaluation was done by a panel of 30 untrained judges to determine the most acceptable combination. The amount of all the ingredients used are depicted in Table 1. The procedure of making spread is illustrated in Fig 1.

Turmeric candy

A honey based turmeric candy was prepared using black pepper and black salt. Honey was used as a sweetening agent for making candy.

Table 1: Ingredients for Orange turmeric spread

Ingredient	A0	A1	A2	A3
Fruit Pulp	200 gm	200 gm	200 gm	200 gm
Sugar	200 gm	200 gm	200 gm	200 gm
Water	600 gm	600 gm	600 gm	600 gm
Turmeric Powder	-	20 gm	40 gm	60 gm

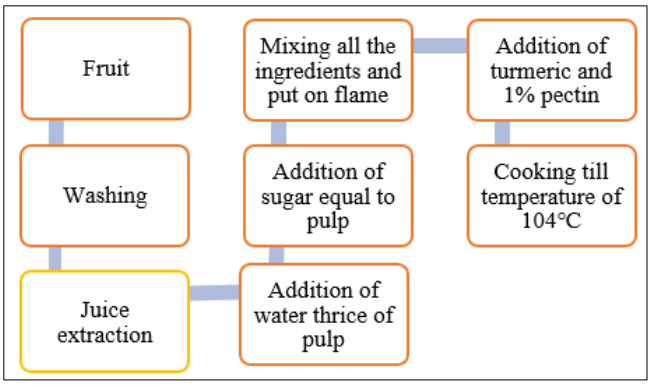

Fig 1: Procedure for making Orange-turmeric spread

A study has shown that piperine (20 mg/kg orally) when consumed with curcumin (2 g/kg orally) increases the absorption of curcumin up to 2000 time (Prasad *et al.* 2014) [9]. Black pepper and black salt were procured from local Pusa market. Honey was procured from beekeeping centre of the university. Candies were prepared in 3 different proportions of honey and turmeric. Control (B0) was made without adding turmeric. The treatment B1, B2 and B3 were prepared by 5%, 10% and 15% substitution of turmeric. Organoleptic evaluation of the products was done by a panel of 30 untrained judges to determine the most acceptable combination. The amount of all the ingredients used are depicted in Table 2. The procedure of preparing candy is illustrated in Fig 2.

Evaluation of turmeric-based products for organoleptic and consumer acceptability

Developed turmeric based products were subjected to organoleptic evaluation by a panel of 30 untrained judges. Evaluation was done using a 9-point Hedonic Rating Scale.
Consumer Acceptability of the products was conducted from rural farm ladies during Kisan mela organised by the university. The evaluation was done by a panel of 30 judges using a 5-point Hedonic scale.

Table 2: Ingredients for Turmeric candy

Ingredient	B0	B1	B2	B3
Honey	100 gm	100 gm	100 gm	100 gm
Black pepper	1 gm	1 gm	1 gm	1 gm
Black salt	1 gm	1 gm	1 gm	1 gm
Turmeric Powder	-	5 gm	10 gm	15 gm

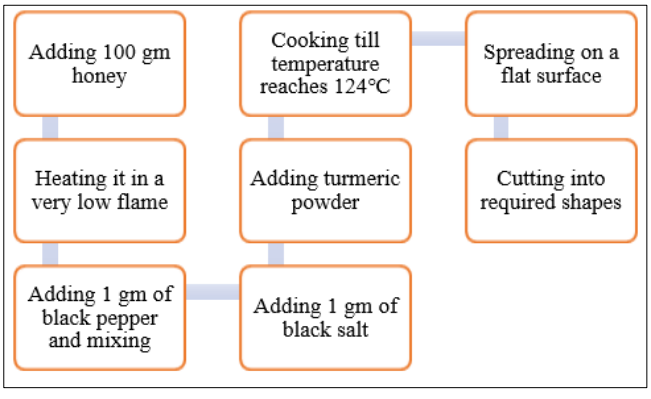

Fig 2: Procedure for making Turmeric Candy

Results and Discussion

Evaluation of organoleptic quality of RTE turmeric based products: The results of organoleptic evaluation of the products as presented in Table 3 and illustrated in Fig. 3 and Fig. 4 revealed that different substitutions were liked by the judges and the most preferred one for the orange turmeric spread was A1 and A2 with the overall acceptability of 7.8±0.6 and 7.2±0.5 respectively. For turmeric candy, the preferred substitution were B1 and B2 with overall acceptability of 7.8±0.7and 7.4±0.8.

Evaluation of consumer acceptability of RTE turmeric based products: The products were also tested for consumer acceptability in the Kisan Mela organised by the university. Testing was done among 30 consumers. A 5-point hedonic scale was used for the evaluation. Most acceptable treatments from the organoleptic evaluation were tested for consumer acceptability i.e., A1 and A2 for turmeric spread and B1 and B2 for turmeric candy. The consumer acceptability values for RTE products as presented in Table 4, for orange turmeric spread in A1 was 4.1±0.2 and for A2 the scores were 4±0.01. For candy the acceptability score was 4.2±0.1 for B1 and 4.02±0.01 for B2.

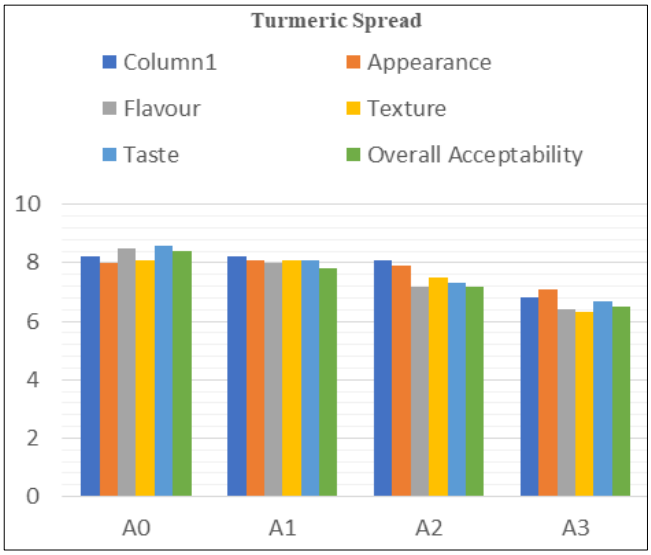

Fig 3: Illustration of organoleptic scores of turmeric spread

Table 3: Organoleptic evaluation of RTE turmeric based products

A. Turmeric Spread					
S. No	**Parameters**	**A0**	**A1**	**A2**	**A3**
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
1.	Colour	8.2±0.9	8.2±0.7	8.1±0.5	6.8±0.9
2.	Appearance	8.0 ±0.1	8.1±0.6	7.9±0.7	7.1±1.0
3.	Flavour	8.5±0.6	8.0±0.4	7.2±0.7	6.4±1.4
4.	Texture	8.1±0.8	8.1±0.8	7.5±0.7	6.3±1.3
5.	Taste	8.6±0.6	8.1±0.5	7.3±0.5	6.7±1.5
6.	Overall acceptability	8.4±0.6	7.8±0.6	7.2±0.5	6.5±1.4
B. Turmeric Candy					
S. No	**Parameters**	**B0**	**B1**	**B2**	**B3**
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
1.	Colour	7.7±0.6	7.9±0.6	7.9±0.6	7.2±0.9
2.	Appearance	8.0±1.0	7.7±0.9	7.7±0.9	7.2±0.9
3.	Flavour	8.0±0.9	7.4±0.8	7.7±0.8	6.5±1.1
4.	Texture	7.8±0.6	7.6±0.5	7.6±0.5	6.7±0.8
5.	Taste	8.0±0.8	7.3±0.5	7.4±0.5	6.5±1.2
6.	Overall acceptability	7.9±0.9	7.8±0.7	7.4±0.8	6.8±1.1

Table 4: Consumer acceptability of RTE turmeric based products

Turmeric Spread		Turmeric candy	
A1	4.1±0.20	B1	4.20±0.10
A2	4.0±0.01	B2	4.02±0.01

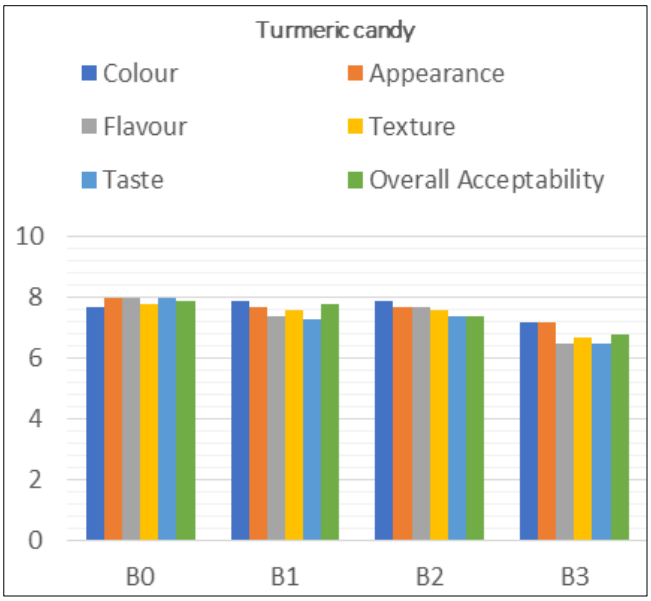

Fig 4: Illustration of organoleptic scores of turmeric candy

Conclusion

A number of pharmacological and therapeutic properties of turmeric have been reported. Despite all these extraordinary properties, there is a concern for the bioavailability of curcumin, the main active ingredient in turmeric. Apart from chemical properties due to which the bioavailability of curcumin is affected, there are other factors too which are responsible for the poor availability of curcumin in turmeric. One of such factors may be the methods adopted for processing of turmeric. A major portion of important components present in turmeric i.e., curcumin and phytochemicals are lost while boiling, and drying processes. Limited use of turmeric in food is also one factor for low curcumin bioavailability in human body. Although people make a variety of traditional recipes using turmeric but that is limited to specific recipes. Keeping these points in mind, two products *Orange Turmeric spread* and Honey based *turmeric candy* were developed. Spread was chosen so that it can be relished even by the younger children and honey-based candy was developed so that even the diabetics can consume it. The products were developed with different substitutions of turmeric *viz*., 10%, 20% and 30% in spread and 5%, 10% and 15% in candy

The products were also analysed for organoleptic quality using a 9-point Hedonic scale from a panel of 30 untrained judges. 10% and 20% substitution of turmeric spread and 5% and 10% substitution of turmeric candy were most accepted with an overall score of 7.8. Consumer acceptability of the products was also carried out in the Kisan mela organised by the university. Here, 5 point hedonic scale was used. The overall acceptability scores were 4.2.

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