

Original Research Article

Sensory Evaluation of Rasmalai blended with Sweet potato (*Ipomoea batatas* L.) pulp

ABSTRACT

Aims: Nutritional benefits of sweet potato blended into Rasmalai was explored in this study by developing a value-added Rasmalai. This work aimed to facilitate utilization of sweet potato pulp not only increases nutritive value of product but also improved sensory quality. This study finds out optimum level of sweet potato pulp in Rasogolla part of Rasmalai with two sugar level in concentrated milk.

Study design: This research was experimental and performed in a laboratory.

Place and Duration of Study: This study was conducted at Department of Animal Husbandry and Dairy Science, College of Agriculture, Dr.BSKKV, Dapoli Maharashtra , India, during 2022-23

Methodology: The Rasmalai was prepared from cow and buffalo milk by incorporating sweet potato pulp @0%(T₀),5% (T₁), 10% (T₂), and 15 % (T₃) in Rasogolla part and two sugar level i.e. 7 % (S₁) and 8 % (S₂) in concentrated milk based on weight of Chhana and initial milk respectively. All treatments were analyzed for sensory attributes i.e. colour and appearance, body and texture, flavour and overall acceptability by using 9-point Hedonic scale. Research Conducted with Five Replication.

Results: Most optimum level of sweet potato pulp @10 % found in Rasmalai with 7 and 8 percentsugar level had obtaining maximum score for colour and appearance (8.18 and 8.18) and, body and texture (8.34 and 8.28), flavour (8.34 and 8.50) and overall acceptability (8.54 and 8.58) respectively. The statistical analysis of the data shows that the impact of sweet potato pulp was significant at the 1% level of probability, but the effect of sugar and the interaction effect of sugar X SPP were non-significant.

Conclusion: The study concludes that incorporating up to 15 % sweet potato pulp in Rasmalai can improve its sensory characteristics without compromising its traditional appeal, offering a nutritious twist to the dessert. The most acceptable quality Rasmalai can be prepared by using 10 % SPP with both sugar level.

Keywords: cow milk, sweet potato, chhana, rasmalai, sensory

1. INTRODUCTION

India is the largest milk producing country in the world with its 230.6 mt milk production and 459 g person⁻¹ daily milk consumption, enjoys number one position in

terms of milk production (Anonymous2024 and 2024a) Out of the total milk produced, about 45 to 50% is converted into indigenous dairy products. The coagulation of milk with organic/inorganic acid at a higher temperature, followed by chilling and filtering of the coagulum, results in heat and acid coagulated dairy products (Sahu & Das 2010, Dhawade et al., 2024). Under acid precipitated milk product, chhana and paneer are the main products. Chhana, a well-known traditional indigenous milk product is used extensively as a base material for large variety of Indian delicacies viz. Sandesh, Rasogolla, Chamcham, Rasmalai and many other such product. Rasogolla is a typical sweet dessert prepared from coagulated milk protein locally known as Chhana (Sengupta and Bhowal, 2017; Sarkar et al., 2020). Despite its origins in East India, Rasogolla is popular throughout the country and worldwide (Kaur and Goswami, 2017, Sarkar et al., 2020). Rasmalai, sometimes known as Rossomalai, is a dessert from the eastern Indian subcontinent. This sweet has a very delicate texture and flavour. Chhana and condensed milk are utilized as basic ingredients in the creation of Rasmalai; chhana is necessary for Rasogolla manufacturing, while condensed milk is required for dipping these Rasogolla before serving. It is widely popular in India, Bangladesh and Pakistan. Rasmalai sweet is one of the best desserts of Indian subcontinent which seems to be favorites to all age group specially children. It plays pivotal role in festival season of India.

Sweet potato (*Ipomoea batatas* L.) is the world's sixth most valuable food crop, and novel applications for it have been identified. Sweet potato is one of the crops selected by the National Aeronautics and Space Administration (NASA) for use as a major food source in a regulated ecological life support system. A recent study found that sweet potatoes have beneficial components such as polyphenols, anthocyanins and dietary fiber (Singh et al., 2021). Sweet potato, a delicious vegetable with multifaceted medicinal properties, has been used since ancient times for its anti-cancer, anti-diabetic, anti-inflammatory, antioxidant, and antibacterial properties. Its high potassium content and magnesium content promote relaxation, calmness, and nerve health, making it a top superfood among vegetables (Parle and Monika, 2015). The sweet potato is praised as a “poor man’s crop” as it characteristically grown and consumed by inadequate resource communities especially by women headed families (Bhuyan et al., 2022).

Sweet potato has high nutritive value as well as its meditational importance. So far sweet potato has been successfully utilized for the value addition of milk products like Fasting Gulab-Jamun (Maboodurrahman et al., 2019), Basundi (Deshmukh et al., 2021), Ice-cream (Wijaya et al., 2021), Milk Cake (Singh et al., 2021) designed colostrum cake (Deshmukh et al., 2023) and chocolate ice cream (Atanu Jana et al., 2024) Thus,

considering the nutritive value and peculiar flavour of Sweet potato, the present study was aimed to evaluate the utilization of sweet potato pulp in developing Rasmalai..

2. MATERIAL AND METHODS

Location and period of study

The present study was carried out at the Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli (Dr. BSKKV DAPOLI)- 415 712, Ratnagiri, Maharashtra, India during 2022- 2023.

2.1 Material:

Cow milk for Chhana preparation, Buffalo milk for preparation of concentrated milk, Citric acid used as coagulant, Sugar used for preparation of sugar syrup during Rasogolla making as well as concentrated milk, sweet potato Cv.Konkan Ashvini used in Rasogolla part and muslin cloth for draining whey during Chhana preparation.

2.2 Methodology

2.2.1. Preparation of Sweet potato pulp

SPP was prepared as per the procedure given by Deshmukh et al., (2021) with minor modification, as follows:

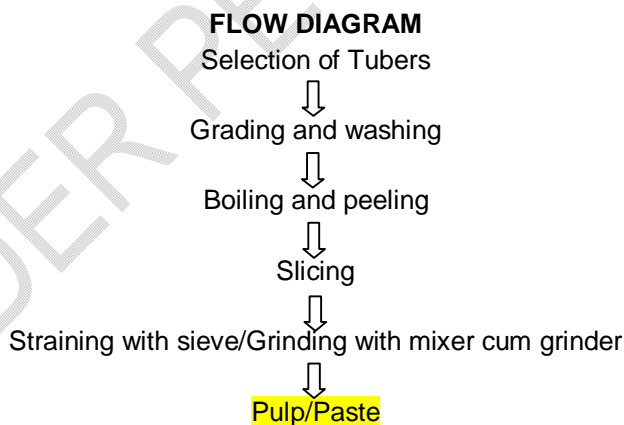
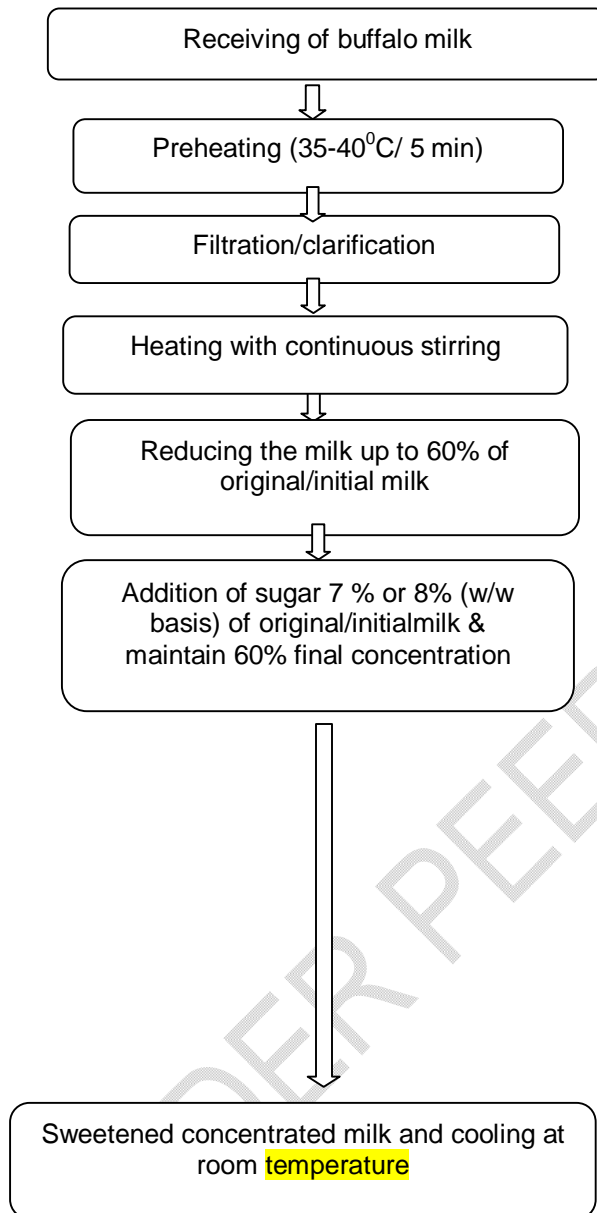


Fig. 1: Flow chart for SPP preparation

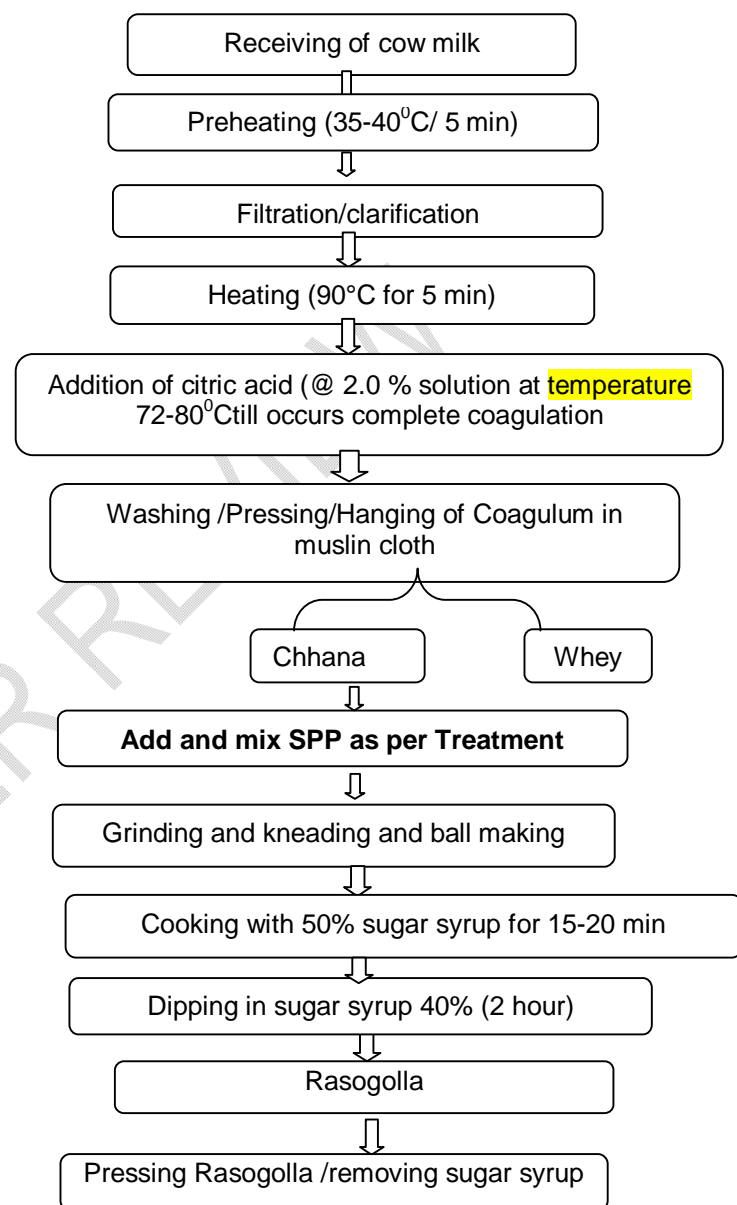
2.2.2. Preparation of Rasmalai

With minor Modification, Rasmalai was made according to the process specified by sharma 2004 and Sayedatunneshah et al., 2008 and as shown in the flow diagram below

Preparation of Concentrated Milk



Preparation of Rasogolla



Rasmalai

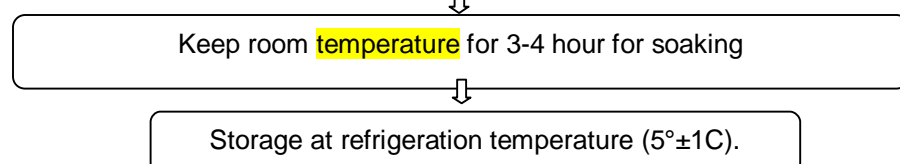


Fig-2 Preparation of Rasmalai

2.2.3 Treatments

The research trials were carried out with the following different levels of sweet potato pulp with two sugar level.

2.2.3.1 *Levels of sugar and sweet potato pulp*

Two Level of sugar was added in Rasmalai was 7 per cent (S_1) and 8 per cent (S_2) of weight of Initial milk for Concentrated milk.

Levels sweet potato pulp

T_0 = Without Sweet potato pulp (w/w)

T_1 = Sweet potato pulp 05 per cent of Chhana for Rasogolla part (w/w)

T_2 = Sweet potato pulp 10 per cent of Chhana for Rasogolla part (w/w)

T_3 = Sweet potato pulp 15 per cent of Chhana for Rasogolla part (w/w)

2.2.3.2 *Treatment Combination*

T_0S_1 = Without Sweet potato pulp & 7 per cent sugar

T_1S_1 = 05 per cent sweet potato pulp & 7 per cent sugar

T_2S_1 =10 per cent sweet potato pulp & 7 per cent sugar

T_3S_1 =15 per cent sweet potato pulp & 7 per cent sugar

T_0S_2 =Without Sweet potato pulp & 8 per cent sugar

T_1S_2 =05 per cent sweet potato pulp & 8 per cent sugar

T_2S_2 =10 per cent sweet potato pulp & 8 per cent sugar

T_3S_2 =15 per cent sweet potato pulp & 8 per cent sugar

2.2.4 Replications

The research was conducted with Five replications.

2.2.5 Analytical Methods for Sensory evaluation Rasmalai

The product was evaluated for sensory attributes, viz. colour and appearance, flavour, body and texture and overall acceptability using 9-points hedonic scale by panel of not less than 8 semi-trained judges as per IS: 6273, (Part-II), 1971..

2.2.6 Statistical analysis

In present study Factorial Completely Randomized Block design (FCRD) was employed using five replications.

3. RESULTS AND DISCUSSION

The present investigation was undertaken to evaluate sensory quality of Rasmalaiby using different level of sweet potato pulp. The results of present research work are average of 5th -time replicated data tabulated, presented, and discussed along with statistical analysis under following main heads. This is Phase I which determine optimum level of sweet potato pulp by using sensory evaluation

Sensory evaluation of Rasmalai

Sensory evaluation of any consumable product is the best method of judging the acceptability of the product by the consumers. Sensory evaluation plays vital role in product development as well as in determining the shelf-life of a product. The sensory assessment was done by studying the parameters like Colour and Appearance, Body and Texture, Flavour, and Overall Acceptability of the product by the panel of judges by using “Nine Point Hedonic Scale” score card. The results of the study presented herein under in Table 1

Table 1: Effect of different levels of sweet potato pulp and sugar on Sensory attributes of Rasmalai

TREATMENTS		SENSORY PARAMETER (SCORE OUT OF 9)			
		Colour and Appearance	Body and texture	Flavour	Overall acceptability
		Average Score of Five replication			
T₀S₁		7.48	7.38	7.32	7.42
T₁S₁		7.76	7.68	7.72	7.76
T₂S₁		8.18	8.34	8.34	8.54
T₃S₁		7.90	7.70	7.88	7.80
T₀S₂		7.58	7.36	7.54	7.46
T₁S₂		7.88	7.80	7.94	7.98
T₂S₂		8.18	8.28	8.50	8.58
T₃S₂		7.88	7.60	7.98	7.82
SEM±	S	0.069	0.052	0.047	0.059
	T	0.098	0.073	0.067	0.083
	S×T	0.139	0.104	0.095	0.117
CD AT1%	S	0.269	0.201	0.184	0.227
	T	0.380	0.285	0.260	0.322
	S×T	0.537	0.402	0.368	0.455

Note: S-Sugar Level T: Sweet Potato Pulp(SPP) Level , S×T: Interaction

3.1 Colour and Appearance

The data presented in Table 1 showed that the score for colour and appearance was increased due to addition of SPP the highest score for colour and appearance for Rasmalai

was observed for treatment T_2S_1 and T_2S_2 i.e. 10 % Sweet potato pulp for both 7% and 8% sugar (8.18), followed by treatment T_3S_1 i.e. 10 % SPP each and 7 % sugar (7.90) and T_1S_2 and T_3S_2 i.e. 5 % and 20% SPP and 8 % sugar each (7.88). The lowest score for colour and appearance for Rasmalai was observed for treatment T_0S_1 i.e., 0 % SPP and 7 % sugar (7.48), and treatment T_0S_2 i.e. 0 % SPP and 8 % sugar (7.58).

The statistical interpretation of data reveals that effect of sugar as well as interaction effect of sugar X SPP were non-significant at both the levels of probability. However, effect of SPP was significant at 1% level of probability. The statistical interpretation of data indicates that for different levels of SPP treatments were statistically different from other treatment. Treatment T_1 , T_2 and T_3 were at par with each other at 1% level of probability. In the present investigation combinations of SPP were used to prepare Rasmalai, with two sugar levels viz., 7% and 8 %. It has been found that at both the levels of sugar, addition of SPP @10% provided most optimum results.

Sweet potato pulp gives the a very light yellowish colour to finished product where sugar used, is of pure white in colour, did not play any role in imparting colour to the product. Increasing level of SPP score increasing trend up to Treatment T_2 with both level of Sugar score high (8.18) and slowly decline on 7.9 (T_3S_1) and 7.88(T_3S_2).

Nearby Similar colour and appearance score observe Basundi blended with sweet potato @8,10 and 12 per cent treatments obtain score ranges from 7.13-8.24 (Deshmukh et al., 2021), designed colostrum cake @7.5 per cent obtained highest score 8.30 (Deshmukh et al., 2023) and Herble Rasmalai has Score 8.26 (Ambali et al., 2023).

3.2 Body and texture

Body and texture are commonly used to characterize the distinct mouthfeel qualities of dairy product. The perusal of Table 1 reveals that at 7% level of sugar highest score for body and texture attribute was gained by T_2S_1 (8.34) followed by T_3S_1 (7.70), T_1S_1 (7.68) and least by treatment T_0S_1 (7.38). For 8 % sugar treatment T_2S_2 (8.28) gained highest points followed by T_1S_2 (7.80), T_3S_2 (7.60) and least by treatment T_0S_2 (7.36).

The statistical interpretation of data Indicates that effect of SPP was significant at 1% level of probability, whereas effect of sugar as well as interaction effect of sugar X SPP was non-significant. In case of addition of SPP it is observed that the increasing level of SPP results in increasing the score for treatment T_0 to T_2 then slightly decreased for T_3 . Increasing Sweet potato pulp increase bulkiness or density of Rasmalai compared with Control treatment i.e. T_0 due to SPP rich in fiber and natural sugars. The high-water content

in sweet potatoes could add moisture, potentially softening the overall texture. Due to its starch content, sweet potato pulp might give the Rasmalai a firmer, creamier texture. However, it may also create a denser product compared to the typical soft and spongy texture of control Rasmalai.

Nearby Closer Body and texture score observe Basundi blended with sweet potato @8,10 and 12 per cent treatments obtain score ranges from 7.02-8.15 (Deshmukh et al., 2021), designed colostrum cake @7.5 per cent obtained highest score 8.57 (Deshmukh et al., 2023) and Herble Rasmalai has Score 7.38 (Ambali et al., 2023)

3.3. Flavour

A detailed review of Table 1 revealed that at 7% level of sugar highest score for flavour attribute was achieved by T_2S_1 (8.34) followed by T_3S_1 (7.88), T_1S_1 (7.72), and least by treatment T_0S_1 (7.32). whereas 8 % sugar treatment has T_2S_2 (8.50) gained highest points followed by T_3S_2 (7.98), T_1S_2 (7.94), and least by treatment T_0S_1 (7.54).

The statistical interpretation of data indicates that effect of SPP was significant at 1% level of probability, whereas effect of sugar as well as interaction effect of sugar X SPP was non-significant. Addition of 10 % level of SPP statistically differ from all other treatments, whereas addition of 5 % and 15% SPP were statistically at par with each other. In the present investigation SPP was used for Chhana ball making whereas sugar was used as sweetening agent in Concentrated milk during phase I of Rasmalai preparation. Obviously, the flavour attained by the product is a result of combined and/or interactive actions of these ingredients.

Flavour is combined impact of two different sensory attributes i.e. smell and taste. Smell is perceived through nose and taste is through tongue. Receptors of nose and tongue send their perception to brain and on that basis individual judges rates the product. In this case SPP and sugar were two ingredients responsible for furnishing typical flavour to product.

It is quite evident that higher level of sugar (8%) provides better score than lower level (7%) each and even SPP level. However, effect of addition of SPP was best for 10% addition as compared to 5% or 15 %. Which itself indicative of the fact that SPP plays distinctive role in providing flavour. SPP is having which might have accepted by judges. However, at higher level (15%) it might have given over masking effect over typical flavour of Rasmalai. It is evident that addition of SPP enriched flavour attribute 6 % higher score was

secured at 5% addition of SPP over control, whereas it was about 7% at 15% addition of SPP and 12% at 10 % addition of SPP.

Nearby similar finding of flavour score observed Basundi blended with sweet potato @8,10 and 12 per cent treatments obtain score ranges from 7.27-8.05 (Deshmukh et al., 2021), designed colostrum cake @7.5 per cent obtained highest score 8.15 (Deshmukh et al., 2023) and Control Rasmalai has Score 8.43 (Ambali et al., 2023)

3.4 Overall acceptability

Detail Reviewed of Table 1. reveals that at 7 % level of sugar highest score for overall acceptability attribute was achieved by T_2S_1 (8.54) followed by T_3S_1 (7.80), T_1S_1 (7.76) and least by treatment T_0S_1 (7.42). For 8 % sugar treatment T_2S_2 (8.58) gained highest points followed by T_1S_2 (7.98), T_3S_2 (7.82) and least by treatment T_0S_2 (7.46).

The statistical analysis of the data shows that the impact of SPP was significant at the 1% level of probability, but the effect of sugar and the interaction effect of sugar X SPP were non-significant. However addition of SPP was significant at 5% level of probability. Treatment T_2 was distinctly different from other treatment. Whereas treatment T_1 and T_3 were at par with each other. Treatment T_0 also differs from all other treatments.

To establish a product's broad acceptability, all its qualities are evaluated simultaneously. Consumers examine the entire performance of all sensory elements and their influence on the senses when considering overall acceptability, hence the average of all sensory qualities is being investigated.

Overall acceptability of product is not average of remaining attributes but is all the way different phenomenon. A product scoring highest overall acceptability need not to score highest score in all remaining parameters. Overall acceptability is collective and interactive effect of all the parameter. In the present investigation it has been observed that treatment T_2 i.e 10 % SPP proved best treatment for both sugar levels.

Comparatively similar finding of flavour score observed by some research worker and revealed that Basundi blended with sweet potato @8,10 and 12 per cent treatments obtain score ranges from 7.23-8.33 (Deshmukh et al., 2021), designed colostrum cake @7.5 per cent obtained highest score 8.52 (Deshmukh et al., 2023) and Control control as well as herbal Rasmalai has Score 8.18 and 8.07 respectively (Ambali et al., 2023).

According to the results of the current investigation, Rasmalai prepared with 10% SPP each performed best and the provided most acceptable score for overall acceptability

for both the levels of sugar addition i.e. 7 % and 8 %. were selected for further studies in phase II.

4 CONCLUSION

The study concludes that incorporating up to 15 % sweet potato pulp in Rasmalai can improve its sensory characteristics without compromising its traditional appeal, offering a nutritious twist to the dessert. Most acceptable quality Rasmalai can be prepared from Rasmalai blended with 10% sweet potato pulp for Rasogolla part and 7 or 8 % sugar for Concentrated milk part of Rasmalai.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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

COMPETING INTERESTS

Authors have declared that no competing interests exist

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare 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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T_0S_1



T_1S_1



T_2S_1



T_3S_1

Plate I: Rasmalai with different levels of sweet potato pulp and 7 % sugar



T_0S_2

T_1S_2



T_2S_2

T_3S_2

**Plate II: Rasmalai with different levels of sweet
potato pulp and 8 % sugar**

UNDER PEER REVIEW