

## Physio-chemical and microbiological evaluation of Ragi (*Eleusine coracana*) based ready-to-drink (RTD)

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### ABSTRACT

Functional beverages are a growing trend in the food market. The additional health benefits and prevention of nutrition related diseases are attractive for consumers that are seeking a healthy lifestyle and improvement of their eating habits. In the growing market of functional beverages, there is a lack of products that make use of this cereal/millet (Thakur and Tiwari, 2019). Some studies have shown the beneficial effects of consuming ragi based mixes. Ragi is rich in carbohydrates and is a good source of macro and micronutrients. The need for the present study is to utilize, develop and evaluate value added products of underutilized grain ragi. Ragi based RTD was prepared evaluated for its organoleptic, physical, chemical and microbiological quality on initial and after six months of shelf life. Results shown that retorted ragi ready to drink product remains good in organoleptic, physical, chemical and microbiological qualities after six months of shelf life. Retorting has significantly reduced the total microbial population and much less physio-chemical changes were recorded after processing, when compared to the control (Kumar *et al.*, 2017).

**Key Words :** RTD, Retorting, Rancidity, Shelf life

### INTRODUCTION

Iron deficiency anemia is one of the most widespread chronic health problems in the India, combating it with the development of functional foods that are appealing to the consumer is an emerging opportunity. Some studies have shown the beneficial effects of consuming ragi based mixes. It is comparable to rice with regards to protein (6-8%) and fat (1-2%) and is superior to rice and wheat with respect to minerals and micronutrient contents (Verma and Patel, 2013). The need for the present study to utilize develop and evaluate value added products of underutilized grain ragi. Ragi based RTD was prepared evaluated organoleptic, physical, chemical and microbiological quality on initial and after six months of shelf life. The results shown that the keeping quality of RTD after six month of expiry was acceptable in terms of organoleptic (color, flavor, consistency), physical, chemical and microbiological

parameters. However, in the growing market of functional beverages, there is a lack of products that make use of this cereal/millet. Heat treatments for shelf-life extension such as ultra-high temperature (UHT) or retorting processes are commonly performed (David *et al.*, 2006).

### Objectives:

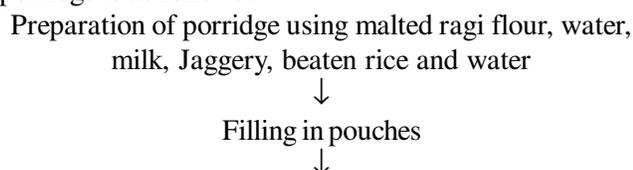
1. To formulate a consumer acceptable ragi based RTD
2. To study the organoleptic quality
3. To study the shelf life quality of the product after 6 months

### METHODOLOGY

Preliminary beverage formulations were developed using laboratory-scale trials with experimental combinations with different levels of Malted ragi flour, water, milk, Jaggery, beaten rice and water, were

evaluated. Dry ingredients were mixed to the liquid ingredients and heated to a boiling temperature of about  $80 \pm 5^{\circ}\text{C}$  for 10 min. (Jain *et al.*, 2016). Porridge was carefully filled in four layer laminated retort pouch and was processed in a steam/air mixture over a pressure retort. The filled and sealed pouches were subjected to thermal processing at  $121.1^{\circ}\text{C}$  and 17 F<sup>0</sup> value for 20 min. rapid cooling was done to  $55^{\circ}\text{C}$ . Ji-Hekim *et al.* (2016) in their study suggested that sterilization at  $121^{\circ}\text{C}$  for 17 min to be optimal for producing microbiologically safe cake (*songpyeon*) with the best quality characteristics. The processed retort pouches were stored in cool dry place for further storage studies at ambient temperature ( $35^{\circ}\pm 2^{\circ}\text{C}$ ) as defined Walstra *et al.* (2006)

The process flow chart for the preparation of porridge is as follows:



**Physical/Organoleptic analysis:**

Organoleptic analysis were done by trained taste panel using 9-point hedonic scale (Peryam and Pilgrim, 1957) where 9 is like extremely and 1 is dislike extremely. Appearance, flavor and mouthfeel decide the acceptance of the food (Srilakshmi, 2006).

**Microbiological analysis:**

Microbiological studies were carried out for the developed RTD by the following methods described in Table 1, the parameters analyzed were Total plate count, Yeast and Mold, Salmonella and *E. coli*. Kim *et al.* (2017)

Table 1 : Microbial parameters analyzed for the RTD		
Tests	Method	Reference
Total plate count	Petri film aerobic plate count method	AOAC Official method 990.12
Yeasts and molds	Serial dilution plate method	BAM 8 <sup>th</sup> Edition TH; 18: 2001
Salmonella	Inoculation method	BAM 8 <sup>th</sup> Edition TH;5:2014
<i>E. coli</i>	Most Portable Number method	BAM 8 <sup>th</sup> Edition

Table 2 : Chemical parameters analyzed of the RTD		
Tests	Method	Reference
Moisture Content	Oven	IS:1797:1985; RA 2013
Total Ash	Muffle furnace	IS:1797:1985; RA 2013
Acid Insoluble Ash	Muffle furnace	IS:1797:1985; RA2013
Alcoholic Acidity	Alkali titration	AOAC 17 <sup>th</sup> Edition
Total Fat	Soxhlet	IS:12711:1989 and AOAC 19 <sup>th</sup> Edition, 2012, 922.06
Protein	Kjeldahl	AOAC 19 <sup>th</sup> Edition 2012, 920.87, Ch 32
Total Sugar	Fehling solution	IS 12711: 1989 and AOAC 19 <sup>th</sup> Edition
Peroxide Value	Sodium thio- sulphite titration	IS:12711:1989 (RA 2009); Ch21
Carbohydrate	Calorimetric	AOAC 19 <sup>th</sup> Edition 2012, 986.25 Ch 50
Sodium	Flame photometer	IS 9497: 1980 (RA 2010).
Saturated Fat		
Monounsaturated Fat	Gas chromatography	AOAC 21 <sup>th</sup> Edtn, 2019;996.06 Ch; 41
Polyunsaturated Fat	Gas chromatography	AOAC 21 <sup>th</sup> Edtn, 2019;996.06 Ch; 41
<b>Cholesterol</b>		
Dietary Fiber	Enzymatic-Gravimetric Method	AOAC 19 <sup>th</sup> Edn.2012,991.42;Ch32
Potassium	Flame photometer	IS9497:1980(RA2010)
Energy	Calculation –in lab	Lab SOP No-FQLRc/SOP/C/409; Issue no 02/02.01.2017
Iron	Spectrophotometric	AOAC 20 <sup>th</sup> Edtn 2016,944.02

found that sterilization of *songpyeon* at 121°C for 15 min resulted in complete eradication of *Bacillus cereus* and *B. subtilis*, Total plate count, yeast, fungi, and coliform counts were below detection.

**Chemical analysis:**

Ready to Drink ragi were tested during the entire storage for its chemical parameters viz., Moisture, Acid Insoluble, Alcoholic Acidity, Total Fat, Protein Total Sugar, Peroxide Value, Carbohydrate, Sodium Saturated Fat, mono unsaturated fat, Polyunsaturated Fat, Cholesterol, dietary Fiber, Potassium and Energy (Table 2).

**RESULTS AND DISCUSSION**

The product RTD was developed using retort technology and stored for 6 months. The product was studied for their organoleptic, chemical and microbiological parameters and found that there is no significant changes during storage because retortable pouches doesn't permit further moisture and other quality changes like off- flavor and off-color. Thin profile containers like retort pouch facilitate larger surface area which helps to increase the rate of heat transfer into the food and reduce process time and maximize the retention of quality factors of the fish product (Bindu *et al.*, 2011). Studies on the physical, chemical, and microbiological qualities of fresh tilapia meat revealed its suitability for the preparation of ready to eat fish curry packed in retort pouches (Dhanapal *et al.*, 2010).

**Physical/Organoleptic analysis:**

The physical or organoleptic analysis when done was found that the Texture, flavor and colour of the retorted porridge did not change throughout the storage. Lerjun *et al.* (2018) in their study established processing schedule at 121.1<sup>0</sup> C retort temperature were 46 and 37 minutes for canned and pouched congee, changes in their physico-chemical properties and highly acceptable rating for sensory attributes were observed significantly after thermal processing. During storage, a slight increase in the fat content of fish meat was observed, with no significant change in the contents of moisture, protein, and ash (Dhanapal *et al.*, 2010) (Table 3).

The overall acceptance of the product during the initial stage of its development as compared to that control is almost the same. After a period of 6 months when the product was compared with freshly prepared control, it showed no significant variation in terms of its characteristics. The marks obtained by RTD before its storage is 8.43 on an average, while the same scored 8.2 after its storage. Even though it showed slight difference in its characteristics, its marks above 8 proved it to be a good product.

Color of the RTD upon initial life of its production obtained 8.4 while after a period of its shelf life it slightly differed to 8.1, similarly flavor and consistency too showed the same variation *i.e.* from 8.7 to 8.6 for the earlier and 8.1 to 8.10 for the later. Even though all the parameters showed variability, the product still maintained its overall quality, by scoring above 8 in all the fields. Catauro and Perchono (2012 )reported that data obtained through

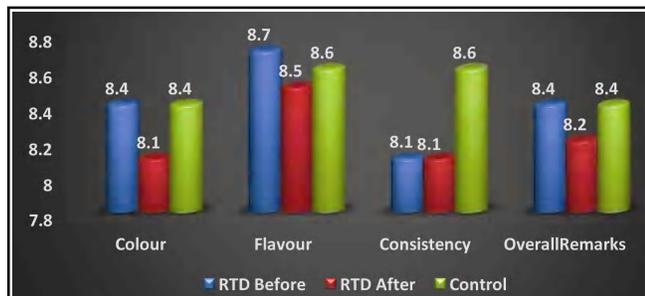
**Table 3 : Results of organoleptic quality of ready to drink**

Organoleptic Parameters	0th day	30th	60th	90th	120th	150th	180th
Texture	Pale reddish cream semi-liquid						
Flavour	Characteristic odour						
Colour	Characteristic colour	Characteristic colour	Characteristic colour	Characteristic colour	Characteristic colour	Characteristic colour	Characteristic colour

**Table 4 : Results of scores got for organoleptic parameters of ready to drink**

	Colour	Flavour	Consistency	Overall remarks
RTD before	8.4	8.7	8.1	8.4
RTD after	8.1	8.5	8.1	8.2
Control	8.4	8.6	8.6	8.4
SD	0.17	0.09	0.24	0.10

analysis of these 13 products were later used to estimate the shelf life values of all retort-processed spaceflight foods, in general, the major determinants of shelf life appear to be the development of off-flavor and off- color in products over time (Table 4 and Fig. 1).



**Fig. 1 : Organoleptic analysis of RTD**

**Microbiological parameters:**

Food spoilage can be defined as “any sensory change (tactile, visual, olfactory or flavor)” which the consumer considers to be unacceptable Rawat (2015). When microbiological parameters are analyzed the results showed Total plate count, Yeast and Mold and E.coli seems absent during the 6 month of storage (Table 5).

**Chemical parameters:**

Different chemical and nutritional parameters of the product was analyzed. Moisture, Total Ash, Acid insoluble ash, Alcoholic acidity, Total fat, Total sugar, and

peroxide value remained the same. Nalini *et al.* (2018 ) in a study of shelf stability for a period of 90 days by microbiological, physico-chemical and sensory revealed that the pepper chicken from broiler meat was biochemically and microbially safe for the entire storage period (Table 6).

Apart from chemical parameters nutritional value of ready to drink were analyzed. Energy, Total fat, Saturated fat, Mono-unsaturated fat, Polyunsaturated fat, Trans fat, Cholesterol, Sodium, Protein, Total Carbohydrate, Dietary Fiber, Sugar, Potassium and Iron were analyzed, the results are as given in Table 7.

**Summary and conclusion:**

Ragi based RTD prepared evaluated for its organoleptic, physical, chemical and microbiological quality on initial and after six months of shelf life. Results showed that retorted ragi ready to drink product remained good in organoleptic, physical, chemical and microbiological qualities after six months of shelf life. A combination of good packaging materials with better barrier properties and retorting can improve the keeping quality of the product considerably. Apart from easy for consumption, this food product is sufficiently good in nutrition and result in healthy life for the consumers. With all these properties the product got accepted and further awareness and popularization of the Ragi based RTD in the market is required. Popularization of this product can definitely bring good commercialization to the product.

	0 <sup>th</sup> day	30 <sup>th</sup> day	60 <sup>th</sup> day	90 <sup>th</sup> day	120 <sup>th</sup> day	150 <sup>th</sup> day	180 <sup>th</sup> day
Microbiological parameters							
Total Plate Count	<10	<10	<10	<10	<10	<10	<10
	cfu/ml	cfu/ml	cfu/ml	cfu/ml	cfu/ml	cfu/ml	cfu/ml
Yeast and Mould	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Salmonella	Absent	Absent	Absent	Absent	Absent	Absent	Absent
<i>E. coli</i>	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Chemical Parameters	0 <sup>th</sup> day	30 <sup>th</sup> day	60 <sup>th</sup> day	90 <sup>th</sup> day	120 <sup>th</sup> day	150 <sup>th</sup> day	180 <sup>th</sup> day	SD
Moisture %	75.74	75	75.24	75.25	75.5	75.3	75.35	24.9
Total Ash %	0.76	0.75	0.75	0.75	0.76	0.76	0.76	0.2
Acid insoluble ash %	0.05	0.054	0.05	0.05	0.05	0.053	0.054	0.02
Alcoholic acidity %	0.315	0.31	0.313	0.314	0.315	0.31	0.31	0.1
Total Fat(g)	1.32	1.31	1.3	1.32	1.3	1.3	1.3	0.4
Total Sugars %	3.8	3.78	3.81	3.8	3.83	3.8	3.8	1.2
Peroxide Value (Meq/kg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0

**Table 7 : Results of nutritional parameters of ready to drink**

Nutritional parameters	Values	%
Saturated Fat(g)	0.3	2
Monounsaturated Fat (g)	0.2	0
polyunsaturated Fat (g)	0.5	0
Cholesterol(g)	0.004	0
Energy (Kcal)	375	
Trans Fat(g)	0	0
Sodium (mg)	15.32	1
Protein (g)	9.3	
Total carbohydrate (g)	8.5	3
Dietary Fiber (g)	0	0
Sugar (g)	3.8	
Potassium (mg)	87	2
Iron(mg)	1	
Total Fat (g)	1.32	2

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