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## DEVELOPMENT AND SHELF LIFE STUDY OF FROZEN READY-TO-EAT MILLETS *BISIBELEBATH*

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### **Abstract:**

*Bisibelebath, is a spicy rice-based meal with its origin in the state of Karnataka, traditionally made of rice, lentils, spices and vegetables. Today's woman finds it difficult to cook many of our traditional recipes due to lack of time and requirement of elaborative preparations. To meet the requirements of modern consumers, an attempt was made to develop Frozen RTE millets bisibelebath and its physicochemical, nutritional and sensory attributes were evaluated during the entire storage period of 50 days. The idea for developing this product was to enlighten people about millet consumption, nutritional composition and its health benefits. For better shelf life and flavour enhancement, tamarind was replaced with tartaric acid along with other preservatives. HDPE retort pouches were used for packaging. The product was kept in a deep freezer at -5 to -15 °C. The sensory scores and quality parameters were within the acceptable range for 40 days. On the 50<sup>th</sup> day, slight reduction was observed in sensory scores. The most affected sensory parameters were taste and texture which changed significantly. Moisture and salt content was decreased significantly while acid content was increased. No deterioration seen in terms of peroxide value. Microbiological profile of frozen RTE millets bisibelebath indicated that there were no significant growth of bacteria, yeast and moulds throughout the storage period of 50 days under freezing temperature. The frozen RTE millets bisibelebath found to contain significant amount of crude fibre(27.6%), total ash(3.12%), fat(30.58%), calcium(25mg%), iron(1.08mg%), zinc(0.71mg%) and magnesium(31.08mg%). Hence, the frozen RTE millets bisibelebath stored in HDPE retort pouches showed better retention of sensory and physicochemical parameter upto 40 days.*

**Keywords:** *Ready to eat, frozen foods, millets.*

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### **Introduction:**

India is one of the world's fastest growing economies, and all of its industries are doing quite well. India's

processed food industry is on the verge of a ready-to-eat revolution. The RTE offers both vegetarian and non-vegetarian alternatives for frozen, branded, and

packaged heat-and-eat ready meals. The market for convenience foods has expanded quickly in recent years. Because they require a minimum amount of time and effort for preparation, ready-to-eat (RTE) products are becoming more and more popular with consumers. Nowadays, people are starting to bring food home, but it is Ready-made Frozen Food (RMFF) from markets or big-box stores. Foods of high quality can be preserved quite effectively through freezing. More types of food are frozen now than ever before since freezing better retains food's flavour, texture, and nutritional content than any other method. The regulation of the freezing process, as well as proper pre-freezing preparation and post-freezing handling of the product, are essential for maintaining the quality and nutritional value of frozen meals. High-quality raw materials are required to produce frozen foods of a high calibre, and each step of the production, distribution, and storage processes must be closely monitored. Careful selection of a product-specific packaging strategy may preserve the quality of frozen food products. Consumer acceptance of the product is also influenced by packaging.

Millet is a group of highly variable small seeded grasses widely grown in India, as cereal crops or grains for human food and fodder. Despite its

superior nutritional quality it has received less attention compared to the major cereals. Millets also offer several health benefits to consumers. Millet consumption can also lower glycemic response, which can be helpful for the treatment of type II diabetes (Choi et al. 2005). Inclusion of millet in the human diet can also lower the risk of duodenal ulcers, anemia and constipation (Jayaraj et al. 1980; Nambiar et al. 2011). Millets are also rich in phenolic acid and has high anti-oxidant activity (Chandrashekhar and Shahidi 2010). They are valuable sources of some essential minerals such as potassium, magnesium, calcium, iron and zinc (Ravindran 1991). The concept of processing and product development of regional and traditional millets will benefit the non-consumers of millets with their specific nutrients in the form ready-to-eat (RTE) products. These RTE foods from millets will not only help the producers in improving their socio-economic status but also helps in improving the health of the consumers to fight against life style disorders such as diabetes mellitus, obesity and cardiovascular diseases. Therefore, attempts have been made by many researchers utilizing and converting millets into diversified forms of novel products such convenient mixes which are readily available for the consumers. Popular breakfast food items such as *Idli* and *Dosa*

were developed by substituting different types of millet flours such as finger millet, kodo millet, foxtail millet, proso millet and little millet with rice and black gram dhal (Srinivasan et al, 2013) and were highly acceptable and popular among urban mass. In this line, *Bisibelebath* popular breakfast item normally prepared with rice and red gram dhal along with addition of spices has occupied top place in the minds of consumers as a mouth watering breakfast item. Looking into the acceptability of *Bisibelebath* by the consumers and its superior nutritional quality, the frozen RTE millets based *Bisibelebath* mix using millet and pulse combinations was planned with an objective of developing RTE *bisibelebath* and study its physicochemical, nutritional and storage quality.

#### **Methodology:**

#### **Materials:**

The present study i.e. preparation of frozen ready-to-cook milled based *bisibelebath* was carried out in SNTD College of Home Science, Pune. The raw materials were procured from local market in Pune. After procuring the items were further processed in the laboratory. Preservative was only added to *Bisibelebath* to improve its storage stability. Packaging materials (HDPE retort pouch) were procured from wholesalers in Pune.

*Tanvi Chavan & Amar M. Dhere*

#### **Method:**

#### **Procedure of *Bisibelebath Masala*:**

1. Roast the coriander seeds, mustard seeds, cumin seeds and black pepper separately.
2. Stir fry other ingredients in oil, separately
3. Grind all the ingredients.
4. Mix with turmeric, asafoetida and salt

#### **Procedure of *Bisibelebath* :**

1. Soak rice and millets ingredients in water and then pressure cook for 10-12 mins
2. Soak all the lentils in warm water and the pressure cook for 15 mins.
3. Mix prepared *masala* in little water and form a mixture and add jaggery, tartaric acid and salt as per taste
4. Mash the cooked *dal* properly. Pour the cooked *dal* and *bisibelebath* masala in vessel. Mix properly. Cool the mixture.
5. Add sorbic acid solution (dissolve sorbic acid in water) and mix properly.
6. In rice millet composition, after cooling add benzoic acid solution (dissolve benzoic acid in water) and mix properly without breaking the rice.
7. Then mix rice-millet and *dal* mixture evenly

**Procedure of Tempering:**

1. Heat 1 to 2 tablespoons *ghee* or oil in a small pan
2. Add cashews and fry them until light golden. Then add mustard and red chilli.
3. When the mustard splutters, add curry leaves. When the leaves turn crisp, add *hing*.
4. Pour the seasoning over the *bisibelebath*
5. For packaging use a sterilised retort pouch and store it in deep freezer from desirable period.

**Development of frozen RTE millets *bisibelebath*:**

The trials for the product were conducted in the Food Laboratory of SNTD College of Home Science, Pune. After preparing each treatment sample, product was subjected for sensory evaluation. Screening of most acceptable treatment was carried out by subjecting each treatment sample to the 30 trained and semi-trained panel members. The sensory properties such as appearance, colour, consistency, flavour, taste and overall acceptability of finished product were evaluated on the basis of 5 point hedonic scale. The 10 formulations were prepared and evaluated for overall acceptability of ready-to-eat *bisibelebath* and 2 formulations of *bisielebath masala*.

**Table 1: Trials for *bisibelebath Masala***

Ingredients	Trial 1	Trial 2
Coriander seeds	7.5 gm	15 gm
Cumin seeds	2.5 gm	5 gm
Mustard seeds	1.25 gm	2.5 gm
Black gram dal	2.5 gm	5 gm
Bengal gram dal	2.5 gm	5 gm
Green gram dal	2.5 gm	5 gm
Black pepper	2.5 gm	5 gm
Fenugreek seeds	1.25 gm	2.5 gm
Red chillies (in numbers)	12	23
Cinnamon	1 inch bark	2.5 inch bark
Curry leaves	10 gm	20 gm
Pigeon pea	2.5 gm	5 gm
Rice	2.5 gm	5 gm
Salt	as per taste	as per taste
Sunflower seed oil	15 ml( for shallow frying)	25 ml( for shallow frying)
Asafoetida	1.25 gm	2.5 gm
Turmeric powder	1.25 gm	1.75 gm

**Table 2: Trials for millets *Bisibelebath***

Trials	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Rice	50	50	50	50	50	50	50	50	50	50
Foxtail Millet	5	5	5	5	5	5	2.5	2.5	5	5
Barnyard Millet	5	5	5	5	5	5	2.5	2.5	5	5
Kodo Millet	5	5	5	5	5	5	2.5	2.5	5	5
Pigeon Pea	5	5	5	5	5	5	2.5	2.5	5	5
Bengal Gram Beans	5	5	5	5	5	5	2.5	2.5	5	5
Green Gram Beans	5	5	5	5	5	5	2.5	2.5	5	5
Red Lentils	5	5	5	5	5	5	2.5	2.5	5	5
Tamarind	5	5	5	5	5	5	-	-	-	-
Tartaric Acid	-	-	-	-	-	-	0.025	0.05	0.1	0.1
Jaggery	-	-	-	-	-	-	2.5	5	7	7
<i>Bisibelebath Masala</i>	23	23	23	15	15	15	7.5	7.5	15	12
Desiccated coconut	2.5	2.5	2.5	2.5	2.5	2.5	1.25	1.25	2.5	2.5
Salt	4	4	4	4	4	4	2	2	4	4
Types of rice used	<i>Indrayani</i> rice	brown rice	red rice	<i>wada kolam</i>	<i>sona masoori</i>	<i>wada kolam</i>	<i>wada kolam</i>	<i>wada kolam</i>	<i>wada kolam</i>	<i>wada kolam</i>

The above ingredients changes were made according to the responses of participants till the desired quality of the final product.

### **Bulk Preparation:**

The ingredients mentioned in the table for T10 were used and procedure flow sheet was followed for preparation of bulk. The prepared bulk was aseptically packed in 12 HDPE retort pouches and stored in deep freezer i.e. at -5 to -15°C freezing temperature for entire 50 days. The storage study was done total 50 days, with the interval of every 5 days for 30 days and then with interval of each 10 days for remaining 20 days. The product was tested for its physical, microbial and sensory properties.

**Table 3: Materials required for Bulk preparation of *bisibelebath masala***

Ingredients	Amount
Coriander seeds	15 gm
Cumin seeds	5 gm
Mustard seeds	2.5 gm
Black gram dal	5 gm
Bengal gram dal	5 gm
Green gram dal	5 gm
Black pepper	5 gm
Fenugreek seeds	2.5gm
Red chillies	23
Cinnamon	2.5 inch bark
Curry leaves	20 gm
Pigeon pea	5 gm
Rice	5 gm
Salt	as per taste
Sunflower seed oil	25 ml (for shallow frying)
Asafoetida	2.5 gm
Turmeric powder	1.75 gm

**Table 4: Materials required for Bulk preparation of *bisibelebath***

Ingredients	Amount
Rice (Variety)	500gm <i>Wada kolam</i>
Foxtail Millet	50gm
Barnyard Millet	50gm
Kodo Millet	50gm
Pigeon Pea	50gm
Bengal Gram <i>Dal</i>	50gm
Green Gram <i>Dal</i>	50gm
Red Lentils	50gm
Tartaric Acid	1.0gm
Jaggery	70gm
<i>Bisibelebath Masala</i>	150gm
Desiccated coconut	60gm
Salt	30gm
Benzoic acid	0.185gm
Sorbic acid	0.085gm

**Table 5: Materials required for tempering**

Ingredients	Amount
Oil	120ml
Cumin seeds	12gm
Mustard seeds	12gm
Asafoetida	2gm
Red chillies	12 no.
Curry leaves	12gm
Cashew	50gm
BHA	0.027gm

**Storage Study and Analysis:**

Shelf life study of Ready-to-Eat *Bisibelebath* on the basis of changes occurring in physicochemical, Microbial, Sensory attributes was carried out for period of 2 months and 20 days with an interval of 5 days for a month and then with interval of 10 days.

**Analysis of physicochemical, microbial, nutritional and sensory of Frozen RTE millets *bisibelebath***

Chemical analysis such as moisture, acidity, and salt were estimated as per the standard method (Ranganna, 2014). Microbial analysis was also conducted with 10 day intervals till end of the storage period. The sensory analysis is carried out as per the experiment sampling protocol and was presented in the respective tables for the sensory quality parameters using 5-point Hedonic Scale (30 panelists) with an interval of 5 days for a month and then with interval of 10 days (Ranganna, 2014).

Crude fat was estimated by extraction with petroleum ether (65°C) while Crude fibre and ash were estimated as per AOAC (2000). Protein was calculated as per IFCT 2017. Minerals such as magnesium, iron and zinc were estimated by Atomic Absorption Spectrophotometer as per AOAC (2000) protocol. Calcium was estimated by

gravimetric method as per AOAC (2000) protocol.

**Statistical Analysis-** Data was analysed statistically in terms of mean for sensory evaluation of frozen RTE millets *bisibelebath* and on rank basis the product quality was observed.

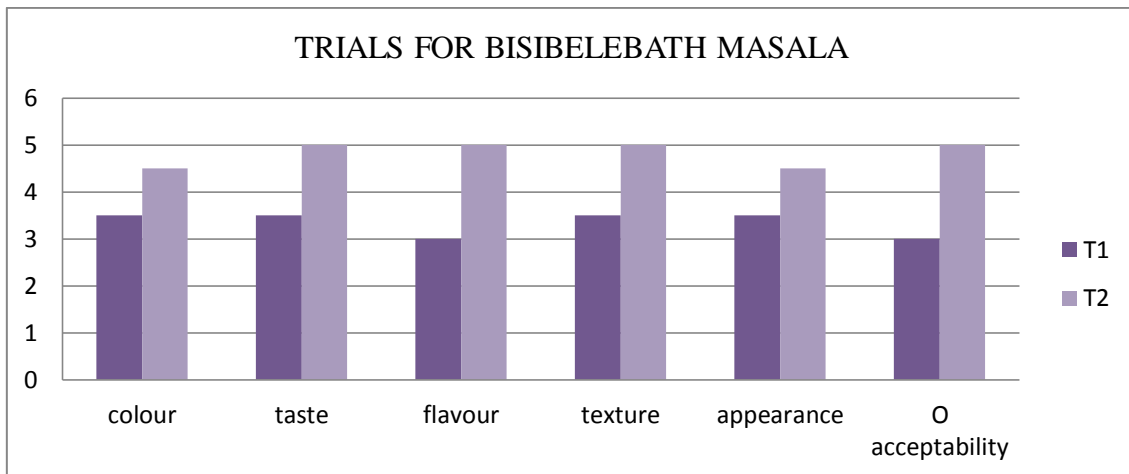
**Result and Discussion:**

12 independent trials were conducted to standardise the product ingredients and processing techniques. Two treatments for development and standardization of *Bisibelebath masala* and 10 treatments for Ready-to-Eat *Bisibelebath*. After preparation of product in every trial, the products were screened to sensory panellist and were evaluated. The sensory properties such as appearance, colour, consistency, flavour, taste and overall acceptability of finished product were evaluated on the basis of 5 point hedonic scale by 30 semi-trained sensory evaluators. In trial 10, the developed product was screened to 30 sensory panellist and was approved and accepted on basis of sensory parameters. The trial 10 was selected for the bulk preparation as it got highest points. The *bisibelebath masala* was approved in second trial, which was used for preparation of trial products and also for bulk preparation.

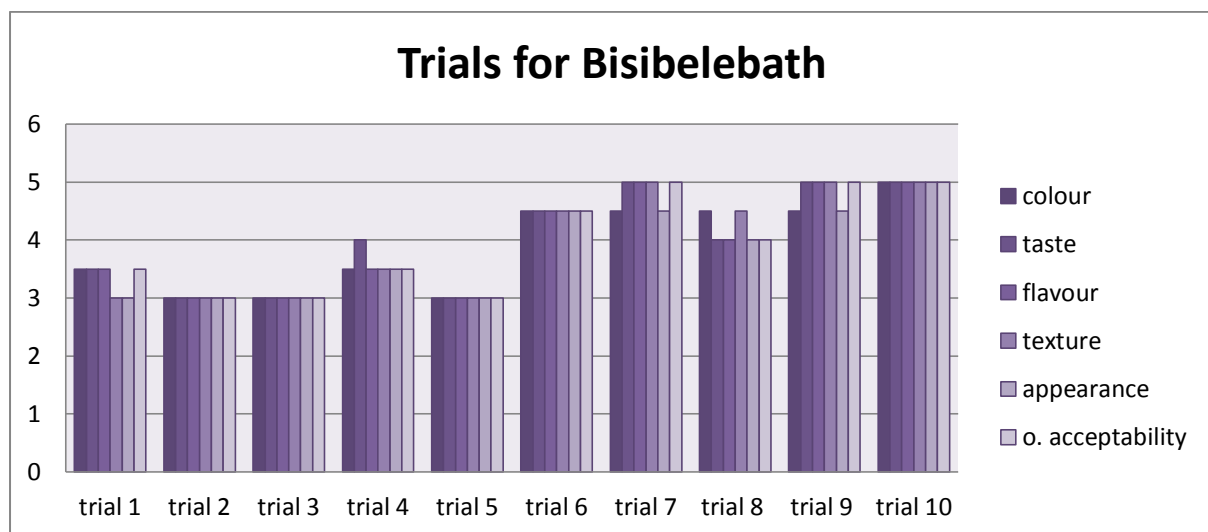
**Sensory Evaluation for Trials Conducted:**

The sensory evaluation was conducted on Frozen RTE millets based *Bisibelebath* which was made using different formulation. These samples were

given to 30 semi-trained panel members and sensory scores were recorded using 5-point hedonic rating scale. The evaluation was based on the colour, flavour, taste, texture, appearance and overall acceptability.

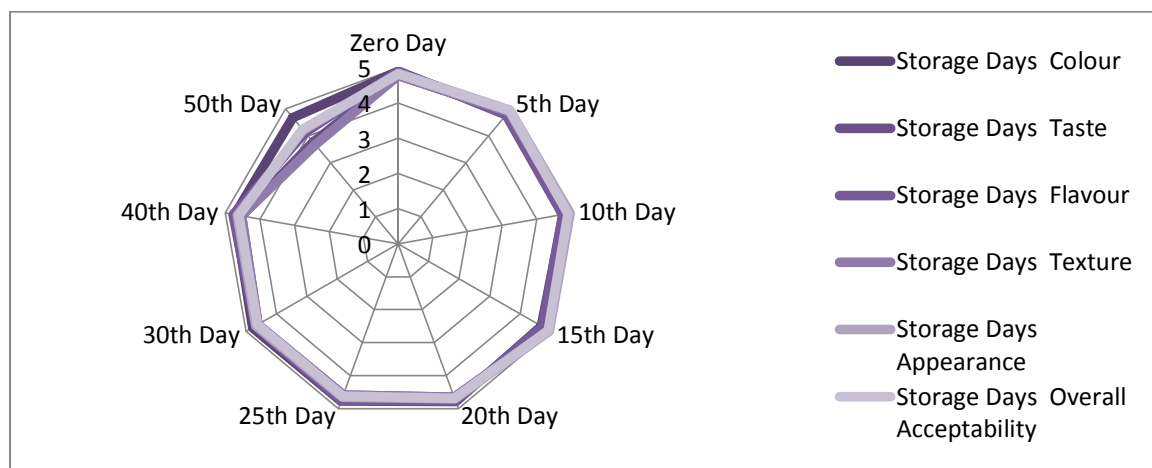


**Graph 1: Graphical representation of sensory quality evaluation data collected throughout the trials for standardising the recipe for *bisibelebath* masala**



**Graph 2: Graphical representation of sensory quality evaluation data collected throughout the trials for standardising the recipe for RTE millets *bisibelebath*.**





**Graph 3: Graphical representation of sensory quality evaluation data collected throughout the period of shelf life 50 days**

#### Proximate composition of *Bisibelebath*:

The perusal of table depicts the nutritional composition of Frozen RTE millets based *Bisibelebath*. It was noticed that product exhibit significant amount of fat and crude fibre (30.58% and 27.6%) which is due to addition of other ingredients such three types of millets, four varieties of dal, cashew, etc. The data

on nutritional composition of FRTE millets based *Bisibelebath* is significantly more when compared to data on reports of previous investigation such as Brundha AR et.al. (2022). Magnesium and calcium contents are relatively higher, iron and zinc contents are slightly lower when compared to Brundha AR et.al.(2022).

**Table 6: Proximate analysis of *bisibelebath***

Sr. No.	Parameters	Result
1	Moisture (%)	62.52%
2	Salt (%)	2.32%
3	Ash (%)	3.12%
4	Crude Fat (%)	30.58%
5	Crude Fibre (%)	27.6%
6	Protein (per 100 gm)	9.28 gm
7	Magnesium (mg/100gm)	31.80mg
8	Iron (mg/100gm)	1.08mg
9	Zinc (mg/100gm)	0.71mg
10	Calcium (mg/100gm)	25 mg

**Storage Studies-** The FRTE millets based *Bisibelebath* was packed in HDPE retort pouches and stored in deep freezer (-5 to -

15°C). Product was packed and studied for 50 days with interval of each 5 days for 30

days and then with interval of 10 days for remaining 20days.

The moisture loss was observed in the product during the storage period from 62.52% to 49.12%. It is evident that storage period and temperature affected the total moisture content of the product. As it was observed that the overall texture of the product was changed. The acidity of product was increased from 2.25% to 1.31%. However, 1.31% of acidity remained within acceptable range as product contains 1% tartaric acid. Salt content was decreased significantly during the entire 50 days storage from 2.34% to 1.32%. The product remained in good

### Sensory Analysis

condition during the storage period of 50 days in the deep freezer. As after 50 days, there was no rancidity or off flavour observed in the product, the product was suggested to be in good condition and acceptable even after 50 days.

Microbiological profile indicated that there were no bacterial, fungi and moulds observed on first day. On 40<sup>th</sup> day, the total plate count gradually increased to  $2.3 \times 10^3$  CFU/ml. On 50<sup>th</sup> day, total counts were  $3.1 \times 10^3$  CFU/ml. no growth was seen in YMC. According to the observed data, it is evident that the product was still in good condition and acceptable even after 50 days of storage period.

**Table 7: Sensory Evaluation during storage**

Storage Days	Sensory Parameters						Mean	Rank
	Colour	Taste	Flavour	Texture	Appearance	Overall Acceptability		
0 Day	4.9	4.78	4.9	4.78	4.85	4.83	4.84	I
5 <sup>th</sup> Day	4.8	4.9	4.77	4.9	4.95	4.93	4.88	I
10 <sup>th</sup> Day	4.77	4.92	4.75	4.93	4.97	4.91	4.88	I
15 <sup>th</sup> Day	4.7	4.92	4.73	4.93	4.97	4.93	4.86	I
20 <sup>th</sup> Day	4.78	4.65	4.77	4.65	4.7	4.68	4.71	I
25 <sup>th</sup> Day	4.77	4.58	4.75	4.58	4.65	4.62	4.66	I
30 <sup>th</sup> Day	4.78	4.6	4.7	4.6	4.67	4.62	4.66	I
40 <sup>th</sup> Day	4.73	4.53	4.77	4.53	4.65	4.6	4.62	I
50 <sup>th</sup> Day	4.68	3.77	4.13	3.67	4.21	4.25	4.12	II

\*Means of the means evaluated on 5-point hedonic scale by 30 semi-trained sensory panellist.

Score Key: 1= poor to 5= excellent

Rank key:

Score >4.5= I rank

Score 4.5-4.0= II rank

Score < 4.0 = III rank

The perusal of the above table depicts the changes in sensory attributes during storage of Frozen RTE millets based *Bisibelebath* for 50 days. The evaluation is based on a 5-point scale, where a higher score indicates better quality. By the 50<sup>th</sup> day of storage, product score decreased significantly to 4.12, received overall rank II. It is evident that significant reduction in sensory attributes was observed. The most affected sensory attributes were tastes and texture decreased significantly during storage period of 50 days at freezing temperature. It was observed that the product lost its consistency i.e. moisture loss was seen, spice content was increased and tanginess was reduced. The grain texture of rice and dals was change. Overall, the data suggests that the sensory quality of the product decreased with increasing storage time, particularly after 40 days.

### Conclusion

An acceptable frozen RTE millets *bisibelebath* was prepared by combining *Wada kolam* rice, foxtail, barnyard and kodo millets, Bengal gram *dal*, green gram *dal*, pigeon pea and split red lentils in

*Tanvi Chavan & Amar M. Dhere*

50:15:30 ratio, respectively with prepared *bisibelebath masala*. To come up with an innovative product and to increase shelf life of product, tamarind was replaced with tartaric acid. The developed product was packed aseptically in HDPE retort pouches and stored in deep freezer at -5 to -15°C during entire storage period of 50 days. Sensory evaluation and quality analysis were checked with interval 10 days for the period of 30 days and then after every 10 days for remaining 20 days. The sensory scores and quality parameters were within the acceptable range upto 40 days. On the 50<sup>th</sup> day, slight reduction was observed in sensory scores and moisture content of the product. Nutritionally, frozen RTE millets *bisibelebath* was found to be superior in fibre, fat and minerals content. Hence, the frozen RTE millets *Bisibelebath* stored in HDPE retort pouches showed better retention of sensory and physicochemical parameter under freezing temperature for 40 days. Further study can be performed based on frozen RTE millets *bisibelebath* with different varieties and proportion of rice, millets and other ingredients. Development of RTE *bisibelebath* using tamarind can be performed. Dried

vegetables can be added. Various processing techniques can be applied for the preparation of *bisibelebath*. Other packaging method can be used such as vacuum packaging for preserving better quality for long period of time.

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