

Synergistic marmalade for sports person to improve muscle performance and ergogenic activity

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Abstract

The aim of this study is to provide natural ergogenic food products to the sports person. Marmalade is a food product made using fruit, peel and pulp. This acts as a convenient food for a sports person before a performance on the go. The ingredients Purple grapes, Watermelon and Beetroot juices were selected due to the following reasons. Purple grapes provide high run time (ergogenic effect) with the consumption of single dose. Watermelon juice relieves muscle soreness and fatigue. Beetroot juice increases the level of phosphocreatine resynthesis, increases muscle power in trained athletes and improves the release and reuptake of the calcium at the sarcoplasmic reticulum. The Synergistic marmalade was prepared in different variations and is compared with standard Grapes marmalade and the best one (Variation D) was selected using sensory analysis by 30 semi-trained panel members. The Nutrient analysis and Physiochemical analysis were carried out. The nutrients such as Potassium and Magnesium in Standard Grapes marmalade and Selected best sample were 210.3mg/100g and 10.16mg/100g and 213.6mg /100g and 12.32mg/100g respectively. Physiochemical analysis such as TSS was 65 % for standard as well as the selected variant, Titrable acidity was 0.67% for standard and 0.39% for selected variant and pH was 3.5 for standard and 3.27 for selected variant. All these parameters were tested to check the physical and chemical attributes of the Synergistic marmalade to be compared with the standard marmalade. The best variation was stored in two different packaging material – Glass jar and a Airtight plastic container in a refrigerator for a period of 21 days. During this period shelflife study was carried out using sensory evaluation and microbial analysis on 1st, 7th, 14th and 21st day. The results showed that the product is fit for consumption until 21 days and both the packaging were good for storage. The synergistic marmalade was popularized among adult sports persons by briefing on the significance, nutritional aspects, functional properties and other health benefits with the help of a pamphlet and questionnaire and analyzing the aftermath of the session.

Keywords: Synergistic Marmalade, Ergogenic activity, Physiochemical parameters, Shelflife study, Popularization

1.Introduction

Food processing is the technique of converting a agricultural product into a one form or one form of food to another edible form. Food preservation is any technique used to keep the food away from deterioration and spoilage for a period of time and to maintain aseptic condition. Some of the techniques include drying, freezing, smoking, canning, salting, freeze-drying, sugaring and salting. Addition of sugar is a type of food preservation technique. Sugar in high concentrations acts as a food preservative under the principle osmosis. When sugar is added it increases the concentration of the food product using osmosis principle as sugar attracts the water content and the a_w will not be reduced below 0.845, which creates a bacteriostatic environment and is more than enough to inhibit the growth of mesophilic bacteria and yeast but not mold. It dehydrates the microorganism and inhibits the microorganism to multiply further.

Marmalade is any product made by using peel, juice and pulp of any fruit or vegetable by boiling it, with or without water, and also by adding artificial sweeteners. It is boiled to such a consistency where gelatinization takes place after cooling it. Marmalade is usually made using citrus fruits such as grapefruit, lemon, lime, orange, grapes etc., It is actually a mixture of jam along with bits of candied peel or rind and pulp. Usually orange marmalade is consumed as a healthy breakfast by spreading it over a toasted bread. (**Abhishek S Kasav et al, 2019**).

The ingredients selected were Purple grapes, Watermelon and Beetroot. Purple grapes have ergogenic effect in a single dosage (**Alexandre Sérgio Silva et al., 2020**). It has various phytochemical compounds such as phenolics, flavonoids, anthocyanins, stilbenes, proanthocyanidins, and vitamin E. It also has cardiometabolic benefits which aid sports persons. Watermelon aids in relieving sore muscles (**Fernando Alacid et al., 2013**) and fatigue (**Mochammad Rizal et al., 2019**) as it has l-citrulline and lycopene. They are rich in Vitamins such as A, B, C and also amino acids. This Vitamin B is responsible for boosting energy levels in the body. Watermelon rinds are also used as it has pectin content which is responsible for the formation of gel like structure which gives the marmalade proper texture and consistency. Beetroot helps to increase the phosphocreatine resynthesis, increase muscle power and at the sarcoplasmic reticulum beetroot helps to increase the reuptake and also the release of calcium (**Raul Dominguez et al., 2017**). It also as folate, fibres, carotenoids, phenols, betalains, Vitamin B complex, magnesium, sodium, zinc, potassium, phosphorus, iron, copper and manganese.

General Objective

- To prepare a marmalade for sports person using Beetroot, Watermelon and Purple grapes to improve muscle performance and ergogenic activity.

Specific Objective

- To evaluate the best proportions of the prepared marmalade.
- To analyze the nutrient content of standard grapes marmalade and the selected best variation of the synergistic marmalade.
- To perform physiochemical analysis such as Total soluble solids (TSS) and acidity of the marmalade.
- To determine the microbial analysis of the product.
- To estimate cost of the prepared product.
- To popularize the product among adult sports person.

2. Materials and Methods

2.1. Selection of ingredients and its Procurement

The ingredients selected for the preparation of marmalade are Purple grapes, Watermelon and Beetroot along with the watermelon rind and purple grapes pulp. All these ingredients required for the preparation of the marmalade were procured from the local market as it is convenient for the researcher.

2.2. Extraction of Juices

The following Figure shows the method used to extract the juice from the Purple grapes, Watermelon and Beetroot for the preparation of the Synergistic Marmalade.

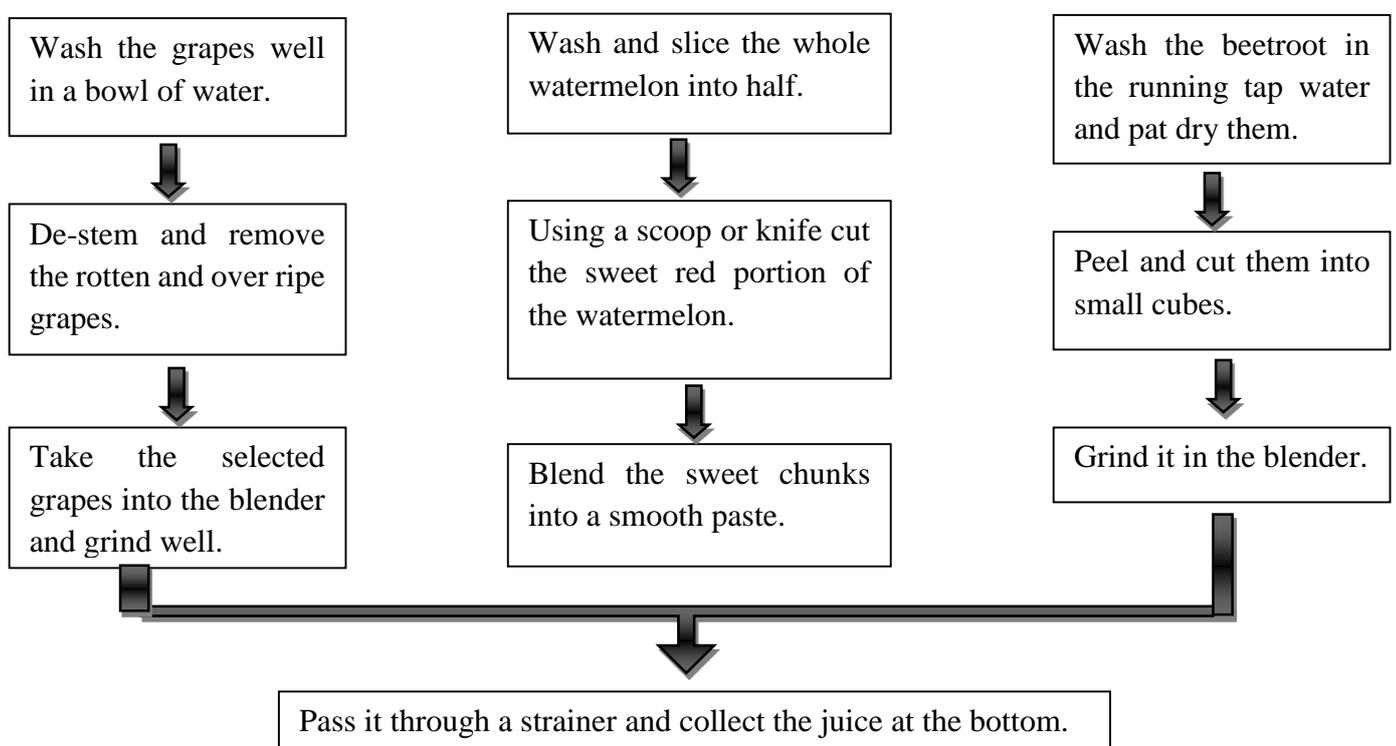


Figure I: Procedure for the extraction of juices

2.3. Processing of watermelon rind and purple grape pulp

The following figure shows the method used for the processing of watermelon rind and purple grape pulp.

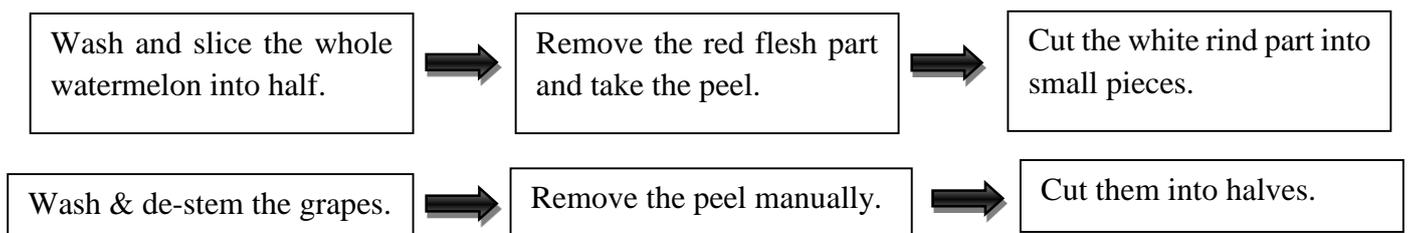


Figure II: Processing of watermelon rind and purple grape pulp

2.4. Consistency of the marmalade

To achieve a proper consistency of a marmalade the fruits added should contain pectin and it requires acid and sugar to extract the pectin which helps to form a gel like consistency. So Pectin test is performed to know the strength of the pectin the ingredient and to determine the amount of acid and sugar to be added. To check the setting point of the marmalade Plate or Spoon test is performed.

a. Pectin test

The strength of the Pectin content can be determined by two ways Alcohol test and Jelmeter test. But most commonly alcohol test is used as it is more reliable and also jelmeters are not easily available nowadays. This method is mainly performed to know the amount of sugar to be added for the formation of gel like consistency.

The procedure of Alcohol test is as follows

Take a teaspoonful of the strained juices and mix well. Take three teaspoonfuls of the methylated spirit (rubbing alcohol) and add it to the mixed juices gradually. Gently rotate it and allow it to stand for few minutes. After few minutes observe the changes. If there is a formation of a whole lump or clot, it indicates that the pectin strength is high. So equal amount of sugar should be added. If there is a formation of less firm and fragmented clot, it indicates that the pectin strength is moderate. So three fourths the amount of sugar is to be added. If there is the formation of numerous small granular clots, it indicates that the pectin strength is poor and it requires one half the amount of sugar.

b. Sheet or Spoon test

Take a cool metal spoon. Dip it into the preparing marmalade. When the spoon is lifted, if the mixture run off quickly the marmalade is not attained its consistency. When the mixture starts to boil, dip the spoon again the drop will be light and syrupy. After leaving it for few minutes the drops will become heavier, which indicates that the marmalade has got its consistency.

2.5. Preparation method of the Standard Grapes marmalade

Wash, destem and grind the grapes. Extract the juice and keep it aside. Peel the grapes and cut the pulp into small pieces. Keep a heavy bottom pan on a medium flame. Add the extracted juice, and grapes pulp in the pan. Stir continuously and add sugar gradually. When the mixture starts boiling add 2 teaspoon of lemon juice. Stir the mixture continuously. Within 20-30 minutes the mixture will start to thicken and set. Remove it from the heat, allow it to cool and store in the refrigerator.

2.6. Preparation method of the Synergistic marmalade

Wash, Peel and cut all the three fruits and vegetable. Grind them separately and keep them aside. Cut the white portion of the watermelon rind into small pieces. Peel the grapes and cut the pulp into small pieces. Keep a heavy bottom pan on a medium flame. Add all the extracted juices, watermelon rind and grapes pulp in the pan. Stir continuously and add sugar gradually. When the mixture starts boiling add 2 teaspoon of lemon juice. Stir the mixture

continuously. Within 20-30 minutes the mixture will start to thicken and set. Remove it from the heat and allow it to cool. Then store it in refrigerator and enjoy it with Breads.

2.7. Standardization and Sensory evaluation of the product

A formulation process plays a vital role in New Product Development (NPD) as it is the first step for the development of the any food product. The quality of the product such as appearance, colour, consistency, taste and flavor were analysed using the human senses. For Purple grapes, Watermelon and Beetroot were blended as Sample A 30%, 20% and 30%; Sample B 40%, 25% and 15%; Sample C 45%, 30% and 5%; Sample D 50%, 20% and 10% respectively. And for a standard product grapes marmalade has been prepared concerning the sensory evaluation as grapes has been used in higher proportions in the all the four different formulations.

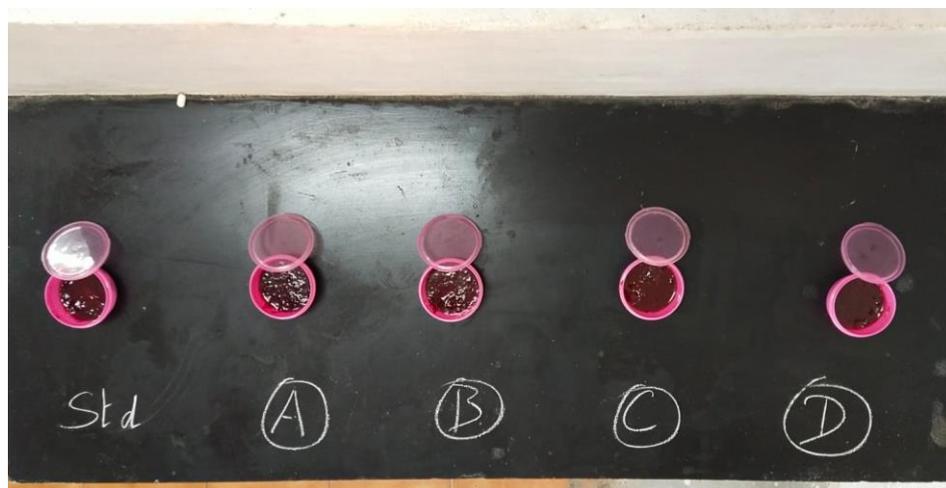


Plate 1: Standard and different level of formulation of the marmalade



Plate 2: Selected best variation

2.8. Nutritional analysis

Nutrient analysis is the process of finding the nutrients present in the food products by various laboratory methods. It helps the consumer to make healthier food choices. The standard and the selected best variant are analysed for nutrients such as Potassium and Magnesium.

2.9. Physiochemical analysis

Total Soluble Solids (TSS) is the amounts of soluble solids present in the liquid. TSS measurement is usually performed by refractometer. Total soluble solids (m/m) of the marmalade according to the FSSAI standard is minimum 65%.

Acidity (Titrable) level of the each fruit will be varying. It helps in the extraction of pectin from the fruit.

pH of the product is determined by using a pH meter. The recommended pH range of marmalade is 3.2 – 3.7, where the 3.5 stays optimum.

2.10. Packaging material

For the storage of the product the researcher used two types of packaging material, they are air tight glass jar and plastic containers. Airtight jars and containers keeps the food fresh for a longer time, prevents rancidity, avoids contamination, protects from spillage, retains original flavor and aroma and also it is easy to store.

2.11. Storage condition

Storage condition is as important as preparing and packing the product. The marmalade should be stored in a airtight container in a refrigerator away from direct sunlight. It should be stored in a dry place and away from sunlight. It can be best stored at 4° C or lower which is the refrigeration temperature.

2.12. Microbial analysis

The microbial analysis of the selected best variant was carried out for 21 days at an interval of 7 days for a period of, that is on 1st, 7th, 14th and 21st day respectively.

2.13. Cost analysis

It was done to compare the price of the standard product and the selected best variant. The cost required for the development of the product is done to check the affordability and it was calculated according to the selling price of the ingredients in the local area.

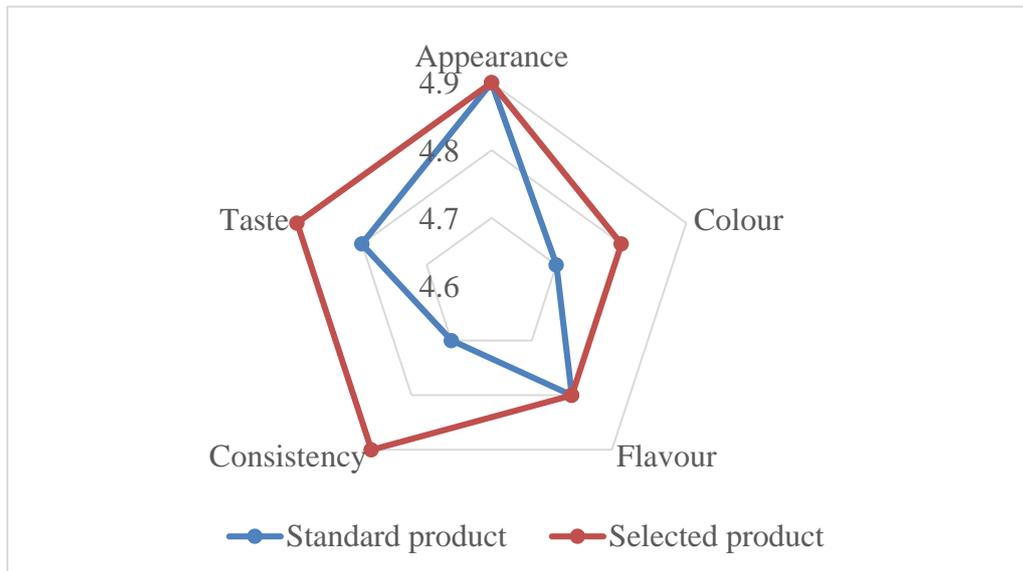
2.14. Popularization

The product, Synergistic Marmalade is popularized among 30 Adult sports persons, where the benefits of Grapes, Watermelon and Beetroot were educated along with explaining what is a marmalade and how it can be added into our food habits.

3.Result

3.1. Comparison of the Selected product with the Standard product

Figure III: Comparison of standard product with selected product using mean scores



3.2. Nutrient analysis of the Selected product

Table II: Nutrient analysis of the standard and selected best variant

S.NO	NUTRIENT	STANDARD	SAMPLE D
1	Potassium (mg)	210.3 mg	213.6 mg
2	Magnesium (mg)	10.16 mg	12.32 mg

Note: Only these two nutrients were compared in the Standard and the Best variant

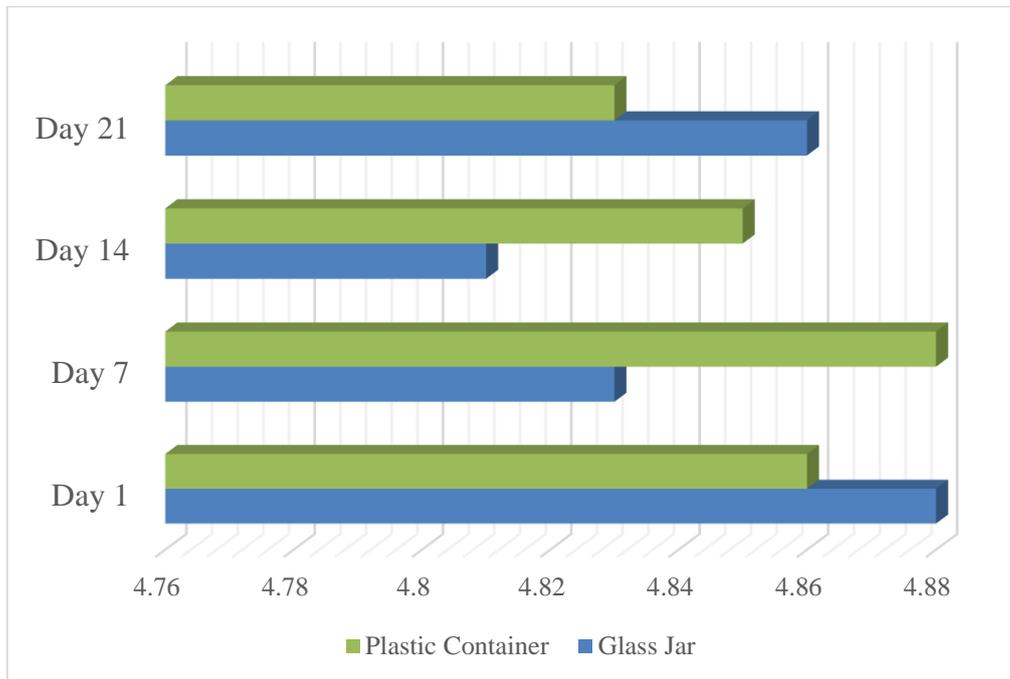
3.3. Physiochemical analysis of the Selected product

Table I: Physiochemical analysis of the best variation

Parameters	Result (Standard)	Result (Sample D)
TSS	65 %	65 %
Acidity (Titrable)	0.67%	0.39%
pH	3.5	3.27

3.4. Sensory analysis of two different packaging material

Figure IV: Sensory analysis of two different packaging material



3.5. Microbial analysis

Microbial analysis of the selected Variant D is stored in two different packaging materials are compared. For the packaging material Glass jar has < 10 cfu/g on 1st, 7th, 14th and 21st day respectively. For packaging material Plastic container has < 10 cfu/g on 1st, 7th, 14th and 21st day respectively. It is evident from the above result that the variation D can be stored in any of the two packaging as both of them has same microbial count of < 10 cfu/g. So it can be concluded that the product stays best until 21 days in both the packaging and is fit for consumption.

3.6. Cost estimation of the standard and chosen best variant

The cost of Grapes marmalade (standard) is Rs. 42.98/- per 100g and the cost of Synergistic marmalade is Rs. 33.57/- per 100g and this was compared with a standard. There is a decrease in the cost of Synergistic marmalade as the cost of purple grapes were differing.

3.7. Popularization

The popularization of the Synergistic marmalade was done among Adult sports person by explaining the nutrients present and the functional properties of Grapes, Watermelon and Beetroot and also by briefing the benefits of the prepared synergistic marmalade. Based on the questionnaire 27 members (90%) knows about sports nutrition whereas rest 3 members (10%) doesn't know about it; 19 members (63.3%) already heard the term marmalade whereas the other 11 members (36.67%) haven't heard of it; 4 members (13.33%) has heard the term ergogenic whereas the rest 26 members (86.67%) haven't heard of the term ergogenic; Only 1 member (3.33%) knows that the natural foods can improve ergogenic activity whereas the rest 29 members (96.67%) didn't know about this; All 30 members (100%) preferred to eat

something before a performance; 28 members (93.33%) liked the synergistic marmalade whereas 2 members (6.67%) didn't like it; 28 members (93.33%) were ready to consume this product before performance and were ready to recommend it to others too whereas 2 members (6.67%) were not ready for the same; 29 members (96.67%) got to know that grapes can improve ergogenic activity whereas 1 member (3.33%) didn't know it; 25 members (83.33%) preferred natural ergogenic foods whereas 5 members (16.67%) still relied on man made products; All the 30 members accepted that they gained knowledge through the session. While asking about the eating habits before the performance 9 members preferred Energy drink, 5 members preferred Protein bars, 13 members preferred Bread with spreads, 3 members preferred light meals whereas no one preferred skipping the food.

4. DISCUSSION

The comparison of the mean sensory scores obtained through sensory evaluation of Standard Grapes marmalade and Variant D and both of them has similarities in most of the aspects than the other variants. So it can be concluded that the Variant D was chosen as the best product and is further analysed. The Potassium content of Standard Purple grapes marmalade was 210.3 mg /100g and that of Synergistic marmalade was 213.6 mg /100g. The Magnesium content of the Standard Purple grapes marmalade was 10.6 mg/100g and that of Synergistic marmalade was 12.32 mg /100g. The TSS value is 65% for both standard and variant D which matches the FSSAI standard, Titrable acidity is 0.67% and 0.39% for Standard and the variant D respectively and the pH is 3.5 and 3.27 Standard and the variant D respectively which lies in between the recommended range of the marmalade. It can be concluded that both the packaging can be used for storing the synergistic marmalade as the comparison of the mean sensory value shows not much differences between them and the overall acceptability is also more or less similar.

5. Conclusion

From the above comparative study and discussion, it can be concluded that the Synergistic marmalade with 50% of Purple grapes, 20% of Watermelon and 10% of Beetroot along with 10% Watermelon rind and 10% Grapes pulp is selected as the best variant. The chosen best variant is high in Potassium and Magnesium when compared with the standard grapes marmalade. The chosen best product is acceptable till 21st day without any microbial growth if stored either in Glass jar or Airtight plastic container at refrigerator temperature. The cost analysis showed that the standard grapes marmalade has slightly higher price than the chosen best variant. In the popularization study most of the participants liked the taste of the synergistic marmalade.

Conflict of interest

There is no conflict of interest.

Acknowledgement

I express my sincere gratitude to the Panel members who helped with the Sensory evaluation.

REFERENCE

- [1]. Abhishek S Kasav, Sunaina S Lad and Saurabh T Kasabe., (2019) Development and quality evaluation of rose petals - orange marmalade, *International Journal of Chemical Studies* 7(4): 733-737.
- [2]. Alexandre Sérgio Silva, Lydiane de Lima Tavares Toscano, Ana Carla Lima de França, Bruno Rafael Virgínio de Sousa, Eder Jackson Bezerra de Almeida Filho, Matheus da Silveira Costa, Aline Telles Biasoto Marques, Darcilene Fiuza da Silva, Klécia de Farias Sena, Gilberto Santos Cerqueira and Maria da Conceição Rodrigues Gonçalves., (2020) A single dose of purple grape juice improves physical performance and antioxidant activity in runners: a randomized, crossover, double-blind, placebo study, *European Journal of Nutrition*, doi 10.1007/s00394-019-02139-6.
- [3]. Fernando Alacid, María, Martha P. Tarazona-Díaz, Carrasco Ignacio Martínez and Encarna Aguayo., (2013) Watermelon Juice: Potential Functional Drink for Sore Muscle Relief in Athletes, *J. Agric. Food Chem.* 61, 31, 7522–7528.
- [4]. Mochammad Rizal, Calista Segalita, Trias Mahmudiono., (2019) The Effect of Watermelon Beverage Ingestion on Fatigue Index in Young-Male, Recreational Football Players. *Asian Journal of Sports Medicine*, 10 (2).
- [5]. Raúl Domínguez¹, José Luis Maté-Muñoz¹, Eduardo Cuenca, Pablo García-Fernández¹, Fernando Mata-Ordoñez, María Carmen Lozano-Estevan, Pablo Veiga-Herreros, Sandro Fernandes da Silva and Manuel Vicente Garnacho-Castaño., (2018) Effects of beetroot juice supplementation on intermittent high-intensity exercise efforts, *Journal of the International Society of Sports Nutrition* 15:2.