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# Exploration of Millet & Vegetables Based High Protein Apple Jam

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**ABSTRACT:** Jam is a traditional food item, commonly used as desserts, cake toppings and bread spreads. It is an intermediate moisture food, which is prepared by using fruit pulp, sugar, acid, pectin and other ingredients hence, has a very sweet taste. The project was planned to improve the nutritive value of basic apple jam with the addition of high protein sources such as ragi, mushroom and spinach. The results of sensory evaluation revealed that the high protein apple jam at (AM2) scored the highest among all treatments for all the organoleptic parameter. The jam at (AS2) least scored all treatments for all organoleptic parameter. The spinach concentration affects the overall acceptability. The lowest pH in jam was found for control apple jam, however highest pH was recorded for the apple + mushroom jam (75:25) (AM2). Titratable acidity was found to be lowest in apple + mushroom jam c (65:35), whereas highest in apple ragi jam b (75:25) (AR2). Moisture content was found to be lowest in apple+ ragi jam a (90:10), whereas highest moisture content found in apple+ spinach jam c (65:35) (AS3). Mineral matters (ash) were found to be lowest in control apple jam, whereas highest in apple ragi jam b (75:25) (AR2). Results of the project advocates the potential of utilizing seasonal vegetables and millets to improve the nutritional quality of regular products.

**KEYWORDS:** High Protein, apple jam, mushroom, Ragi, Spinach, quality parameters, Sensory evaluation.

## I. INTRODUCTION

As per FSSAI, Jam means the product prepared from sound, ripe, fresh, dehydrated, frozen or previously packed fruits including fruit juices, fruit pulp, fruit juice concentrate or dry fruit by boiling its pieces or pulp or puree with nutritive sweeteners namely sugar, dextrose, invert sugar or liquid glucose to a suitable consistency. It may also contain fruit pieces and any other ingredients suitable to the products. It may be prepared from any of the suitable fruits, singly or in combination. It shall have the flavour of the original fruit(s) and shall be free from burnt or objectionable flavours and crystallization.

Jam is the most popular and shelf stable product made from fruits at household and commercial level. Fruit jams are good source of energy but poor source of protein. Ingredients and fruit pulps used for preparing jams are commonly poor in protein content and ultimately results in less protein level in jam. Commercially available jams are poor in protein content as reported by several workers i.e. apple jam - 0.04%, mango jam - 0.15%, jackfruit jam - 0.19%, papaya jam - 0.26%, blueberry jam - 0.31%, strawberry jam - 0.41%, grape jam - 0.27% and apricot jam - 0.43% pineapple jam - 0.46% and orange marmalade jam - 0.79%. So, these need to improve the protein content in jam to make it still a better nutritional food.

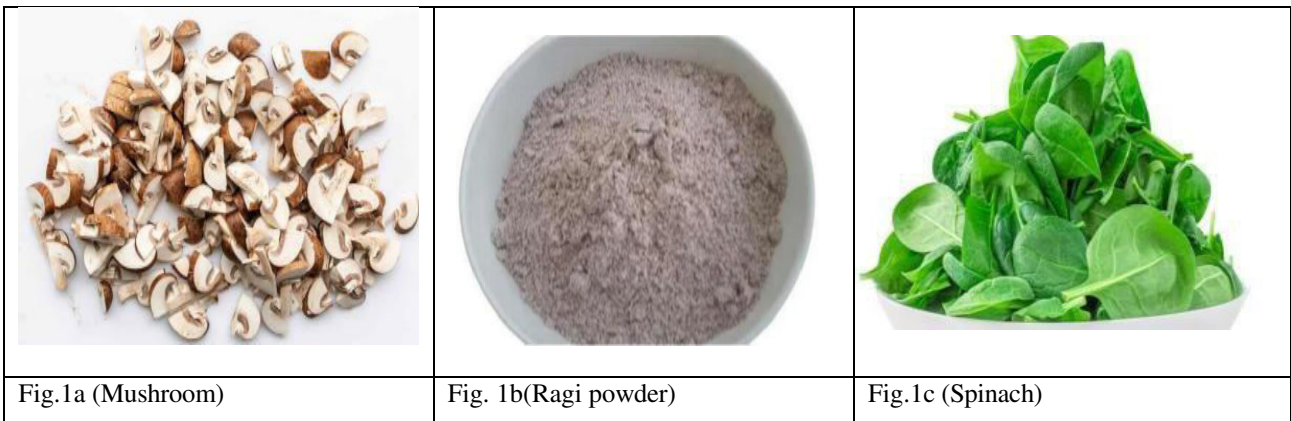
Jam is a traditional food item, commonly used as desserts, cake toppings and bread spreads. It is an intermediate moisture food, which is prepared by using fruit pulp, sugar, acid, pectin and other ingredients hence, has a very sweet taste. Mixed jams associate the characteristics of two or more kind fruits, allowing the achievement of the product with higher nutritional value and pleasant sensory properties, thereby creating the possibility of achieving a larger space in the consumer market. Various ingredients give new flavours and have enhance the storage life, which depends on high sugar content (68-72%) combined with the acidic nature of the fruit that prevent microbial spoilage. (Baker *et al.*, 2005) The quality characteristics of jam depends upon the raw materials, processing conditioned, recipe selections, preserving methods and storage conditions. (Kvikliene *et al.*, 2006). Mushroom is one of the world greatest untapped resources of

nutrition in regards to its palatability and medicinal value for future. It has been recognized effective against cancer, hypercholesterolemia conditions, asthma, stress, hypertension, insomnia, allergies, infections, and diabetes. Recently, mushroom is gaining significant importance as a vegetable meat. It is delicate, nutritious, and delicious and used as flavour enhancer in other foods. Other than protein, it is a good source of folic acid, niacin, biotin, B complex, A, C and D as well as mineral i.e., potassium, phosphorus, calcium, zinc, iron, sodium, magnesium. The fat content in mushroom normally consists of linoleic acid, containing little starches and has no cholesterol; hence considered ideal for hypertensive and diabetic patients.

**Table 1. Nutritive value of the ingredients from various sources**

Nutritional value of mushroom Per /100g (Manikandan, 2010)	Nutritional value of Ragi (Finger millet ) Per /100g	Nutritional value of Spinach (Per / 100g)
Protein- 2.5% Calories- 22kcal Carbohydrates- 4.1g Fat-0.1g Calcium-18g Potassium-448mg	Protein – 7.7g Calries – 390kcal Carbohydrates – 71.4g Vitamin B9 – 26.3mg Calcium – 350mg Potassium – 407mg	Protein – 3g Calries – 23kcal Carbohydrates – 4g Calcium – 99mg Potassium – 558mg

Finger millet (ragi) is considerably rich in micronutrients such as vitamins and minerals in comparison to world’s other major cereals, wheat, and rice. Especially, finger millet is the richest source of calcium and have 10 times more than wheat, maize, and rice and three times greater than milk. The data gives the value of macronutrient content of finger millet, it contains 71.4% carbohydrates, 1.3% fat, 7.7% protein, 19.1% dietary Fiber, 3.6% crude fibre and 3% minerals. (Thompson 1993); (Chethan and malleshi 2007a)



**Figure 1. High Protein Sources used for the preparation of Jam**

Spinach (*Spinacia oleracea*) in an annual herb belongs to the family Chenopodiaceae. It is native to South-west Asia and widely distributed and cultivated through the world including Iran as vegetables for its high nutritious value. Spinach is a good source of minerals (iron, copper, phosphorous, zinc, selenium), vitamin B complex (niacin and folic acid), ascorbic acid, carotenoids (β-carotene, lutein, zeaxanthin), phenols (flavonoids, p-coumaric acid), apocynin and Omega-3-fatty acids. (Ekor, 2003; Jadhav *et al*, 2015; nikdehghan *et al*, 2013).

**OBJECTIVES OF THE STUDY:**

1. To develop apple jam supplemented with high protein sources Ragi (finger millet), Mushroom and Spinach.
2. To do sensory & nutritional evaluation of prepared high protein apple jam.



**II. MATERIAL & METHODS**

In this we will see about procurement of Ingredients which have used in this project completion. Jam is one of most effective means of preservation of fruits and vegetables. It is less time to consuming than other means of preservation such as drying and freezing. The result obtained are much more satisfying when jam is prepared properly, Mushroom, the fruiting body of macro fungi is a short reproductive stage in their life cycle. Out of the 1.5 million fungi estimated in the world, approximately 14,000 species produce fruiting bodies that are large enough to be judged as mushrooms (Chang and Miles 1992). Mushrooms are important natural resources of biologically active compounds which have profound medicinal attributes to human body. In this project, all ingredient used were fresh and procured from local *sabji-mandi* and *kirana* shops of nearest market.

Following were the ingredients which have been used in the completion of this project.

Ingredients

- Apple – Local market
- Mushroom- Local veg. market
- Spinach - Local veg. market
- Finger millet - Local market
- Sugar – Kirana store

**Standardization of apple jam preparation**

Jam is prepared by boiling the fruit pulp with enough sugar to a thick consistency, firm enough to hold fruit tissues in position. Jam contained 0.5-0.6% citric acid, sugar was not more than 40% and pulp are 45%. The detailed amounts of each ingredient is given in table 2.

**Table 2. List of Formulations for standardization of jam recipes**

S. No.	Apple (g)	Ragi (g)	Spinach (g)	Mushroom (g)	Sugar (g)	Pectin (g)	Citric acid (g)
1.control (Apple Jam)	200	0	0	0	110	1	1
2. apple+ ragi (AR <sub>1</sub> )	180	20	0	0	110	1	1
3.apple+ragi (AR <sub>2</sub> )	150	50	0	0	110	1	1
4.apple+ragi (AR <sub>3</sub> )	130	70	0	0	110	1	1
5apple+mush. (AM <sub>1</sub> )	180	0	0	20	110	1	1
6apple+mush (AM <sub>2</sub> )	150	0	0	50	110	1	1
7apple+mush (AM <sub>3</sub> )	130	0	0	70	110	1	1
8apple+spinach (AS <sub>1</sub> )	180	0	20	0	110	1	1
9apple+spinach (AS <sub>2</sub> )	150	0	50	0	110	1	1
10apple+spinach (AS <sub>3</sub> )	130	0	70	0	110	1	1



Figure 2. Different jam samples for sensory evaluation

All the preparations were evaluated sensorically by total of 10 semi trained panels for various scores

**Quality evaluation of jam**

Different parameters were performed to check the quality of the product so that whether the nutritional quality of apple jam has improved with the addition of other sources.

Different Test which were conducted included

pH test (Potential of Hydrogen)

The pH of the products was measured using food grade pH meter. The solution for reading pH was prepared in a ratio of 1:10.



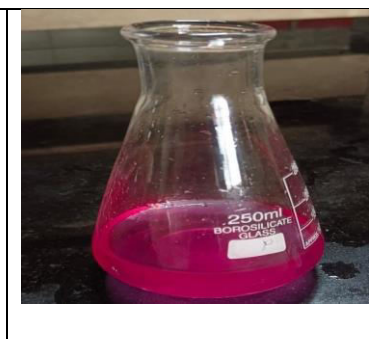
It is done to check the nature of the product, acidic or basic.

Process:

Take the 10ml sample in the beaker and dilute it with the distilled water.

Now start the analyzer & now place the sample in the analyzer and put glass electrode in it will.

After few seconds it will tell us the calculated pH.

		
<p>pH meter</p>	<p>Refractometer with sample</p>	<p>Titrateable acidity</p>

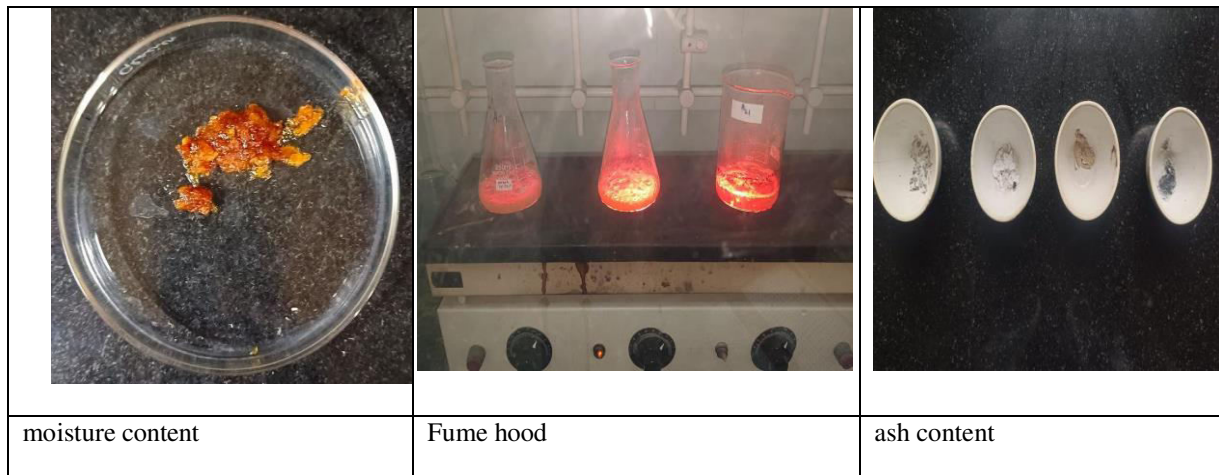


Figure 3. Instruments used procedures followed during the project

TSS (Total Soluble Solid)

This test is done to calculate the total soluble solid in the jam. It is done by the help of the refractometer.

Process;

Calibrate the refractometer with the help of the water.

Now take the sample on the screen and close the screen

Take it in the light and the reading will be shown in the screen.

Titrate acidity determination is centred on the amount of base (not strength) required to neutralize the acid in the sample.

Process:

Make the solution of NaOH with the help of distilled water (0.1N) Soln.

Now take the sample in the conical flask and add 2-3 drops of indicator.

Now put the NaOH soln. in the burette.

Now titrate it with NaOH till the color changes. When color is changed stop it

Calculation:

$$\text{Acidity\%} = \text{Vol of NaOH (Used)} * \text{Normality of NaOH} * 0.067 * 100 / \text{Weight of sample.}$$

Ash content:

The principle of ashing is to burn the organic matter and determine the inorganic matter remained. Which will be converted to the ash when kept in the muffle furnace at 550°C for 2.5 hours.

Procedure:

Take the crucible and weight them empty, note it down (A)

Now add 10ml sample in the crucible. (a)

Now on the muffle furnace it will take time to reach at 550°C. when temp. is reached put the sample in it and now start the time.

After completion of 2.5hours take out the sample and keep it in the desiccator for 10 mins.

Now weight the crucible (B).

Calculation

$$\text{Ash \%} = \text{B} - \text{A} * 100 / \text{total weight of crucible + sample.}$$

Moisture Content:

This process is done to check the dry matter or the moisture content in the jam. It is done by many methods we have done it with the hot air oven.

It determined accurately by measuring the number or mass of water molecules present in known mass of sample.

Procedure:

Take the petri dish and keep it in the hot air oven so that extra moisture can be removed.



Now take out the petri plate and weigh it notes down.  
 Now add 5ml sample to it. Now keep it in the hot air oven at 120°C for 2.3 hours.  
 Now weight it and note it down.  
 Now keep it in the desiccator. Calculation:  
 Dry Matter % = Final Wt. – Initial Wt.(plate) \* 100 / sample weight  
 M.C % = 100 – Dry matter.

Crude fiber:

The crude fiber represents the component which is resistant to acid and alkali hydrolyses and therefore it is most commonly determined by sequential hydrolysis by acid and alkali.

Procedure:

Weight 1-2 of fat free dried sample in a 1 liter tall beaker.  
 Add 200ml 1.25% hot H<sub>2</sub>SO<sub>4</sub> and few drops of antifoam.  
 Heat to boiling with in 1 minute in the crude fiber apparatus.  
 Keep the solution boiling exactly 30 minutes under bulb condensers. Beaker may be rotate continuously.  
 Filter the contents of beaker through Buchner funnel. And wash the sample with 200ml 1.25% sodium hydroxide.  
 Again, bring to the boiling point and boil for exactly 30minutes.  
 Transfer all inorganic matter in dried crucible .  
 Wash twice with alcohol.  
 Dry at 100°C to constant weight.  
 Ash in muffle furnace at 550°C for 1 hour.  
 Cool the crucible in a desiccator and reweigh.

Calculation:

Crude fiber =  $W_2 - W_3 * 100 / w_1$   
 W<sub>1</sub>= weight of sample  
 W<sub>2</sub>= weight of insoluble matters  
 W<sub>3</sub>= weight of ash

**III. RESULTS AND DISCUSSIONS**

Production of jam necessitates availability of raw materials and availability of other ingredients such as pectin, citric acid, sugar, and jam jar at reasonable prices. Mushroom, the fruiting body of macro fungi is a short reproductive stage in their life cycle. Out of the 1.5 million fungi estimated in the world, approximately 14,000 species produce fruiting bodies that are large enough to be judged as mushrooms (Chang and Miles 1992). Mushrooms are important natural resources of biologically active compounds which have profound medicinal attributes to human body.

Prepared apple jam was served to the judges on the same day and evaluate for the quality and acceptability on 9-Hedonic Scale by semi-trained panel of academic staff members of the faculty and research scholars with 9 for sampled, like extremely to 1, dislike extremely. Apple jam samples were evaluated for sensory parameters like color & appearance, texture, taste, aroma, and overall acceptability. The average scores recoded and presented in table 2.

**Table 3. Sensory evaluation of prepared apple jam (9- Point Hedonic Scale)**

S. No	Color & Appearance	Texture	Taste	Aroma	Overall acceptability
Control apple jam	8	8	8	8	8
AR <sub>1</sub>	8	8	9	9	8
AR <sub>2</sub>	8	8	9	9	8
AR <sub>3</sub>	8	8	9	9	8
AM <sub>1</sub>	9	9	9	9	9
AM <sub>2</sub>	9	9	9	9	9
AM <sub>3</sub>	9	9	9	9	9
AS <sub>1</sub>	7	8	8	8	8

AS <sub>2</sub>	7	8	7	7	7
AS <sub>3</sub>	7	7	8	8	8

The results of sensory evaluation in Table 2 revealed that the concentration of exploration of millet & vegetables based high protein apple jam at (AM2) highest scored among all treatments for all the organoleptic parameter. The jam at (AS2) least scored all treatments for all organoleptic parameter. There was less variation in the score given by the judges for appearance. AM1, AM2, AM3 samples received highest scored of 9 for color followed by treatment (AS1, AS2, AS3) samples with scores 7. The spinach concentration affects the color of apple jam. The result of taste scored represented variation in the scores given by judges for taste. The jam (AR, AM) samples received highest scored of 9 for taste followed by treatment (AS2) sample with score 7. The spinach concentration affects the taste of apple jam. The results, variation in overall acceptability score. The treatment (AM) samples” like extremely”. The lower score was observed in treatment (AS2) sample “like moderately”. The spinach concentration affects the overall acceptability.

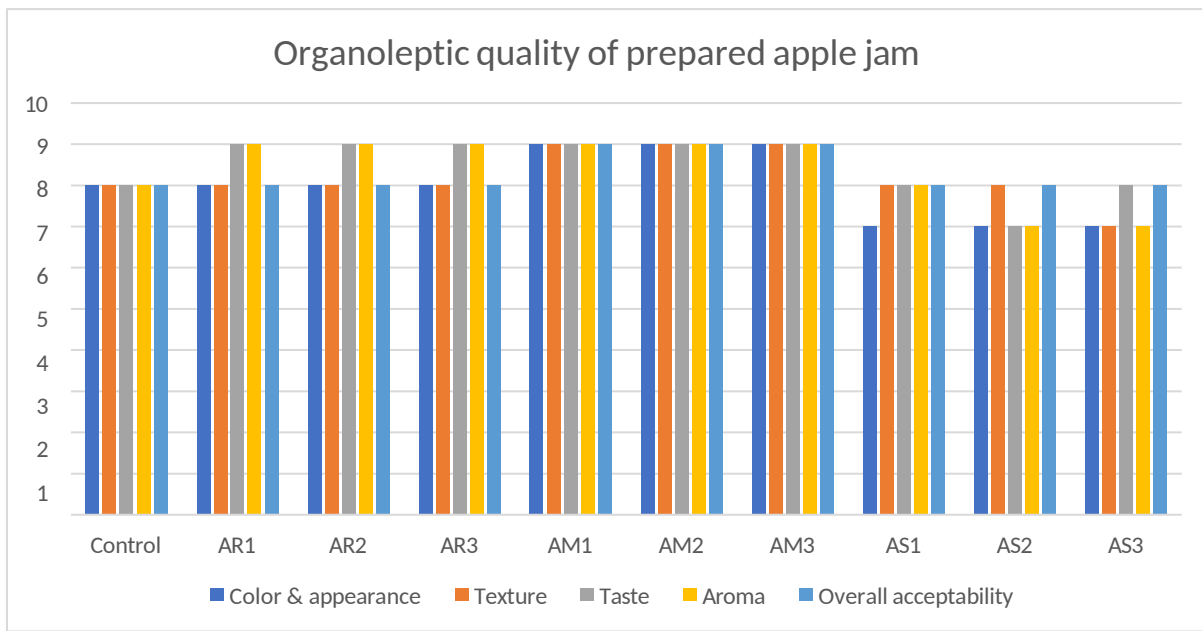


Figure4. Organoleptic evaluation of different apple jam preparations

Out of all the samples, jam prepared from mushroom in all proportions were best acceptable for all characters on Hedonic Scale for sensory characteristics. The lowest pH in jam was found for control apple jam, however highest pH was recorded for the apple + mushroom jam (75:25) (AM2). Titratable acidity was found to be lowest in apple + mushroom jam c (65:35), whereas highest in apple ragi jam b (75:25) (AR2). Moisture content was found to be lowest in apple+ ragi jam a (90:10), whereas highest moisture content found in apple+ spinach jam c (65:35) (AS3). Mineral matters (ash) were found to be lowest in control apple jam, whereas highest in apple ragi jam b (75:25) (AR2). The results of sensory evaluation in Table 2 revealed that the concentration of exploration of millet & vegetables based high protein apple jam at (AM2) highest scored among all treatments for all the organoleptic parameter.



Table 4. Quality evaluation of prepared jam

S. No.	TSS °Bx	pH	Titrateable acidity (%)	Moisture (%)	Ash (%)	Protein (g)
1.control (Apple Jam)	68	3.3	1.41	22.15	2.8	0.3
2. apple+ ragi (AR <sub>1</sub> )	68	3.5	1.6	14.74	18.72	5
3.apple+ragi (AR <sub>2</sub> )	68	3.4	1.47	20.31	21.6	6.5
4.apple+ragi (AR <sub>3</sub> )	68	3.6	1.42	22.26	20.9	7.2
5apple+mush. (AM <sub>1</sub> )	67	3.4	1.14	22.7	21.4	2.9
6apple+mush (AM <sub>2</sub> )	67	3.5	1.27	22.57	20.93	3
7apple+mush (AM <sub>3</sub> )	68	3.5	1.07	25.5	20.8	3.4
8apple+spinach (AS <sub>1</sub> )	68	3.4	1.34	19.7	11.21	2.8
9apple+spinach (AS <sub>2</sub> )	68	3.5	1.48	20.34	13.5	3
10apple+spinach (AS <sub>3</sub> )	68	3.4	1.27	26.4	17.45	3.5

The jam at (AS<sub>2</sub>) least scored all treatments for all organoleptic parameter. There was less variation in the score given by the judges for appearance.(AM<sub>1</sub>, AM<sub>2</sub>, AM<sub>3</sub>) samples received highest scored of 9 for color followed by treatment (AS<sub>1</sub>, AS<sub>2</sub>, AS<sub>3</sub>) samples with scores 7. The spinach concentration affects the color of apple jam. The result of taste scored represented variation in the scores given by judges for taste. The jam (AR, AM) samples received highest scored of 9 for taste followed by treatment (AS<sub>2</sub>) sample with score 7. The spinach concentration affects the taste of apple jam. The results, variation in overall acceptability score. The treatment (AM) samples” like extremely”. The lower score was observed in treatment (AS<sub>2</sub>) sample “like moderately”. The spinach concentration affects the overall acceptability.

#### IV. CONCLUSION

Results of the project explores the potential of utilizing seasonal vegetables and millets to improve the nutritional quality of regular products. The study also gives idea of utilizing seasonal vegetables for nutritional security and improved nutritional quality of regular products like apple jam.

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