DEVELOPMENT OF VEGAN PRODUCTS FROM EDIBLE OIL

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ABSTRACT

This research addressed the potential of rice bran oil as a major ingredient in developing vegan mayonnaise, cheese, and ice cream substitutes, motivated by the growing demand for plant-based alternatives. This study intended to promote sustainable and cruelty-free food choices while filling a void in the market for high- end vegan products. The research methodology used several strategies in order to maximize the flavor, texture, and nutritional content of the vegan food, unique recipes and processing methods are developed. The created formulations go through a thorough evaluation process that includes texture profiling, proximate analysis, physiochemical characterization, sensory evaluation by trained panelists, and statistical analysis using ANOVA to identify significant differences. The anticipated outcomes indicate that the formulations created in Trial 2 will have better qualities than those from previous trials, especially when it comes to the nutritional profile, sensory features, and texture characteristics. In comparison to their traditional substitutes, the nutritional profile is anticipated to exhibit a reduced level of saturated fat and a higher amount of vital elements. It is anticipated that sensory qualities would more closely resemble the mouth feel, taste, and scent of traditional products. Lastly, sensory attributes like smoothness in ice cream, texture in cheese, and taste in mayonnaise should be ideal for each particular food. The findings demonstrated how rice bran oil can be utilized to create vegan alternatives with distinct functional and sensory properties. In addition to highlighting the importance of sustainable food development, the study suggested future research avenues for enhancing nutritional content, flavor, and texture while lessening environmental impact. This effort supports the global shift towards sustainable dietary choices by advancing the invention of plant-based food innovation.

Keyword : *Rice bran oil, vegan mayonnaise, vegan cheese, vegan ice-cream, nutritional content*

1. INTRODUCTION

There has been a notable shift in consumer tastes toward plant-based and sustainable options in the modern global scene. This shift in thinking is a reflection of a heightened consciousness of the moral and environmental costs of traditional animal-based products. The food industry has responded by creating a huge number of vegan items, which include plant-based and dairy-free versions of common culinary staples.

1.1 Objectives

Researching the viability of using rice bran oil to create vegan mayonnaise, vegan cheese, and vegan ice cream. Evaluating the nutritional makeup of rice bran oil and any health advantages. Examining the effects of traditional animal-based goods on the environment and human health and highlighting the need for sustainable substitutes. Creating novel recipes and processing methods to provide delectable, premium vegan substitutes. Maximizing the amounts of ingredients, improving the mouth feel, and giving the vegan products the desired sensory qualities.

1.2 Scope

The scope of this research extends to the exploration of rice bran oil as a key ingredient in three popular food items: ice cream, cheese, and mayonnaise. The study intends to provide insights into overcoming problems relating to texture, stability, and overall product quality in addition to furthering our understanding of plant-based formulations by addressing the technical aspects of product creation. The research has importance as it can provide people delicious and ethical choices without compromising on taste or nutritional value.

2. METHODOLOGY

In this project, rice bran oil is used to make vegan ice cream, vegan mayonnaise, and vegan cheese using a variety of techniques. The goal of this initiative is to provide unique and wholesome vegan substitutes for traditional dairy-based items. To assure the flavour, texture, and nutritional integrity of these vegan goods, rice bran oil is a crucial component of the approach.

2.1 Formulations

Table -1: Formulation of Vegan Mayonnaise

Ingredients	Control	Sample a	Sample b
Rice bran oil (ml)	75	100	50
Soy lecithin (g)	38	50	30
Xanthan gum (g)	0.25	0.25	0.5
White vinegar(ml)	38	50	30
Salt (g)	2	3	2
Water (ml)	60	200	75

Table -2: Formulation of Vegan Cheese

Ingredients	Control	Sample a	Sample b
Rice bran oil (ml)	100	75	50
Soy lecithin (g)	20	20	20
Xanthan gum (g)	5	5	5
White vinegar(ml)	30	30	30
Tapioca starch (g)	150	150	150
Dry yeast (g)	50	50	30
Water (ml)	200	205	200

Table -3: Formulation of Vegan Ice-cream

Ingredients	Control	Sample a	Sample b
Rice bran oil (ml)	100	75	50
Soy lecithin (g)	2	2	2
Guar gum (g)	3	3	3
Corn syrup (ml)	86	70	43
Vanilla essence (ml)	0.5	0.5	0.5
Salt (g)	2	3	3
Water (ml)	630	473	315

2.2 Procedure

2.2.1 Preparation of Vegan Mayonnaise

Make sure the blender container and all of the tools are dry and clean. The process of emulsification may be hampered by moisture. Measure out the required quantity of oil and pour it into a different container. Keep the xanthan gum, vinegar, and salt close at hand so you can add them quickly to the blender. Fill the dry blender container with the xanthan gum, salt, and soy lecithin. Place the blender on low and mix for a duration of thirty seconds. This stage guarantees that the dry components are distributed evenly. Slowly drip the oil into the dry ingredients while the mixer is still running on low speed. Its steady addition is essential to achieve the emulsification. Keep adding the oil in a thin, steady stream until it is completely mixed together. Watch as the mixture progressively thickens and gets creamier. After adding all of the oil, turn the mixer up to medium-high and blend for a minute. This guarantees appropriate emulsification and helps to further enhance the texture. Blend for a further 30 seconds after adding the vinegar. If necessary, use a spatula to scrape down the edges of the blender container to guarantee even mixing. Taste Test: Use a tiny bit of mayonnaise and give it a taste. As needed, add more vinegar or salt to the spices.

Keep in mind that excess seasoning is tough to get rid of, but you can always add more. Check for Consistency: If the consistency is too thick for your taste, mix in 1 teaspoon of water at a time until the right texture is achieved. Water should not be added in excess as this might severely thin the mayonnaise. Although not required, you may utilize this step to get a thicker consistency especially if you like your mayonnaise to have a thickness more akin to store- bought kinds. Spoon the vegan mayonnaise into a heatproof, stovetop-safe container that has been warmed. Heat the mayonnaise for five to eight minutes over low heat, stirring often. See how the mixture begins to gradually thicken. Let the vegan mayonnaise come to room temperature and cool fully. After the mayonnaise cools, move it to a sanitized, sealed jar. The vegan mayonnaise should be refrigerated for at least an hour before using. Cooling enhances the consistency and lets the flavours develop.

2.2.2 Preparation of Vegan Cheese

By mixing the oil, lecithin, and starch, they distribute equally among themselves, giving the finished cheese a constant texture and flavour. Tapioca starch activation: By heating the starch in the presence of moisture, such as water, the starch can gelatinize and thicken the cheese. Make use of a pot or saucepan that can be heated on the stove. Turn up the heat to medium and add the rice bran oil. Measure out the tapioca starch and soy lecithin while the oil is cooking. Once the oil is heated, whisk continuously to avoid clumping as you gradually add the soy lecithin and tapioca starch. For one to two minutes, keep whisking and heating until a smooth, slightly thicker foundation is achieved. In this phase, the mixture is given moisture (water) and acidity (vinegar). Moisture: Water is necessary for the cheese's general texture and consistency.

Acidity: Vinegar adds a tangy or "cheesy" taste while also helping to balance the flavours. Turn down the heat. Add the white vinegar to the mixture gradually while continuing to stir. Add a little at a time, perhaps 1 tablespoon at first, and work your way up to the appropriate degree of tanginess. After the vinegar has been combined, add the water a little at a time while whisking continuously to guarantee a uniform distribution. Depending on the desired final consistency of the cheese, different amounts of water may be required.

To get a thick and somewhat pourable consistency, start with a lower amount (such as 1/4 cup) and gradually add more. A typical thickening ingredient in vegan cheese recipes is xanthan gum. By forming a gel network throughout the slurry, it aids in achieving a consistency akin to that of cheese. Turn off the heat source for the pot. Weigh out a very little amount of xanthan gum typically less than 1/2 teaspoon and distribute it uniformly over the mixture's surface. Take care not to add it all at once because xanthan gum tends to clump. Gently fold the xanthan gum into the mixture with a whisk until it is completely mixed and no lumps are evident. Nutritional yeast, a deactivated yeast product, gives vegan cheese a cheesy, umami flavour. Calculate the nutritional yeast. Gently stir in the nutritional yeast with a spatula or whisk until it is equally distributed after adding it to the mixture.

At this stage, taste the mixture to determine the appropriate level of cheesiness and modify the amount of nutritional yeast if necessary. This stage helps the cheese firm even more and melds the flavours. Cooling: To guarantee that the cheese sets correctly, the mixture must be cooled to a precise temperature to stop it from cooking any more. Put the saucepan back on low heat and simmer the mixture for ten to fifteen minutes, stirring now and again to avoid burning. During this time, the mixture ought to thicken and become more opaque. Take the pot off of the hob and let it cool to 40°C (104°F). This can be accomplished by setting the saucepan in a basin of cold water and stirring from time to time, or by allowing it to cool naturally at room temperature. The cheese mixture can fully solidify and acquire its texture and flavour by being refrigerated after it has cooled. Transfer the mixture to an airtight container once it has cooled to 40°C (104°F). Place the cheese in the refrigerator for a minimum of 24 hours, or better yet, for several days, to enable the flavours to develop and the texture to solidify even more.

2.2.3 Preparation of Vegan Ice-cream

In the blender, combine the guar gum and soy lecithin. Gradually add the rice bran oil, mixing constantly to achieve even integration and avoid clumps. After the oil has been well mixed in, add the corn syrup little by little while continuing to combine the mixture until it is smooth and uniform. When necessary, scrape down the blender's sides to ensure even mixing. Stirring continuously, bring the mixture to a temperature of 80°C (176°F) over medium heat in a saucepan. For precise temperature monitoring, use a thermometer. Ensure that every component of the combination reaches the desired temperature by holding the temperature at 80°C for 15 seconds. Take the saucepan off of the burner right away, and set it in an ice bath to quickly chill the mixture. This quick cooling aids in the inhibition of bacterial development.

To further break down the fat particles in the mixture and get an extraordinarily smooth and creamy texture, use a homogenizer. Add flavourings, such as vanilla essence, to the mixture and again homogenize the mixture. Transfer the mixture into a lidded container that can be frozen at -20°C. To avoid huge pieces of ice from developing, stir the mixture every 30 to 60 minutes until the mixture is frozen for several hours. In order to have a smooth texture without using an ice cream machine, you must stir by hand. Use a blender to break up any ice crystals that may have developed during freezing after the ice cream has completely frozen. For the finished product to be creamy and smooth, this stage is crucial. Process the ice cream until the required consistency is reached. Avoid over-blending since this might introduce air and result in a less thick and lighter ice cream. For best texture and ease of scooping, transfer the blended ice cream to an airtight container and place it in the freezer at -20°C (-4°F) for at least 12 to 24 hours.

2.3 Process Flow chart

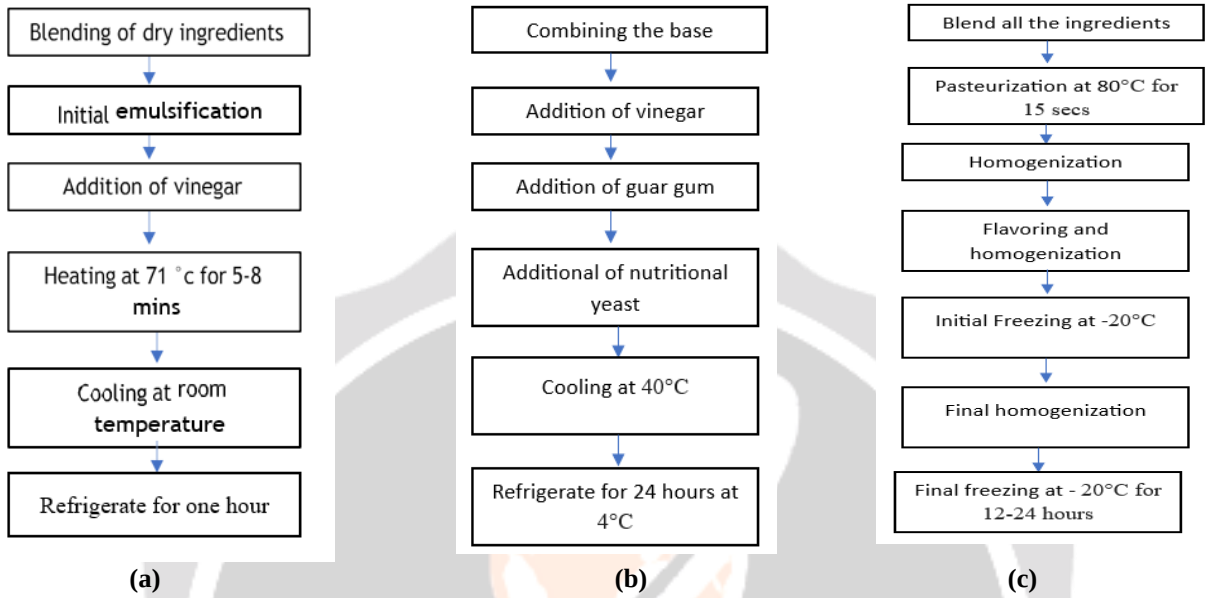

Fig -1: (a): Flow chart of Vegan Mayonnaise, (b): Flow chart of Vegan Cheese, (c): Flow chart of Vegan Ice-cream

2.4 Testing methods

2.4.1 Proximate analysis

- Kjeldahl method for protein analysis
- Soxhlet apparatus for fat determination
- Moisture analyzer for moisture analysis
- Muffle furnace for analyzing mineral content

2.4.2 Physiochemical analysis

- Ph meter for testing Ph
- Determination of water activity using water activity meter
- Determination of colour using hunter lab colorimeter

3. RESULT AND DISCUSSION

The result obtained during investigation "Development of Vegan Mayonnaise, Vegan Cheese and Vegan Ice-cream" is discussed here.

(a) **(b)** **(c)**

Fig -2: (a): Reference, (b): Trial 1, (c): Trial 2 of Vegan Mayonnaise

Table. 4 Result of Proximate analysis of vegan mayonnaise

Parameters	Reference	Trial 1	Trail 2
Moisture analysis	17.82 %	12.65 %	19.23 %
Fat	78.57%	82.5 %	77.0 %
Protein	0.69 %	1.86 %	0.59 %
Fiber	1.32 %	1.34 %	1.28 %
Carbohydrate	1.6 %	1.65 %	1.9 %

Table. 5 Result of Physio chemical analysis of vegan mayonnaise

Parameters	Reference	Trial 1	Trail 2
pH	3.71	3.61	3.81
Color (L*, a*, b*)	L* = 64.43 a* = 8.47 b* = 44.62	L* = 68.05 a* = 7.00 b* = 41.58	L* = 66.44 a* = 7.86 b* = 43.88
Water activity	0.999	0.983	0.980

Based on the above table we conclude that the trial 2 sample is best because of its high pH value and low water activity.

(a) **(b)** **(c)**

Fig -3: (a): Reference, (b): Trial 1, (c): Trial 2 of Vegan Cheese

Table. 6 Result of Proximate analysis of vegan cheese

Parameters	Reference	Trial 1	Trail 2
Moisture analysis	11.36%	15.33 %	20.56 %
Fat	42.5 %	38.29 %	34.72 %
Protein	31.6 %	31.84 %	30.02 %
Fiber	2.3 %	2.5 %	2.7 %
Carbohydrate	12.24 %	12.04 %	12.00 %

Table. 7 Result of Physio chemical analysis of vegan cheese

Parameters	Reference	Trial 1	Trail 2
pH	6.66	6.63	6.41
Color (L*, a*, b*)	L* = 81.40 a* = -1.71 b* = 17.61	L* = 76.29 a* = -0.57 b* = 25.88	L* = 78.32 a* = -0.95 b* = 22.59
Water activity	0.996	1.006	0.995

Based on the above table, we conclude that the trial 2 sample is best vegan cheese among the three samples because of its low water activity and low pH.

(a) **(b)** **(c)**

Fig -4: (a): Reference, (b): Trial 1, (c): Trial 2 of Vegan Ice-cream

Table. 8 Result of Proximate analysis of vegan ice-cream

Parameters	Reference	Trial 1	Trail 2
Moisture analysis	63.45 %	68.37 %	69.89 %
Fat	12.7 %	11.3 %	11.8 %
Protein	1.8 %	1.1 %	1.5 %
Fiber	0.98 %	0.95 %	0.92%
Carbohydrate	21.07 %	18.28 %	15.89 %

Table. 9 Result of Physio chemical analysis of vegan ice-cream

Parameters	Reference	Trail 1	Trial 2
pH	5.40	5.29	5.07
Color (L*, a*, b*)	L* = 66.07 a* = 3.73 b* = 29.48	L* = 64.39 a* = 4.65 b* = 29.80	L* = 64.45 a* = 4.50 b* = 28.94
Water activity	0.996	0.997	0.994
Overrun	40.05 %	6.11 %	54.50 %

Based on the above table, we conclude that the trial 2 sample is the best sample because of its low pH, low water activity and high overrun.

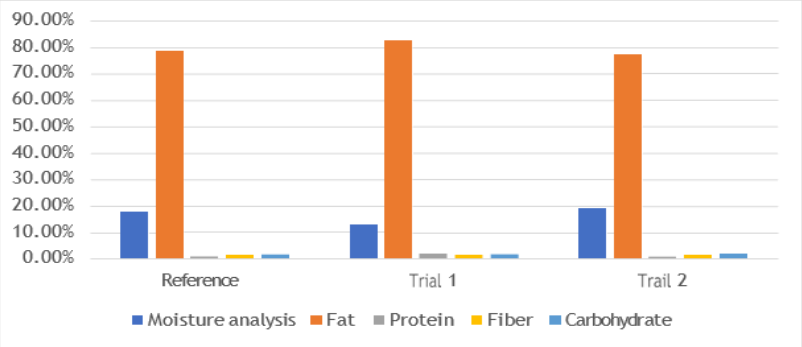

Chart -1: Nutritional analysis of Vegan Mayonnaise

The moisture content of the Reference sample is the highest and is noticeably greater than that of the other two samples. It has the least amount of fat and the most reasonable levels of fiber, carbs, and protein. The fat level of Trial 1 is the highest and is significantly greater than that of the other two samples. It has a modest quantity of fiber and the lowest levels of protein, carbohydrates, and moisture. The largest protein and carbohydrate concentrations are seen in Trial 2, along with moderate levels of fat and fiber. Like Trial 1, it has a low moisture content. Trial 2 would be preferred because the objective is to have a mayonnaise with a greater protein and carbohydrate content.

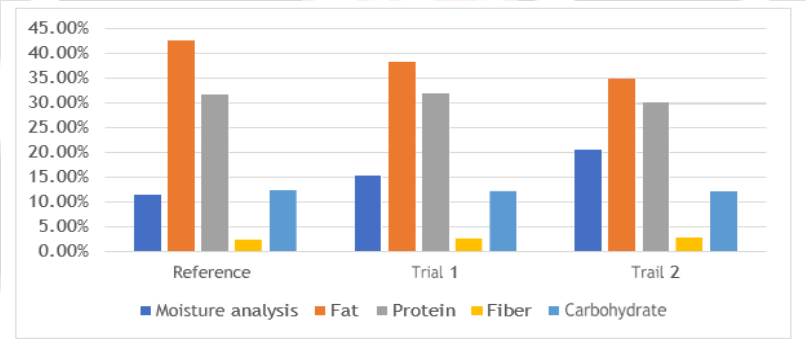

Chart -2: Nutritional analysis of Vegan Cheese

Trial 2's moisture content is lower than Trial 1's and Reference's. Out of the three, Trial 2 contains the most fat. Additionally, Trial 2 contains the most protein. Trial 2's fiber content is higher than the Reference but lower than Trial 1's. Based on the study, Trial 2 seems to be the best sample in terms of texture, taste and nutritional value. These attributes are frequently desirable for vegan cheese and include a greater protein and fat along with lower moisture and carbohydrate content.

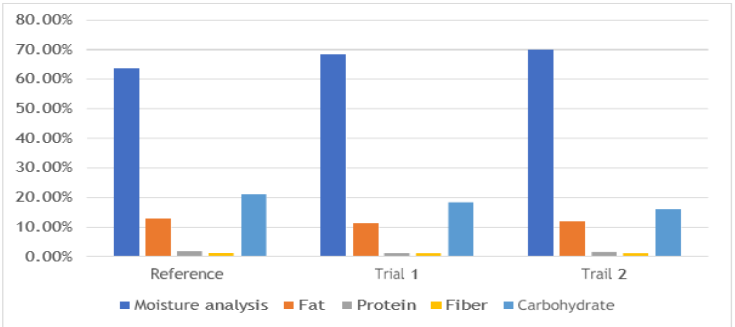

Chart -3: Nutritional analysis of Vegan Ice-cream

Trial 1 is the ideal option if a higher fat content for creaminess is required. Trial 2 is notable for having a high protein and carbohydrate content, which may be especially helpful for people trying to boost their protein consumption or seeking a more energy-dense alternative. For people who place a high value on these nutritious components in their die t, Trial 2 is a great option because of this.

4. CONCLUSION

By using ANNOVA (Paired t-test) we had concluded that the trial 2 sample is best in all the three developed vegan products (vegan mayonnaise, vegan cheese and vegan ice-cream) based on the p-value. If $p<0.05$ it represents alternate hypothesis (there is a difference between means) If $p>0.05$ it represents null hypothesis (there is no difference between means) Low p values are considered as best samples. In conclusion, the project suggests that the development of vegan products such as cheese, mayonnaise, and ice cream from rice bran oil of trial 2 sample offers several advantages, including longer shelf life, reduced microbial growth, and improved sensory attributes. Therefore, rice bran oil can serve as a viable alternative to traditional oils in the formulation of vegan products, providing both functional and sensory benefits to consumers.

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