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Valorization of Residual Orange Peel for the Development of Flavoured Mayonnaise

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ABSTRACT: The study evaluated the incorporation of orange peel powder into mayonnaise and its effect on nutritional, sensory, and microbiological properties. The researchers used two methods of drying orange peels, sun drying and tray drying, and found that tray drying resulted in the lowest moisture content and the highest aroma and flavor intensity. The researchers conducted ten trials of orange-flavored mayonnaise and found that trials 3, 6, and 10 were the most well-received in terms of sensory attributes, with trial 10 having the highest composition of egg yolks and orange peel powder. The addition of orange peel powder improved the nutritional value of the mayonnaise, including dietary fiber, calcium, and vitamin C. The researchers also found that mayonnaise stored at room temperature was susceptible to spoilage within four days due to microbial growth, but refrigerated storage at temperatures between 5-10 degrees Celsius was the best condition to maintain the quality and safety of the orange peel powder mayonnaise. This storage condition extended the shelf life of the mayonnaise up to 22 days, compared to only 4 days of shelf life when stored at room temperature due to microbial growth. Proper refrigerated storage conditions, including temperature, moisture, light, and air, were recommended to maintain the nutritional, sensory, and microbiological properties of the mayonnaise.

KEYWORDS: Orange peel powder, mayonnaise, Nutraceutical.

I. INTRODUCTION

Mayonnaise, a mixture of egg, vinegar, oil and spices is probably one of the oldest and most widely used sauces in the world today. Traditional mayonnaise is an oil-in-water emulsion despite containing 70–80% fat. Careful mixing of the ingredients and the addition of minor constituents help to maintain a closely packed foam of oil droplets. The characteristic flavour of mayonnaise is derived principally from the addition of mustard, which contains isothiocyanates[1]. Nowadays, mayonnaise has emerged as a popular condiment, which is used as a spread for sandwiches or burgers, dips for snacks, and base for tacos or rolls. The global mayonnaise market exhibited moderate growth during 2017-2023. There are multiple flavors, including Classic mayo, Pepper mayo, Garlic mayo, Matchup, to cater to the diversified tastes and preferences of an extensive consumer base in the market. In addition to this, we have introduced a new flavor called Orange flavored mayonnaise which is made by utilizing the orange peel powder as a flavoring agent[2]. Industrial extraction of orange juice produces a large amount of solid waste, mainly orange peel, which is about 45–50% of the original weight of orange fruit[3]. Those wastes are considered as a ecological problem, because they are dumped on the land around the area. Over the past few years, utilization of orange peel has been inefficient[4]. It is used as a fertilizer, fodder, feedstock for animal feed. The main aim of the project is to present the primary benefits of orange peel to develop a new products focusing on orange peel powder, as a source of healthy and nutritional compounds that could be utilized in the way of production offlavored mayonnaise[5].

II. RELATED WORK

According to (Andersson I, 2015) Mayonnaise is an oil in water emulsion with a high oil content dispersed in a continuous water phase. The egg is used as the emulsifier, which stabilizes the oil droplets in the continuous phase. The objective was to increase the knowledge of the mayonnaise production process and its impact on the mayonnaise quality. The results from the experiments showed that several parameters have an impact on the properties of mayonnaise. Variations in the recipe showed that oil content, emulsifier content and type of emulsifier have a great influence on the properties of mayonnaise. The addition of thickener to the product significantly impacted both texture and droplet size of the

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mayonnaise. From the mixing parameters it was concluded that both mixing time and mixing speed during the emulsification has an impact on the texture and droplet size of the mayonnaise[6].

Depree, J. A et al., (2001) says that Low-fat mayonnaises need additional ingredients to maintain their stability. Mayonnaise, in common with all high fat foods, is susceptible to spoilage due to auto-oxidation, its stability depending on the type of oil used. Salt, as well as being important in the development of the flavour and stability appears to influence the rate of oxidation of the oil in the emulsion. The characteristic flavour of mayonnaise is derived principally from the addition of mustard, which contains isothiocyanates. These isothiocyanates are stabilized in the aqueous solution by the addition of citric acid. An understanding of the physical and chemical processes involved in the formation of emulsions has allowed the manufacture of mayonnaise, which is much more stable during long-term storage and the development of products which contain a greater range of novel flavours[7].

Dubbelboer, A et al., (2015) explained that the optimization of the sensory product attributes by changing the processing conditions or product recipe was the main objective of this research. The physicochemical emulsion properties were subsequently correlated to the sensory attributes with a Neural Network. This allowed us to estimate panel scores on sensory attributes. Second, an optimization case study was formulated with the objective to increase mayonnaise creaminess while fixing the oil concentration to a minimal value. The overall result was that the creaminess could be increased, but at the expense of other sensory attributes[8].

Evanuarini, H et al(2020)., showed that the use of banana peel flour gave a significant difference in pH and acidity, highly significant difference with moisture content and gave no difference to the sensory evaluation of low fat mayonnaise. The use of banana peel flour can increase the stability of the emulsion and can be acceptable. The conclusion of the study using 1% banana peel flour produced good quality mayonnaise[9].

Kantekin-Erdogan et al., (2019) says that the mayonnaise incorporated with 98% MG showed the highest stability and reduction in the MG concentration in the emulsifier mixture decreased the emulsion stability. Rheological measurements indicated that the control sample without emulsifier had the highest viscosity and shear stress values. The increment of the MG concentration in the emulsifier mixtures resulted in only small differences on the rheological properties of mayonnaise[10-12].

Karas, R et al., (2002) proposed that Storage temperature, storage time and type of mayonnaise influence significantly the stability, homogeneity, mouth feeling, acid odour and flavour, rancidity, pH, acid and peroxide values. At any point of storage and under both temperature regimes, the samples of light mayonnaise had lower pH value and higher acid value in comparison with standard mayonnaise[13-15].

Mozafari, H. R et al., (2017) explained that the optimized process variables for mayonnaise low in cholesterol and fat, which contained soy milk as a yolk substitute with different levels of Xanthan gum, Zodo gum, and oil, were determined by response surface methodology using a central composite design[16-18].

III.METHODOLOGY

Methods and materials

1. Weighing of ingredients
2. Drying of orange peel
3. Preparation of mayonnaise.
- 4 mixing of orange peel powder to the prepared mayonnaise
5. Various trials of orange flavored mayonnaise
6. Sensory evaluation
7. Nutritional analysis
8. Microbial analysis
9. Packaging and storing the final product

PREPARATION OF ORANGE PEEL POWDER DRYING OF ORANGE PEEL BY SUN DRYING

Fresh and ripe oranges were chosen. Washed them thoroughly and patted dry with a clean cloth. Peeled off the outer layer of oranges using a peeler. Spreaded the orange peels in a single layer on a clean, flat surface in direct sunlight and allowed

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them to dry for 24 hours until they became hard and brittle. Turned the peels over every few hours to ensure even drying[19].



Fig.1 Orange Fruit



Fig 2. Peel Separation



Fig 3. Sun Drying for 24 hrs

DRYING OF ORANGE PEEL BY TRAY DRYING

Washed and peeled the oranges as described above. Cut the peels into small pieces or thin strips. Arranged the peels in a single layer on a clean, flat surface and placed them in a tray dryer set to 50-60°C for 8-12 hours until they were hard and brittle. Checked on the peels every few hours and turned them over to ensure even drying[20].



Fig 4. Orange Peel Thin strips



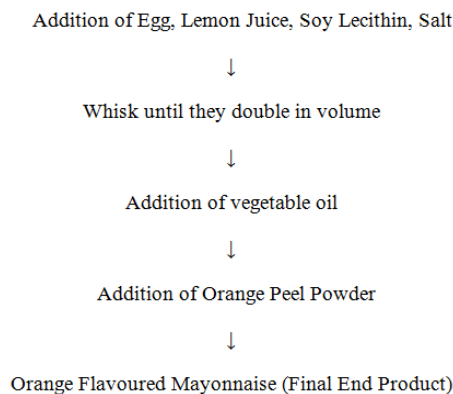
Fig 5. Tray Drying at 50°C



Fig 6 Dried Orange Peel

The incorporation of Orange peel powder enhanced the nutritional level of dietary fiber, Calcium and vitamin C in orange-flavored mayonnaise which may provide some health benefits, such as improved digestion and immune function. The microbial analysis was taken for mayonnaise stored in refrigerated condition and unrefrigerated condition to check the microorganisms such as Total plate count, Coliforms, Escherichia coli, Staphylococcus aureus and the result shows that all the microorganisms are under recommended level in refrigerated mayonnaise but the unrefrigerated mayonnaise has presence of microorganisms which exceeded the recommended level and unfit for consumption[21-24].

Flow Chart of Orange Flavoured Mayonnaise Preparation



Preparation of Orange Flavoured Mayonnaise

In a mixing bowl, added 5 egg yolks and 7.0 grams of soya lecithin powder. Whisked them together until well combined.

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Gradually added 20ml of water and 7.0 ml of lemon juice and 50 grams of orange peel powder while whisking continuously to make a smooth mixture. Added 1.3 grams of salt and 1.2 grams of sugar to the mixture[25]. Whisked again until all the ingredients are fully combined. Transferred the mixture to a high-speed food processor until the mixture is smooth and creamy. While the blender was running, slowly poured 200 ml of sunflower oil in a steady stream to emulsify the mixture. Blended until the mayonnaise is thick and glossy[26-27]. Tasted the mayonnaise and adjust the seasoning as per preference. Transferred the mayonnaise to a clean, airtight container and finally refrigerate[28].

IV. EXPERIMENTAL RESULTS**COMPARATIVE STUDY B/W STANDARD AND ORANGE FLAVOURED MAYONNAISE**

SI No	Parameters	Unit	Standard	Orange Flavoured
1	Energy	Kcal/100g	681	667
2	Carbohydrate	g/100g	0.6	3
3	Protein	g/100g	1	1.2
4	Fat	g/100g	75	74.6
5	Cholesterol	mg/100g	42	41
6	Dietary fiber	g/100g	0	3
7	Total Sugar	g/100g	0	0
8	calcium	mg/100g	17.6	52
9	Vitamin C	mg/100g	0	36

Table 1. Comparative Study B/W Standard And Orange Flavoured Mayonnaise

Orange-flavored mayonnaise, containing orange peel powder, had the following nutritional values: 667kcal of calories, 74.6g of fat, 41mg of cholesterol, 3g of carbohydrates, 1.2g of protein, and 52 mg of calcium. The addition of orange peel powder increased the dietary fiber content and introduced vitamin C, which was absent in standard mayonnaise[29].

Nutritional Value of Standard Mayonnaise

According to Gan et al. (2021), standard mayonnaise lacks dietary fiber, total sugar, and vitamin C. However, it is high in calories (680 kcal) and fat (75g) and contains cholesterol (42mg), while having low levels of carbohydrates (0.6g), protein (1g), and calcium (17.6mg). This nutritional profile suggests that standard mayonnaise is a high-energy, high-fat food that provides little in the way of other essential nutrients. In this comparative study, Orange-flavored mayonnaise contains dietary fiber and vitamin C, which are not present in standard mayonnaise. However, the total sugar content remains absent in both types of mayonnaise[30-32].

Compared to standard mayonnaise, orange-flavored mayonnaise has slightly lower levels of calories (667 kcal), fat (74.6g), cholesterol (41mg) and a similar level of protein (1.2g). It also has a slightly higher level of carbohydrates (3g), calcium (52mg) and Vitamin C (36g)[33-34]

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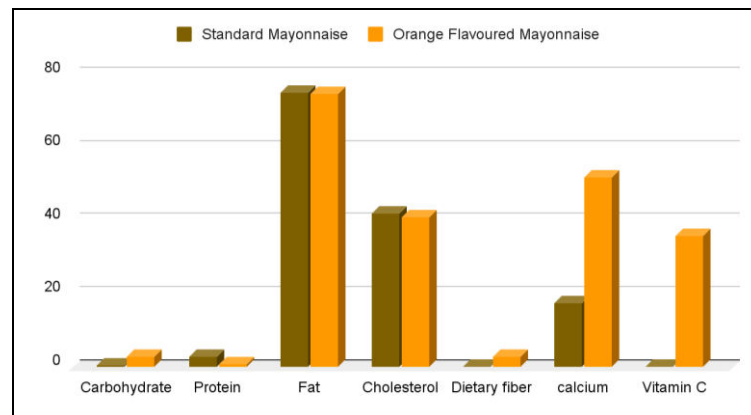


Fig 7. Graphical Comparative Study B/W Standard and Orange Flavoured Mayonnaise

Thus the incorporation of Orange peel powder enhanced the nutritional level of dietary fiber, Calcium and vitamin C in orange-flavored mayonnaise which may provide some health benefits, such as improved digestion and immune function[35].

V. CONCLUSION

The incorporation of orange peel powder into mayonnaise not only enhances its sensory attributes but also improves its nutritional value. Tray drying was found to be the most effective method for drying orange peels, resulting in a product with the lowest moisture content and the highest aroma and flavor intensity. Response surface methodology (RSM) was used to optimize the concentration of orange peel powder and egg yolk in the mayonnaise, leading to trials 3, 6, and 10 being the most well-received in terms of sensory attributes. The use of orange peel powder mayonnaise as a healthy alternative to traditional mayonnaise is recommended, with proper refrigerated storage conditions being necessary to maintain its quality and extend its shelf life. Further research can be conducted to explore food products and its impact on human health.

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