

Development and Evaluation of a Functional Soup Premix Incorporated with Mushroom and Apple Peel Powder

ABSTRACT

The study was undertaken for the development and evaluation of ready-to-use soup premix incorporated with Mushroom and Apple Peel Powder along with other ingredients such as vegetables and spices. For the preparation of the soup premix, various processes were required such as cleaning, drying, grinding, sieving, mixing all ingredients in correct proportions, and then assessing the product's characteristics. This included evaluation of its physical, chemical, microbiological properties, and sensory attributes. Sensory evaluation involved assessing the product on parameters like appearance, aroma, flavor, etc., to find consumer acceptance of the product. Ingredients of the product were examined, along with its physicochemical and microbial properties. Consumer acceptance of the product was found satisfactory based on factors like appearance, aroma, flavor, etc., if consumers found it acceptable overall. When looking at the components, we found out that the product contained water 9.23 %. There was protein in it 5.69 %, and there was some fat 1.55 percent. Additionally, the product consisted of ash 10.06 % and contained some fiber content 6.80 %. The analysis of the chemical composition of the soup revealed that the product was slightly acidic in pH 6.5. There were some solid matters in it 3°C and some particulate substance 2.82 %. Also, it possessed a sour

taste 0.133 %. Among other components, we have managed to identify such chemicals as phenolic compounds, flavonoids, tannins, and saponins.

Keywords: Mushroom powder, Apple peel powder, Functional food, Soup premix, Antioxidants, Waste valorization.

1. INTRODUCTION

Functional and convenience foods are highly sought after nowadays because of the changing lifestyle of consumers, urbanization, and improved awareness regarding health issues. Function foods include foods that have some additional benefits apart from their nutritional value because of the presence of various bioactive ingredients, antioxidants, dietary fibers, vitamins, and minerals. In the category of ready to eat foods and ready to cook foods, the soup premixes have become very popular because of their ease of preparation, nutritive content, stability, and consumer appeal.

Mushroom is a highly nutritious food because of its composition of proteins, dietary fibers, vitamins, minerals, and other bioactive components such as phenolics and β -glucans. These bioactive ingredients provide antioxidant properties, antimicrobial properties, and immunomodulatory activity. Thus, the addition of mushroom powder into foods improves nutritional and functional properties of the product.

Apple peels form an important by-product of fruit processing industries which are normally considered as waste material. However, apple peels contain dietary fiber, polyphenols, flavonoids, and antioxidants. The inclusion of apple peel powder in foods helps improve nutritional value and provides sustainable production process in foods.

Incorporation of mushroom and apple peel powders into the preparation of soup premix is highly likely to contribute positively towards improving nutrient content such as proteins, fiber, and antioxidants in addition to functionality of the soup. With this consideration, this current

research project is targeted towards formulation and characterization of a functional soup premix based on mushroom and apple peel powders. Therefore, incorporation of mushroom and apple peel powders in soup premix is highly expected to improve nutrition of the soup in terms of proteins, fiber, and antioxidant content. On this note, the following research was carried out to formulate a functional soup premix based on mushroom and apple peel powders.

2. MATERIALS AND METHODS

2.1 Development and Standardization of Soup Premix

2.1.1 Location and Time of Conducting Research

The above study was conducted in the Department of Food and Nutrition, Babasaheb Bhimrao Ambedkar University, Lucknow during the time January 2026 and May 2026.

2.1.2 Source of Raw Material

Fresh Agaricus Bisporus mushroom, apples, carrots, peas, onion, garlic and other required ingredients were obtained from the market of Lucknow, Uttar Pradesh. Suitable selection of raw material according to the freshness and quality of the ingredients was made.

2.1.3 Preparation of Mushroom Powder

Firstly, fresh mushrooms were washed with running water in order to remove any dirt and impurities present on the mushrooms. The sliced mushrooms were dried by tray drying process. These dried mushrooms were further grounded to make fine powder. This mushroom powder was sieved and stored.

2.1.4 Preparation of Apple Peel Powder

Fresh apples were thoroughly cleaned by washing. Then these apples were manually peeled by hand. The peels obtained from these apples were dried by tray drying method. The peels thus obtained were then grounded to form powder and sieved to give fine powder.

2.1.5 Preparation of Vegetable Powders

Vegetables like carrot, peas, onion and garlic were cleaned, washed, sliced and then subjected to dehydration individually under controlled conditions.

2.1.6 Preparation of Soup Premix

Soup premix was prepared by combining mushroom powder, apple peel powder, vegetable powders, spices, salt and thickening agent. The mixing was carried out to ensure uniformity of all the powders used in the soup premix. The prepared soup premix was later put in air-tight containers.

2.1.7 Evaluation Using Organoleptic Properties

The organoleptic analysis for the design soup premix was done using a technique known as 9-point hedonic scale technique. The samples of the prepared soup were tasted based on various parameters like color, taste, flavor, appearance, texture and acceptability of the design product to a commercial soup premix.

2.1.8 Formulation of Soup Premix

Table 1: Standard Formulation of Mushroom and Apple Peel Powder Soup Premix

Ingredients	Quantity(g)
Mushroom powder	20
Apple peel powder	15
Carrot powder	10

Garlic powder	3
Onion powder	8
Peas powder	7
Cornstarch	30
Salt	4
Coriander powder	1.5
Oregano	0.5
Chili flakes	0.5
Black pepper	0.5
Total	100 g

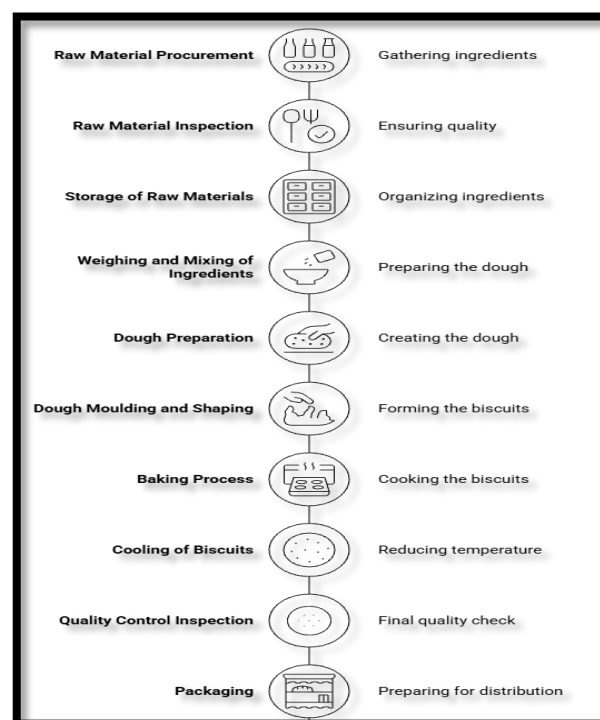


Fig.1 Schematic Flow Diagram for the Preparation of Mushroom and Apple Peel Soup Premix

2.2 Proximate Analysis

Proximate analysis was performed to evaluate the nutritional value of the prepared soup premix based on standard AOAC protocols.

2.2.1 Moisture Analysis

Moisture content was determined by performing the hot air oven test. Samples weighing approximately 5 g were dried in a hot air oven until constant weight was attained, with moisture content calculated based on the loss in weight during drying. Reduced moisture content implies improved storability of the sample.

2.2.2 Ash Content

Percentage of ash content was determined by burning the samples in a muffle furnace to 550°C, resulting in the formation of a light gray color, which indicates minerals present in the sample.

2.2.3 Protein Content

Protein content was determined using the Kjeldahl process in which the samples were treated with concentrated sulfuric acid, followed by distillation and titration to determine nitrogen content. Protein content was estimated from the nitrogen value obtained by multiplying it with the required conversion factor.

2.2.4 Fat Content

Crude fat content was analyzed using Soxhlet method, whereby samples were continuously extracted in petroleum ether for long hours. The left-over residue was dried to acquire crude fat.

2.2.5 Fiber Content

Crude fiber content was analyzed using acid and alkali hydrolysis methods. The sample was treated using dilute acid followed by dilute alkali to extract digestible fiber. Residue obtained was then dried and its weight measured before being burnt.

2.2.6 Carbohydrate Content

Carbohydrates content was analyzed using difference method. Its formula can be expressed as;

$$\text{Carbohydrate (\%)} = 100 - (\text{Moisture} + \text{Protein} + \text{Fat} + \text{Ash} + \text{Fibre})$$

2.2.7 Energy Content

Energy value of soup premix was analyzed using Atwater factors. Proteins and carbohydrates were multiplied by 4kcal/g, while fat was multiplied by 9 kcal/g.

2.3 Physico-Chemical Properties

2.3.1 Determination of pH

Determinations of the pH values of the mixture were performed using a pH meter. Calibrations were made prior to recording the readings. The determination of pH is a measure of acidity and alkalinity of a food product.

2.3.2 Determination of Total Soluble Solids (TSS)

Determinations of total soluble solids (TSS) were performed using a hand refractometer. It was indicated as %TSS.

2.3.3 Determination of Total Dissolved Solids (TDS)

The determination of total dissolved solids (TDS) was performed in the laboratory. Values were obtained in terms of percentages. Salinity of the soup was determined by titration method. A certain amount of mixture was combined with distilled water and then filtered. Titration was performed using standard AgNO₃ solution. Potash alum was used as an indicator wherein the

reddish-brown coloration showed that the reaction had reached its endpoint. From this, the amount of sodium chloride present in the solution can be known and expressed in percentages.

2.3.4 Salt Content %

The salt content of the soup premix prepared was evaluated through titration technique. Some quantity of the premix was dissolved in distilled water and then filtered. The filtrate was analyzed using standard silver nitrate solution whereby potassium chromate was used as the indicator. Endpoint for this test was reddish-brown color. The amount of sodium chloride was determined in percent. Salt content determination was important in determining the concentration of sodium and the taste of the soup premix.

2.3.5 Titrable Acidity Measurement

The titrable acidity of the soup premix was measured against the standard NaOH solution using phenolphthalein as the indicator. The acidity was expressed in percentage.

2.4 Phytochemicals Analysis

Phytochemical analyses were conducted on the mushroom and apple peel soup premix (sample A) and the commercial soup premix (Sample B) to evaluate their respective active ingredients which could be attributed to the biological and antioxidant activities of the samples. It is pertinent to note that the phytochemical screening revealed the presence of flavonoids, phenolics, tannins, saponins, glycosides and terpenoids in sample A, and phenolics and glycosides in sample B.

2.4.1 Flavonoids

There were flavonoids in the developed soup premix (Sample A), while there were no flavonoids in Sample B. The reason could be attributed to the use of natural sources including

apple peel powder, mushroom powder, and vegetables. Flavonoids act as strong antioxidants and help reduce oxidative stress.

2.4.2 Phenolics

Both Samples A and B had phenolics. Sample A was more functional than Sample B because of the presence of natural sources containing phenolic compounds. It is beneficial to have phenolics in the soup premix in order to avoid damage due to free radicals.

2.4.3 Tannins

There were tannins present in the developed soup premix only. The role of tannins in enhancing antimicrobial and antioxidant qualities makes them functional and helps in improving the shelf life of the developed product.

2.4.4 Saponins

There were saponins present in Sample A only but not in Sample B. Saponins increase the biological value of the soup premix because they possess anti-cholesterol and immunomodulatory activities.

2.4.5 Glycosides

Glycoside content was present in both developed and commercial soup premixes. Glycosides have important biological and antioxidant activities in food.

2.4.6 Terpenoids

Presence of terpenoids in the soup premix was noticed only in developed samples due to the addition of mushrooms, vegetables, and spices. Terpenoids provide antioxidant, antimicrobial, and anti-inflammatory effects improving the biological significance of the developed product.

In conclusion, phytochemical evaluation indicates that the developed mushroom and apple peel soup premix is rich in phytochemical content compared to the commercial soup premix. In other words, the developed soup premix has higher levels of antioxidants and biological activity making it suitable for health benefits.

2.5 Scanning Electron Microscopy Analysis (SEM)

Surface morphology and particle structures of the dried soup premix powders were analyzed via scanning electron microscopy (SEM). Samples were dried before SEM analysis. Dried samples were attached to aluminum stubs. Different magnifications were utilized during the SEM analysis of samples.

3. RESULTS AND DISCUSSION

3.1 Proximate Analysis

NOTE: Sample A - Mushroom & Apple Peel Soup Premix

Sample B - *Commercial Soup Premix*

Table 2: Proximate Analysis of Mushroom & Apple Peel Soup Premix and Commercial Soup Premix

Parameter	Sample A	Sample B
Moisture (%)	9.23	6.00
Protein (%)	5.69	5.51
Fat (%)	1.56	2.51
Ash (%)	10.06	7.24
Crude Fibre (%)	6.806	2.17
Carbohydrate (%)	66.66	76.57
Energy(kcal)	303.44	350.91

The premixed soup prepared had high nutritional value due to higher amounts of protein, fiber, and minerals in it compared to the commercially available soup.

3.2 Physicochemical Analysis

Table 3: Physicochemical Analysis of Mushroom & Apple Peel Soup Premix and Commercial Soup Premix

Parameter	Sample A	Sample B
pH	6.5	6.0
TSS (°Brix)	3	5
TDS (%)	2.82	3.52
Acidity (%)	0.13	0.20
Sodium (%)	2.00	2.50

Physicochemical characteristics were deemed satisfactory for the product while also possessing excellent product stability.

3.3 Phytochemical Analysis

Table 4: Phytochemical Analysis of Mushroom & Apple Peel Soup Premix and Commercial Soup Premix

Phytochemical	Sample A	Sample B
Flavonoids	+	-
Phenolics	+	+
Tannins	+	-
Saponins	+	-
Glycosides	+	+
Terpenoids	+	-

It was established that the premixed soup prepared had certain bioactive ingredients that made the product antioxidative in nature.

3.4 Analysis by Scanning Electron Microscope (SEM)

The study was carried out using the scanning electron microscope (SEM) with a view to determining the surface morphology and chemical composition of the soup premix made from the mixture of mushroom and apple peel powder. Information on the surface morphology, particle size, surface features, and organization of powdered food products can be provided using scanning electron microscopy. The surface morphology features of the soup premix are important in determining its ability to be hydrated and its texture.

The SEM images of the soup premix revealed that the particles have irregular shape with porous surfaces. The porous surfaces could be attributed to the drying procedure employed in the preparation of the mushroom powder, apple peel powder, and other vegetable powders used in making the soup. Such structures in the instant soup premix help in improving the water absorptivity of the soup. From the SEM images obtained, it is clear that the particles are distributed evenly in the soup. The surface morphology features of the manufactured soup

premix might have been caused by the use of ingredients containing high amounts of fibre such as mushroom powder and apple peel powder.

This is attributed to the fact that fibre helps enhance the functionality and nutritional quality of the product. Furthermore, from the structure of the particles, it was noted that there was uniform distribution of the ingredients in the soup premix. From the elemental analysis carried out together with SEM results, it was established that the major elements present included carbon (C), oxygen (O), potassium (K), phosphorus (P), and chlorine (Cl). Two of these major elements which include carbon and oxygen are present in significant amounts, indicating the presence of carbohydrates and fibres.

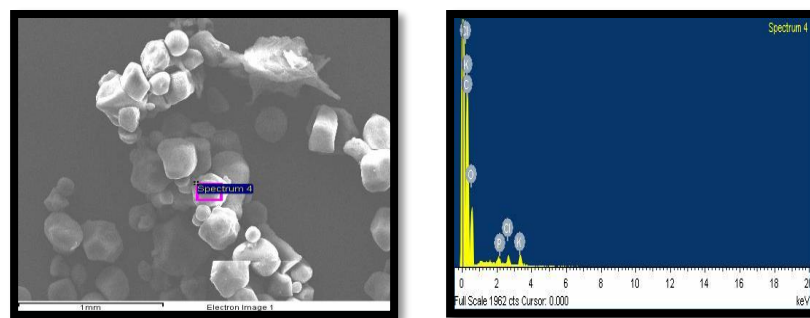


Fig.2 Scanning Electron Microscopy (SEM) Analysis of Developed Mushroom and Apple Peel Soup Premix

Table 5: Elemental Composition of Soup Premix by EDS Analysis

Elements	Weight %	Atomic %
C K	47.60	55.65
O K	49.03	43.04
P K	0.55	0.25
Cl K	1.23	0.49
K K	1.58	0.57

Totals	100.00	-
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4. EXISTING SOUP PREMIXES IN THE MARKET

In the recent years, the field of convenient foods both globally as well as in India has seen a great deal of development on account of the process of urbanization, change in food habits, fast pace of life, and high demand for ready-to-cook foods. Soup premix happens to be one of the more popular convenience foods due to reasons of their wide availability, cost-effectiveness, and long shelf life. The commercially available branded soups such as Knorr, Maggi, Ching's, and other brands from India offer many varieties of soup premixes that include tomato soup, mushroom soup, sweet corn soup, vegetable soup, hot and sour soup, and mixed vegetable soup. Such soups generally come in a powder form and only require water for preparation.

Flavoring agents, coloring agents, stabilizers, and preservatives are some of the common ingredients used in the manufacture of commercial soup premixes as means of improving their taste, shelf life, and appearance. However, although easily consumable and attractive to the consumer, commercial soups are generally sodium-rich, with low fiber content and functional ingredient.

Therefore, there will be a growing consumer interest in healthy soups that need to contain natural ingredients and have high levels of antioxidants and dietary fibers.

Over the past few years, much importance has been attached to healthy foods made up of vegetable-based products, mushrooms, herbs, fruits, and biologically active substances. Consumers are becoming more interested in healthy foods that can help in boosting their immunity, improving digestion, controlling body weight, and overall well-being. Therefore, it will be possible to prepare nutritious soups by using natural ingredients such as mushrooms and apple peel.

5. MARKET CHALLENGES

Some of the challenges in the market concerning the development and production of instant soup premix and functional foods in the market despite the increase in demand include the issue of meeting the nutrition and sensory qualities of the product. It means that there needs to be inclusion of nutritious elements in addition to sensory attributes like good aroma, color, texture, and others. Addition of certain ingredients such as mushrooms and apple peel powder in the soup formulation could affect its sensory attribute and thus the need for standardization.

Another important challenge that is associated with the market is the shelf-life aspect in the market since it is a function of natural ingredient addition without many preservatives. There are various factors such as moisture, oxidation, flavoring, and contaminations that could influence the food quality. There is a lot of competitive pressure in the convenient food market segment making the introduction of new products difficult. This is because of the presence of strong companies in the industry offering superior food quality.

In addition, increasing prices in raw material costs, packaging costs, transportation costs, and others related to quality may influence economics involved in introducing the new product. Consumer awareness about clean-label products will require improvement in packaging and processing technology on behalf of the producer. Meeting the standard set by regulatory authorities such as FSSAI will be essential.

6. FUTURE POTENTIAL

Future potential of the functional soup premix looks very bright due to increased consumer awareness regarding nutrition, healthy eating habits, and sustainable food consumption. The newly formulated mushroom and apple peel soup premix have several advantages regarding function and nutritional value owing to its fiber, antioxidants, minerals, and phytochemical composition. Incorporation of mushroom powder enhances the functionality owing to protein,

vitamins, minerals, and antioxidant content. Similarly, apple peel powder contributes to fibers and phytochemicals.

Using apple peel as an added value ingredient has also proven that agro-industries' wastes are efficient enough in manufacturing sustainable foods. Not only will this reduce wastage in food materials, but it would also promote sustainable food processing. Future research can be focused on utilizing other types of fruits and vegetables' peels for the formulation of sustainable functional foods. The process may even involve improving the composition of the soup premix by adding proteins, probiotics, prebiotics, vitamins, minerals, and herbal extracts. Formulating premix-based soups that are specifically formulated for certain purposes, like low sodium, high protein, diabetic-friendly, and immunity-enhancing soups, can be considered.

Alternative methods for processing and packaging of the soup premix, such as spray drying and modified atmosphere packaging, can also be considered. The industrial-scale evaluation and commercialization of the soup premix can help in assessing its feasibility. As the focus on health-promoting and convenience food products is increasing, the formulated soup premix will become a profitable functional food in no time.

CONCLUSION

This study successfully met the objectives of formulating a ready to mix soup premix from mushroom powder, apple peel powder, and other vegetables and spices. The developed soup premix was identified to contain adequate nutritional elements, acceptable sensory properties, and stability during storage. Mushroom powder contributed more proteins and bioactive components while the apple peel powder increased dietary fiber and antioxidants in the formulated soup premix. The proximate analysis established that the formulated soup premix contained sufficient amounts of protein, crude fiber, and minerals whereas its fat content was low.

Physicochemical analysis proved that pH, total soluble solids, and acidity were within acceptable values while phytochemical analysis revealed that the soup premix contained phytochemicals such as phenolic compounds and flavonoids. Sensory analysis indicated acceptable results with respect to color, taste, texture, flavor, and overall acceptability. Finally, the formulated soup premix was microbiologically stable because of low moisture content and good dehydration procedures employed during formulation. The study demonstrated that there is need to use agro-industrial wastes such as apple peels to improve on food products. Overall, the developed mushroom and apple peel soup premix can be considered as nutritious, functional, and economic foods with high commercial potential.

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