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INSTANT SOUP MIX FORTIFIED WITH BROCCOLI AND CABBAGE POWDER: A FUNCTIONAL FOOD APPROACH

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Abstract

The study focused on the development and evaluation of an instant soup mix powder formulated with broccoli and cabbage powders, aimed at enhancing nutritional value, sensory appeal, and shelf stability. Five variations incorporating different proportions of broccoli and cabbage were prepared and subjected to organoleptic analysis using a 9-point hedonic scale. Among them, Variation III was identified as the most acceptable in terms of appearance, flavour, texture, colour, taste, and overall acceptability. Physicochemical evaluations revealed improved functional properties in the test sample, with higher oil (2.6 ml/g) and water absorption capacities (5.2 ml/g) compared to the control. Nutritional analysis showed significantly higher energy (379 kcal), carbohydrate (68.1 g), and protein (19.4 g) contents in the test sample. Microbiological analysis confirmed product safety, with minimal bacterial presence even after 15 days of storage. Cost analysis indicated the developed soup mix (₹101/112g) to be cost-effective compared to commercial alternatives. The findings suggest that the broccoli and cabbage-based instant soup mix powder is a promising, nutritious, and economical product suitable for commercial production and public consumption. Its high acceptability and improved nutritional profile position it as a potential functional food in the growing market for healthy convenience foods.

Keywords: Broccoli - Cabbage powder, Instant soup mix, Functional food, Sensory evaluation, Nutritional analysis, Physicochemical properties, Microbiological safety

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INTRODUCTION

In recent years, consumer interest in functional and convenience foods has surged, driven by the growing awareness of the link between diet and health. Instant soup mixes have emerged as a popular solution to meet the demands for quick, easy-to-prepare, and nutritionally balanced meals [1]. The incorporation of vegetable powders into these products offers a promising avenue for enhancing their nutritional quality without compromising shelf life or sensory attributes. Broccoli (*Brassica oleracea* var. *italica*) and cabbage (*Brassica oleracea* var. *capitata*), both members of the Cruciferae family, are rich in health-promoting bioactive compounds including glucosinolates, flavonoids, phenolics, vitamins (notably vitamin C and K), and dietary fiber [2]. These vegetables are known for their antioxidant, anti-inflammatory, and potential anti-carcinogenic properties. However, their seasonal availability, perishability, and strong flavor profiles can limit their direct application in daily diets [3]. Dehydrating broccoli and cabbage into powder form not only extends shelf life but also enhances ease of

incorporation into various food formulations. Using these powders in instant soup mixes can provide a concentrated source of nutrients, improve functional properties, and offer a health-conscious alternative to traditional soup bases often high in sodium and low in essential nutrients [4]. This study aims to develop and evaluate an instant soup mix fortified with broccoli and cabbage powders, focusing on its physicochemical properties, sensory acceptability, and nutritional profile. The goal is to create a convenient, functional food product that addresses modern nutritional challenges while promoting vegetable intake in a palatable form [5-7].

METHODOLOGY

Procurement of raw materials

The primary ingredients, fresh broccoli and cabbage, were procured from a local supermarket. Additional components essential for the formulation of the instant soup mix—corn flour, garlic, onion, tomato, black pepper, cumin, and salt—were also sourced from the same retail outlet, ensuring consistency in quality and availability of all ingredients used in the product development.

Processing of Broccoli and Cabbage Powder

The preparation of broccoli and cabbage powders involved a series of standardized steps to ensure the

retention of nutritional quality and functional properties. Fresh broccoli and cabbage were first selected at optimal maturity and thoroughly washed under running water to eliminate dirt, debris, and surface contaminants. The cleaned vegetables were then blanched in hot water to inactivate enzymatic activity, reduce microbial load, and preserve natural color and nutrient content. Following blanching, the vegetables were cut into uniform small pieces to facilitate efficient and even drying. These pieces were then subjected to hot air drying in an electronic tray dryer at a controlled temperature for approximately 5 hours, or until a constant weight was achieved. After drying, the dehydrated broccoli and cabbage pieces were milled into a fine powder using a high-speed grinder and subsequently sieved to obtain a uniform particle size. The resulting powders were stored in airtight, moisture-proof containers under ambient conditions until further use in the formulation of the instant soup mix.

Standardized Formulation of the Soup Mix Control Formulation

The control sample of the instant soup mix was developed based on protocols described by Kumar et al. (2021) and Singh et al. (2010), with minor modifications. In this formulation, corn flour served as the primary base ingredient, combined with seasonings and spices to provide flavor and consistency. The detailed composition of the control soup mix is presented in Table 1.

Table - 1 Standardized Recipe for Instant Soup Mix (Control Sample)

S.No.	Ingredient	Proportion (g)
1	Corn flour	50
2	Onion powder	10
3	Garlic powder	5
4	Ginger powder	2
5	Black pepper powder	3
6	Salt	3

FORMULATION OF BROCCOLI AND CABBAGE POWDER INSTANT SOUP MIX

Table - 2 Composition of Broccoli and Cabbage Powder-Incorporated Instant Soup Mix (g)

Ingredient	Control	V1	V2	V3	V4	V5
Corn Flour	50	40	35	30	25	20
Broccoli Powder	–	5	7.5	10	12.5	15
Cabbage Powder	–	5	7.5	10	12.5	15
Onion Powder	10	10	10	10	10	10
Garlic Powder	5	5	5	5	5	5
Ginger	2	2	2	2	2	2

Powder						
Black Pepper	3	3	3	3	3	3
Salt	3	3	3	3	3	3

The broccoli and cabbage powder-incorporated soup mixes were developed by partially replacing corn flour in the standardized control formulation with dehydrated broccoli and cabbage powders. The base formulation and ingredient proportions were adapted from Kumar et al. (2021) and Singh et al. (2010), ensuring consistency in taste, texture, and nutritional quality. A total of five experimental variations (V1 to V5) were prepared, each containing different ratios of broccoli powder (BP) and cabbage powder (CP), while keeping the overall number of thickening agents (corn flour + vegetable powders) constant at 50 g. All other ingredients were maintained at the same levels as in the control.

Preparation of Broccoli and Cabbage Powder Instant Soup

The broccoli and cabbage powders were thoroughly mixed with the other dry ingredients as per the proportions detailed in Table 2. Each variation—Control, V1, V2, V3, V4, and V5—was prepared using equal total quantities of the dry mix to ensure consistency in evaluation. For soup preparation, a measured quantity of the instant soup mix was added to boiling water and simmered for approximately 10 minutes, allowing the vegetable powders to fully rehydrate and dissolve, and the flavors from spices and herbs to blend harmoniously. The resulting soup exhibited a smooth texture, balanced seasoning, and a distinct vegetable aroma, depending on the concentration of broccoli and cabbage powders used in each variation.

Sensory Analysis

The consumer acceptability of the developed broccoli and cabbage powder-incorporated instant soup mix was evaluated through a sensory analysis conducted by a panel of 30 semi-trained members. Each panelist received approximately 50 mL of soup from each variation (Control, V1, V2, V3, V4, and V5), served warm in silver bowls along with a spoon. The samples were presented in a randomized order to minimize bias, and each sample was coded for identification. Panelists were asked to evaluate the soup samples based on appearance, aroma, taste, texture, and overall acceptability using a nine-point hedonic scale. The scale ranged from 9 to 1, where 9 represented "like extremely," 8 "like very much," 7 "like moderately," 6 "like slightly," 5 "neither like nor

dislike," 4 "dislike slightly," 3 "dislike moderately," 2 "dislike very much," and 1 "dislike extremely." The data collected from the sensory scores were subjected to statistical analysis to identify the most preferred formulation based on overall acceptability.

PHYSIOCHEMICAL ANALYSIS

Oil absorption capacity

The oil absorption capacity (OAC) of the instant soup mix incorporated with cabbage and broccoli powders was determined using a standard gravimetric method. Approximately 1 gram of the soup mix sample was accurately weighed into a pre-weighed 15 mL centrifuge tube. To this, 10 mL of refined vegetable oil was added, and the mixture was thoroughly stirred using a vortex mixer for 30 seconds to ensure complete interaction between the oil and the sample. The tube was then allowed to stand at room temperature ($25 \pm 2^\circ\text{C}$) for 30 minutes to facilitate absorption. (kavitha.k and Venipriyadharshini, 2022). After the resting period, the sample was centrifuged at 3000 rpm for 20 minutes. The supernatant oil was carefully decanted without disturbing the sediment. The tube containing the sediment was weighed, and the amount of oil absorbed was calculated by the difference in weight before and after centrifugation. The oil absorption capacity was expressed as grams of oil absorbed per gram of sample (g/g). All measurements were performed in triplicate, and the average values were reported.

Water Absorption Capacity

To evaluate the water absorption capacity of the cabbage and broccoli powder instant soup mix, a standard gravimetric method was employed. Approximately 1 gram of the powdered soup mix was accurately weighed and placed into a pre-weighed 15 mL centrifuge tube. Distilled water (10 mL) was gradually added to the sample, and the mixture was stirred thoroughly using a glass rod to ensure complete hydration. The sample was then allowed to stand at room temperature (around 25°C) for 30 minutes to facilitate maximum water absorption. Following the soaking period, the tube was centrifuged at 3000 rpm for 20 minutes to separate the unabsorbed water. The supernatant was carefully decanted, and the weight of the tube containing the hydrated residue was recorded (Venipriyadharshini and kavitha.k, 2022). The water absorption capacity was calculated as the amount of water retained per gram of dry sample (g water/g dry matter) using the formula:

$$\text{WAC} = (\text{Weight of hydrated sample} - \text{Weight of dry sample}) / \text{Weight of dry sample}.$$

This method was performed in triplicate for accuracy, and the average value was reported as the final water absorption capacity of the soup mix.

Table-3 Physiochemical analysis for Broccoli and Cabbage Powder

S.No	Name of the test	Test method
1	Water absorption capacity	BIS/AOAC
2	Oil absorption capacity	BIS/AOAC

NUTRITIONAL ANALYSIS

Nutritional analysis refers to the process of determining the nutrient composition of food products through scientifically validated methods. This analysis provides essential information regarding the health and dietary value of the food. The present study involved the nutritional evaluation of the **best-selected variation** of the broccoli and cabbage powder instant soup mix, along with the **control sample**, to assess and compare their proximate compositions.

Proximate Analysis

Proximate analysis was carried out to determine the energy, protein, fat, and dietary carbohydrate fiber content in both the control and selected variation. All nutrients were analyzed using standard laboratory procedures (Venipriyadharshini, L., and Kavitha. k, 2023). The methods adopted for each nutrient estimation are listed in Table - IV.

Table - 4 Test Methods Used for Proximate Analysis

S.No.	Nutrient	Test Method
1	Energy (kcal)	Bomb Calorimeter
2	Carbohydrate (g)	Anthrone Method
3	Protein (g)	Kjeldahl Method
4	Fat (g)	AOAC Method
5	DietaryFiber(mg)	AOAC Method

CHEMICAL ANALYSIS

The control and the best-selected variation of the broccoli and cabbage powder instant soup mix were subjected to chemical analysis to determine their moisture content, which plays a crucial role in shelf life and product stability. The analysis was performed using standard laboratory procedures to ensure accuracy and reliability.

Table - 5 Test Method Used for Chemical Analysis

S.No.	Name of the Test	Test Method
I	Moisture	Oven Dry Method

Shelf Life Analysis

The term *shelf life* refers to the period during which a food product retains its original texture, composition, and organoleptic (sensory) characteristics under specified storage conditions. In this study, shelf life evaluation was conducted on the selected variation V3 of the broccoli and cabbage powder-incorporated instant soup mix. To assess its shelf stability, the developed soup mix powder was packed in airtight, labeled bottle jars and stored at room temperature. The product was observed for any changes in quality attributes over a period of 15 days, with particular attention to microbial stability and physical appearance. The reconstituted soup from the stored powder was monitored for three consecutive days during storage to assess microbial safety.

Microbiological Analysis

Microbiological analysis was performed to evaluate the microbial stability of both the control and selected variation (V3) of the soup mix. The focus was on Total Plate Count (TPC) and yeast and mold counts, which are key indicators of microbial spoilage and product safety. The Standard Plate Count (SPC) technique was used to enumerate total viable microorganisms at 35°C, following standard operating procedures. Microbial activity was monitored on Day 1, Day 2, and Day 3 of reconstituted soup to ensure that the product remained microbiologically safe for consumption during short-term use.

Table - 6 Test Methods Used for Microbiological Analysis

S. No.	Name of the Test	Test Method
1	Total Plate Count	Standard Plate Count (SPC) Method
2	Yeast and Mold	Biolog automated method for yeast; Die casting method for mold

COST CALCULATION

Cost is a critical factor influencing consumer purchasing decisions, especially for newly developed food products. Therefore, the cost analysis of the broccoli and cabbage powder-incorporated instant

soup mix was conducted to assess its market feasibility and consumer acceptability. The total cost of the product was calculated by considering all expenses incurred during the procurement of raw materials, processing of ingredients (such as drying and powdering), and product development stages. This included the costs associated with broccoli, cabbage, spices, corn flour, utilities, packaging, and labor. The calculated cost per serving or per unit weight of the instant soup mix helps determine pricing strategies and competitiveness in the market. In addition, product labelling was designed in accordance with regulatory requirements, providing detailed information such as the list of ingredients, nutritional composition, storage instructions, and expiry date (shelf life), ensuring consumer awareness and compliance with food safety standards.

PACKAGING AND LABELLING

Effective packaging and labelling are essential for preserving the quality, safety, and marketability of the instant soup mix. The soup mix powder was packaged in airtight, moisture-resistant containers such as plastic jars or laminated pouches to prevent exposure to humidity, preserve flavor and texture, and extend shelf life. The labelling included all mandatory information as per local food regulatory guidelines, such as the product name, ingredient list, nutritional information per serving, net weight, manufacture and expiry dates, and preparation instructions. The label also emphasized key product features such as “vegetable-enriched,” “instant preparation,” and “no added preservatives” to enhance consumer appeal. Additionally, attention was given to visual aesthetics and branding, ensuring that the packaging design was appealing, informative, and reflective of the product's identity. Consideration was also given to eco-friendly packaging options to support sustainability and reduce environmental impact.

STATICAL ANALYSIS

The descriptive statistical analysis was performed using SPSS statistics software. The descriptive statistics were mean and standard deviation. Results were examined using one-way ANOVA test to calculate the significance of control and best selected variation.

RESULT AND DISCUSSION

Organoleptic Evaluation of Developed Broccoli and Cabbage Instant Soup Mix Powder. The 9-point hedonic scale was used to evaluate the sensory acceptability of the developed broccoli and cabbage powder-incorporated instant soup mix. This is one of

the most widely adopted methods for assessing food products based on consumer preferences. The soup mix powders were evaluated for six key sensory attributes: appearance, texture, flavour, colour, taste, and overall acceptability. All six formulations (Control, VI to V5) were subjected to organoleptic evaluation by a panel of semi-trained members.

Table - 7 Organoleptic Evaluation of Control and Variations of Broccoli-Cabbage Instant Soup Mix Powder

S. No	Sensory Attribute	Control	Variation I	Variation II	Variation III	Variation IV	Variation V
1	Appearance	8.03 ± 0.32	7.50 ± 0.78	7.47 ± 0.78	8.47 ± 0.78	7.30 ± 0.80	7.23 ± 0.93
2	Texture	7.97 ± 0.76	7.33 ± 0.76	7.03 ± 0.80	8.60 ± 0.85	7.10 ± 0.96	7.27 ± 0.78
3	Flavour	7.83 ± 0.70	7.20 ± 0.66	7.13 ± 0.68	8.50 ± 0.82	7.33 ± 0.84	7.27 ± 0.74
4	Colour	8.00 ± 0.90	7.57 ± 1.04	7.33 ± 0.96	8.40 ± 0.72	7.00 ± 1.05	7.03 ± 0.56
5	Taste	7.93 ± 0.78	7.20 ± 0.89	7.27 ± 0.58	8.73 ± 0.64	6.87 ± 0.94	6.97 ± 0.81
6	Overall Acceptability	7.83 ± 0.70	7.03 ± 0.67	7.27 ± 0.53	8.70 ± 0.79	7.10 ± 0.92	7.52 ± 0.85

*Values represent Mean ± Standard Deviation. Mean values with different superscripts within the same row were significantly different ($P < 0.05$) according to Duncan's Multiple Range Test.

The results presented in Table 12 indicate that Variation III (which included 30% incorporation of broccoli and cabbage powder) received the highest scores across all sensory parameters, including appearance, texture, flavour, colour, taste, and overall acceptability. According to Duncan's Multiple Range Test, these differences were statistically significant ($P < 0.05$) when compared to the control and other variations. The findings suggest that moderate incorporation (30%) of broccoli and cabbage powder not only enhances the nutritional profile but also improves sensory characteristics, making it the most acceptable formulation among the tested variations.

PHYSICOCHEMICAL ANALYSIS OF BROCCOLI AND CABBAGE POWDER

Oil Absorption Capacity

The oil absorption capacity (OAC) of the test sample was found to be 2.6 ml/g, which is significantly higher than the 1.5 ml/g observed in the control sample. This indicates that the broccoli and cabbage powder-incorporated instant soup mix has an enhanced capacity to absorb and retain oil. A higher oil absorption capacity contributes to improved mouthfeel and flavor retention in food formulations, and it can be advantageous in various food and industrial applications.

Water Absorption Capacity

Water Absorption Capacity (WAC) was assessed based on the method described by Charunuch et al. (2020). A 2.5 g sample was suspended in 30 ml of distilled water in a 50 ml centrifuge tube and stirred intermittently over 30 minutes. The mixture was then centrifuged at 3000 rpm for 10 minutes. The supernatant was carefully poured into a tared evaporating dish, and the remaining gel was weighed to determine the WAC. The test sample showed a water absorption capacity of 5.2 ml/g, compared to 4.2 ml/g in the control. Higher water and oil absorption capacities suggest that the test sample may exhibit superior functionality in food applications, improving the consistency, texture, and stability of the final product.

Table - 8 Physicochemical Analysis of Instant Soup Mix Powder: Control vs Test

S. No	Name of the Test	Test Sample	Control Sample
1	Water Absorption Capacity	5.2 ml/g	4.2 ml/g
2	Oil Absorption Capacity	2.6 ml/g	1.5 ml/g

The incorporation of broccoli and cabbage powder in the instant soup mix significantly enhanced the functional properties, particularly water absorption capacity (WAC) and oil absorption capacity (OAC), when compared to the control sample. The test sample exhibited a WAC of 5.2 ml/g and an OAC of 2.6 ml/g, whereas the control sample showed lower values of 4.2 ml/g and 1.5 ml/g, respectively. The increased water absorption capacity in the experimental soup mix may be attributed to the high dietary fiber content of broccoli and cabbage, which are known to possess hydrophilic components that enhance water retention. High WAC is a desirable attribute in soup mixes, as it improves the texture and consistency of the final product after reconstitution, offering a thicker and more satisfying mouthfeel. Similarly, the higher oil absorption capacity can be linked to the amorphous cell structures of dehydrated

vegetables, which allow for better oil entrapment. Enhanced OAC contributes to better flavor retention and palatability, which is crucial for consumer acceptability. These findings are in agreement with earlier studies by Kumar et al. (2021) and Singh et al. (2010), who reported similar functional improvements upon incorporating vegetable powders into dry food mixes. Overall, the improved functional properties suggest that broccoli and cabbage powders are suitable candidates for incorporation into instant soup mixes. Their addition not only enhances nutritional quality but also improves the physicochemical behavior of the final product, thereby increasing its appeal in health-conscious and convenience food markets.

PROXIMATE COMPOSITION OF BROCCOLI AND CABBAGE INSTANT SOUP MIX POWDER

The nutritional analysis revealed that the incorporation of broccoli and cabbage powders substantially improved the proximate composition of the instant soup mix compared to the control. As shown in Figure - I, II and III, the test formulation demonstrated significantly higher values in terms of energy, carbohydrate, protein, and fat content, while the fiber content remained relatively consistent between both samples.

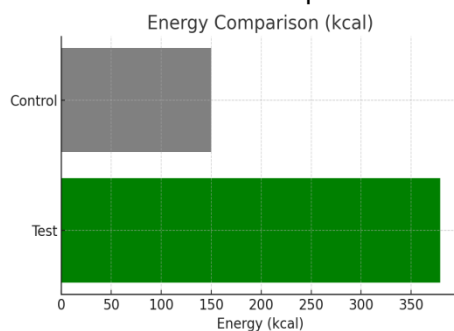


Figure - I

*Control - Source M Gunjal et al., 2024

The energy value of the test sample (379 kcal/100g) was markedly higher than the control (150 kcal/100g), likely due to the enhanced contribution from the nutrient-dense vegetable powders. This increase reflects the superior caloric contribution of broccoli and cabbage, making the mix more energy-rich and suitable as a light meal substitute or functional snack.

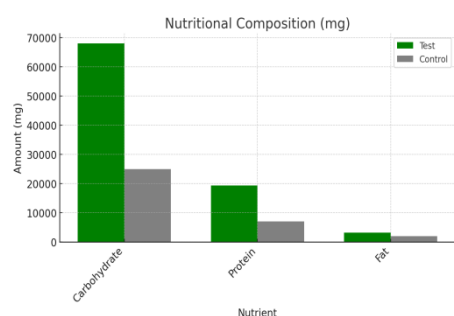


Figure - 2

*Control - Source M Gunjal et al., 2024

Similarly, the carbohydrate content showed a notable increase from 25 mg in the control to 68.1 mg in the test mix. This is consistent with the natural carbohydrate composition of cruciferous vegetables, which also contribute soluble and insoluble fiber that aid digestion and glycemic control. The protein content almost tripled in the test sample (19.4 mg) compared to the control (7 mg), suggesting that broccoli and cabbage can significantly enhance the protein density of plant-based products. This is particularly beneficial in vegetarian diets, where alternative protein sources are vital. Although the fat content remained low in both samples, a slight increase was observed in the test mix (3.2 mg) relative to the control (2 mg), which may be due to the presence of small amounts of natural lipids in the vegetable powders.

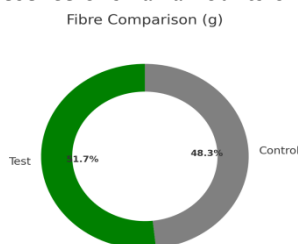


Figure - 3

*Control - Source M Gunjal et al., 2024

Interestingly, the fiber content remained fairly similar (7.5 g in the test and 7 g in the control), indicating that the base formulation already provided adequate dietary fiber, and the added vegetables maintained rather than greatly increased this value. These findings align with Gunjal et al. (2024), who reported improved macronutrient profiles in functional mixes fortified with vegetable powders. Overall, the test formulation demonstrated enhanced nutritional quality, making it a promising product for health-conscious consumers seeking nutrient-dense convenience foods.

SHELF LIFE ANALYSIS

The microbiological analysis of the soup mix powder revealed a Total Plate Count of 3×10^1 CFU/g and absence of yeast and mold. According to the test methods IS 5402:2012/ISO 4833:2003 and IS 5403:1999, the product meets the microbiological standards. These results indicate that the soup mix powder is safe for consumption and has a satisfactory microbiological quality. The study typically involves storing the powder in airtight containers at controlled temperatures and humidity levels, with regular assessments over a specified period. The results help determine the product's shelf life and provide insights into optimal storage conditions and packaging.

Table - 9 Shelf life study for Instant Soup Mix: Control and Test

S.NO	Name of the Test	No of Days	Result
Control Soup Mix			
1	Total Plate Count	1 st day	Absent
2		5 th day	Absent
3		10 th day	Absent
4		15 th day	Absent
Test Soup Mix			
1	Total Plate Count	1 st day	Absent
2		5 th day	Absent
3		10 th day	2×10 ¹
4		15 th day	4×10 ¹

The comparison between Broccoli and Cabbage Instant Soup Mix results and those reported by Kour et al. (2024) highlights a significant difference in shelf life based on microbial stability. In Broccoli and Cabbage Instant Soup Mix shelf-life study, both control and test Soup Mix showed no bacterial growth on days 0 and 1, with the test Soup Mix developing only minimal bacterial presence by day 10 (2×10^1 CFU/g) and day 15 (4×10^1 CFU/g). In contrast, the shelf-life evaluation conducted by Kour et al. (2024) demonstrated substantially higher bacterial counts, with soup mix showing 3.86 log CFU/g on day 0 and rising to 5.03 log CFU/g by day 15. Even the Soup Mix treated with antimicrobial nano-emulsions in their study had an initial microbial load of 3.49 log CFU/g, which gradually increased over the storage period. This sharp difference suggests that the shelf life of Broccoli and Cabbage Instant. Soup Mix is comparatively better in the early storage days due to slower microbial growth. The significantly lower bacterial counts in test Soup Mix reflect the effectiveness of Broccoli and Cabbage Instant Soup Mix formulation or preservation techniques in extending shelf life, potentially outperforming both conventional and nano-emulsion - Soup Mix preservation strategies under similar conditions (Kouret al., 2024).

Microbiological analysis of Broccoli and Cabbage Instant Soup mix Powder

The microbiological analysis of the protein energy bar indicates that it is within the acceptable limits for all tested parameters. The results suggest that the bar is safe for consumption and meets the required quality standards. Table-18 & Plate V shows the Microbiological composition soup mix powder.

Table: 10- Microbial analysis for Broccoli and Cabbage Instant Soup Mix Powder per 100gm

S.N	Nutritional Parameter	Test	Control
1	Total Plate Count	4×10^1 CFU/GM	5×10^1 CFU/gm
2	Yeast and Mold	Absent	Absent

The Broccoli and Cabbage Instant Soup Mix microbial safety profile is satisfactory, with Test revealing absent mold count. This indicates that the bar meets the required microbiological standards, ensuring consumer safety and preventing potential health risks associated with microbial contamination. The absent microbial counts suggest that the bar has been manufactured and stored under good hygiene practices, maintaining its quality and safety for consumption.

Cost Calculation

The production cost is a crucial factor in assessing Broccoli and Cabbage Powder incorporated Soup Mix for consumers. The costs involved in developing the value- added products were calculated based on the prices of raw materials at the time of purchase and during the developed phase and is compared with commercial Soup Mix available in the market.

Table: 11-Cost Calculation of Broccoli and Cabbage Instant Soup Mix powder per 100gm

INGREDIENTS	PRICE/KG/RUPEES	QUANTITY	PRICE RUPEES
Cabbage	35	30	14
Broccoli	150	30	75
Corn flour	100	20	2
Black pepper powder	130	3	2
Onion Powder	130	10	1
Tomato powder	188	10	2
Garlic powder	279	1.5	1
Cinnamon powder	400	1	1
Salt	25	5	1
Cumin powder	287	1.5	1
Mint powder	930	1.5	1
Total	2654	1.5	101

Analysis of the Broccoli and Cabbage Instant Soup Mix Powder revealed a competitive price of rupees 101 rupees per 112 grams, making it a highly economical alternative to convention Soup Mix available in the market. Based on Broccoli and Cabbage Instant Soup Mix provided ingredient costs, the total expense for producing 112g of Broccoli and Cabbage Instant Soup Mix Powder amounts to ₹101. This translates to approximately ₹50.37 per 50g. In comparison, commercially available Soup Mix are priced higher. For instance, Mixed Cook Veg-Up- Soup Mix at ₹250 per 100g, and Knorr sweet corn veg Soup Mix at ₹90 for 42g. Therefore, Broccoli and Cabbage Instant Soup Mix cost of ₹101 per 115g is competitive, especially considering its unique ingredients like Cabbage powder. This suggests that Broccoli and Cabbage Instant Soup Mix Powder formulation is cost-effective compared to many commercial alternatives.

PACKAGING AND LABELING

The packaging for the soup mix powder was designed to e airtight and moisture-resistant, utilizing materials such as plastic pouches, jars, or containers to preserve the product's flavor and texture. The labeling clearly displayed the product name, list of ingredients, nutritional information per serving, and preparation instructions. Compliance with local regulatory guidelines was ensured to maintain consumer safety and transparency. The packaging also reflected the brand's identity, was visually appealing to consumers, and incorporated eco-friendly options to reduce environmental impact.

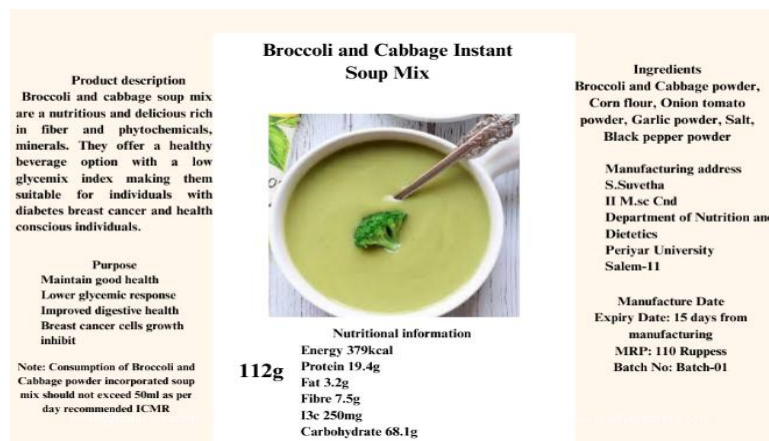


Plate - I Labelling of Instant Soup Mix



CONCLUSION

The present study successfully developed a value-added Broccoli and Cabbage Instant Soup Mix Powder enriched with functional and nutritional benefits. Among the five formulated variations, Variation III demonstrated superior sens attributes in terms of appearance, texture, flavour, colour, taste, and overall acceptability, as evaluated using a 9-point hedonic scale. Physicochemical analysis revealed that the test formulation had significantly higher oil (2.6 ml/g) and water absorption capacity (5.2 ml/g) compared to the control, indicating better functional properties suitable for dry soup mixes. Nutritional evaluation showed that the test sample was markedly richer in energy, protein, and carbohydrate content, making it a promising high-nutrient alternative to conventional soups. Microbiological studies confirmed the product's safety and shelf stability, with only minimal microbial growth observed over 15 days under controlled storage. Cost analysis revealed that the formulated soup mix (₹101/112g) is economically viable when compared to commercial alternatives, while also incorporating underutilized and highly nutritious ingredients like broccoli and cabbage powders. Overall, the developed soup mix powder demonstrates strong potential for commercial application as a healthy, convenient, and affordable food product, especially in addressing consumer demand for nutrient-dense, instant functional foods. Future studies may focus on extended shelf-life evaluation, nutrient retention during storage, and fortification with additional micronutrients.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

INFORMED CONSENT

Not Applicable.

ETHICAL STATEMENT

Not applicable

AUTHOR CONTRIBUTION

Concept - L.Venipriyadharshini (CA)

Design - L.Venipriyadharshini (CA)

Data collection - S.Suvetha (FA)

Analysis - S.Suvetha (FA)

Writing - S.Suvetha (FA)

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