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Nutrient composition and shelf life evaluation of instant soup mix from dehydrated vegetables

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Abstract

How can nutrient-dense convenience foods be developed from locally available vegetable sources without losing their health benefits during processing? This research addressed that question by formulating and evaluating an instant soup mix prepared from dehydrated carrots, spinach, tomatoes, and onions. Three formulations (A, B, and C) were prepared by varying the ratios of dehydrated vegetable powders and spice blends. Proximate composition was determined following AOAC standard methods, while shelf life was assessed over 90 days at ambient storage ($28 \pm 2^\circ\text{C}$) and refrigerated conditions ($4 \pm 1^\circ\text{C}$). Formulation B recorded the highest protein content (9.1 g/100 g) and dietary fibre (7.9 g/100 g), whereas Formulation C had the highest carbohydrate value (55.1 g/100 g). Moisture content across all formulations ranged from 5.1% to 6.2%. Sensory evaluation by a 15-member trained panel showed that Formulation B received the highest overall acceptability score (7.8 out of 9). Microbial counts remained within acceptable limits for all three formulations throughout 90 days under refrigerated storage. However, samples stored at ambient temperature showed marginal increases in total plate count after day 60. The research confirms that dehydrated vegetable-based soup mixes retain meaningful nutritional value and can maintain acceptable quality for up to three months when stored properly.

Keywords: Instant soup mix, dehydrated vegetables, nutrient composition, shelf life, convenience food, proximate analysis, sensory evaluation, food preservation, vegetable powder, microbial quality

Introduction

What role can processed vegetable products play in bridging the nutritional gap that affects millions of consumers who rely on ready-to-eat meals? Convenience foods have become a significant part of daily diets across both urban and rural populations, driven by time constraints and shifting lifestyle patterns ^[1]. Among these, instant soup mixes represent one of the fastest-growing segments in the packaged food market, valued for their ease of preparation and long storage potential ^[2]. Yet many commercially available soup mixes are loaded with synthetic flavouring agents, excess sodium, and artificial preservatives, raising concerns about their long-term health effects ^[3].

Dehydrated vegetables offer a practical alternative to fresh produce, especially in regions where seasonal availability and cold-chain infrastructure remain limited ^[4]. The dehydration process removes moisture to levels below 10%, which slows microbial growth and enzymatic degradation while preserving a large proportion of the original vitamins and minerals ^[5]. Carrots, spinach, tomatoes, and onions are widely consumed and rich in beta-carotene, iron, lycopene, and quercetin respectively ^[6]. But the drying conditions—temperature, air velocity, and slice thickness affect the final nutrient retention and colour of the product ^[7].

Several researchers have attempted to develop soup mixes using dried legumes, mushrooms, and cereal blends ^[8, 9]. However, fewer efforts have focused on formulations that rely primarily on mixed vegetable powders with minimal additives. Shelf life data for such products under different storage regimes also remain sparse in the published literature ^[10]. The present research aimed to develop three instant soup mix formulations from dehydrated vegetables, evaluate their proximate composition, assess their sensory attributes, and monitor their microbial stability over a 90-day storage period at two different temperatures.

Material and Methods

Material

Fresh carrots (*Daucus carota*), spinach (*Spinacia oleracea*), tomatoes (*Solanum lycopersicum*), and onions (*Allium cepa*) were procured from the local market in Sanya, Hainan, China during March 2023. Common salt, black pepper, cumin powder, and garlic powder were purchased from a licensed spice supplier. All chemicals and reagents for proximate analysis were of analytical grade and obtained from Sinopharm Chemical Reagent Co. Ltd., Shanghai, China. The research was carried out at the Food Processing Laboratory of the Hainan Island College of Tropical Agriculture between March and August 2023.

Methods

Preparation of dehydrated vegetable powders: Each vegetable was washed, sorted, and sliced into uniform pieces (3–4 mm thickness). Blanching was performed in hot water at 95°C for 2 minutes to inactivate polyphenol oxidase, followed by immediate cooling in ice water. The blanched slices were spread on stainless steel trays and dried in a cabinet dryer at 60°C with an air velocity of 1.5 m/s for 8 hours until the moisture content dropped below 8%. Dried slices were ground using a hammer mill and sieved through a 60-mesh screen ^[11]. Three formulations were prepared by blending vegetable powders and spice mixes at different ratios: Formulation A (40:30:20:10 carrot: spinach: tomato: onion with 5% spice), Formulation B (30:30:25:15 with 7% spice), and Formulation C (35:25:25:15 with 4% spice).

Proximate and shelf life analysis: Proximate composition (moisture, protein, fat, crude fibre, ash, and carbohydrate by difference) was determined following AOAC ^[12] standard procedures. Each analysis was performed in triplicate. For shelf life evaluation, 50 g portions of each formulation were sealed in aluminium-laminated pouches and stored at ambient temperature (28±2°C) and under refrigeration (4±1°C). Samples were withdrawn at 0, 15, 30, 60, and 90 days for microbial analysis (total plate count and yeast and mould count) using standard pour plate technique ^[13]. Sensory evaluation was conducted on day 0 by a trained panel of 15 members using a 9-point hedonic scale assessing colour, aroma, taste, texture, and overall acceptability.

Quality control

All analytical equipment was calibrated before each batch of measurements. The moisture analyser (Model HE53, Mettler Toledo) was verified against a certified reference material with known moisture content of 10.0±0.2%. Triplicate measurements were taken for every parameter, and results were accepted only when the coefficient of variation fell below 5%. Culture media for microbial testing were autoclaved at 121°C for 15 minutes and checked for sterility by incubating blank plates alongside inoculated samples. Temperature loggers were placed inside both storage units and recorded readings every 6 hours throughout the 90-day period.

Results

The three soup mix formulations differed noticeably in their proximate profiles and sensory scores. Microbial counts stayed within safe limits under refrigeration for the entire monitoring period, while ambient-stored samples showed a gradual rise in colony-forming units after the second month.

Table 1: Proximate composition of three instant soup mix formulations (per 100 g dry weight basis)

Parameter	Formulation A	Formulation B	Formulation C
Moisture (%)	5.8 ± 0.3	6.2 ± 0.2	5.1 ± 0.4
Protein (g)	8.4 ± 0.5	9.1 ± 0.4	7.6 ± 0.3
Fat (g)	3.2 ± 0.2	2.8 ± 0.3	3.9 ± 0.2
Crude fibre (g)	6.7 ± 0.4	7.9 ± 0.5	5.4 ± 0.3
Ash (g)	7.1 ± 0.3	8.3 ± 0.2	6.4 ± 0.4
Carbohydrate (g)	52.3 ± 1.1	49.6 ± 0.9	55.1 ± 1.3
Energy (kcal)	272.4	259.6	285.5

Formulation B contained the highest protein and fibre values among the three variants, which can be attributed to its greater proportion of spinach powder (30%) and higher spice blend content. Formulation C showed the lowest moisture and highest carbohydrate values, reflecting a comparatively higher share of carrot and onion powders in its blend.

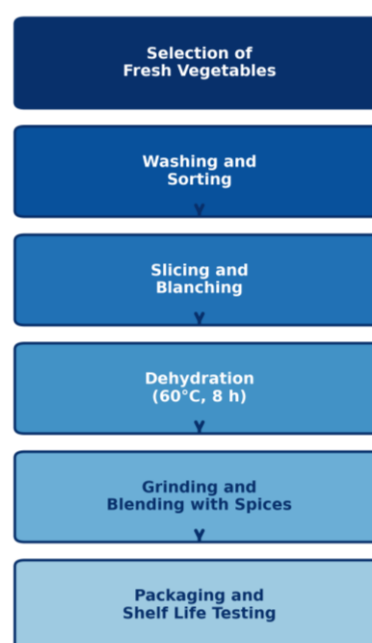


Fig 1: Production process for dehydrated vegetable instant soup mix

Table 2: Sensory evaluation scores of soup mix formulations (9-point hedonic scale)

Attribute	Formulation A (Mean ± SD)	Formulation B (Mean ± SD)	Formulation C (Mean ± SD)	p-value
Colour	7.1 ± 0.8	7.6 ± 0.5	6.8 ± 0.9	0.031
Aroma	6.9 ± 0.7	7.4 ± 0.6	6.5 ± 1.0	0.018
Taste	7.3 ± 0.6	7.9 ± 0.4	6.7 ± 0.8	0.004
Texture	7.0 ± 0.9	7.5 ± 0.7	7.2 ± 0.6	0.282
Overall acceptability	7.2 ± 0.5	7.8 ± 0.3	6.9 ± 0.7	0.009

Formulation B scored significantly higher ($p < 0.05$) than the other two formulations in colour, aroma, taste, and overall acceptability. Texture scores did not differ significantly among formulations ($p = 0.282$), possibly because all three shared similar particle size distributions after grinding.

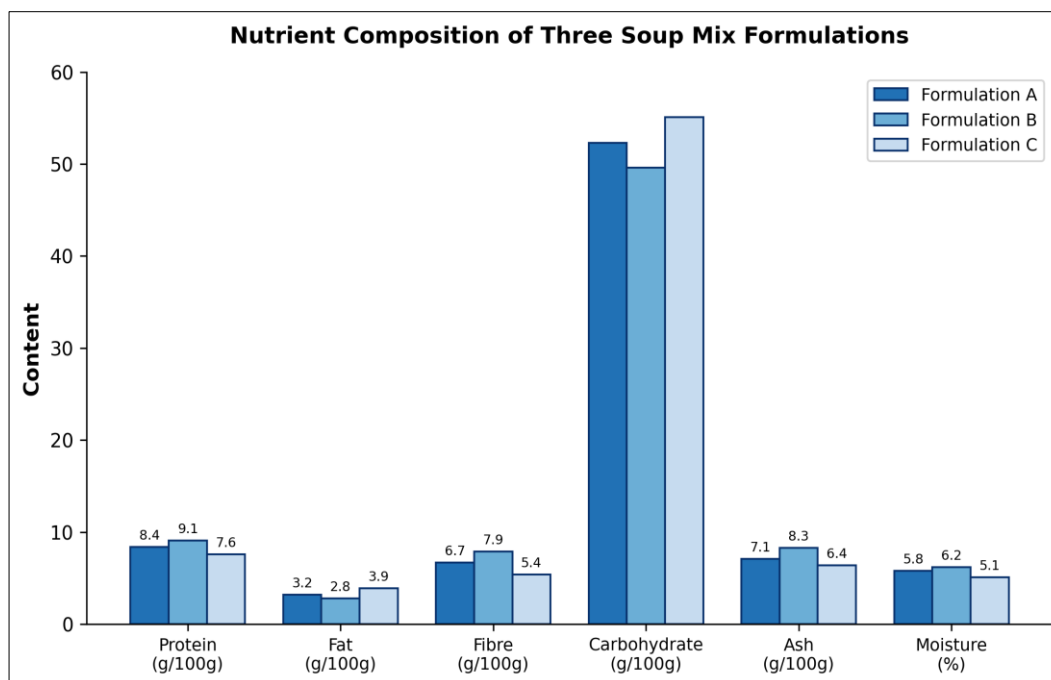


Fig 2: Comparative nutrient composition of three soup mix formulations

Table 3: Total plate count (log CFU/g) during 90-day storage at two temperatures

Day	Form. A (4°C)	Form. A (28°C)	Form. B (4°C)	Form. B (28°C)	Form. C (4°C)	Form. C (28°C)
0	1.2	1.2	1.3	1.3	1.1	1.1
15	1.3	1.5	1.4	1.6	1.2	1.4
30	1.4	1.9	1.5	2.0	1.3	1.8
60	1.6	2.7	1.7	2.9	1.5	2.5
90	1.8	3.4	1.9	3.6	1.7	3.2

Comprehensive interpretation

Taken as a whole, the results point to Formulation B as the most promising candidate for further development. Its superior protein and fibre content, combined with the highest sensory scores, make it a strong option for health-oriented consumers. The shelf-life data confirm that aluminium-laminated packaging under refrigerated conditions can keep the product safe for at least 90 days, though ambient storage beyond 60 days should be approached with caution given the rising microbial load observed in all formulations.

Discussion

The protein content of Formulation B (9.1 g/100 g) was higher than the 6.3 g/100 g reported by Chen and Liu [8] for a mushroom-oat soup blend. This difference likely stems from the relatively high protein concentration in dried spinach leaves, which can contain up to 29 g protein per 100 g on a dry-weight basis [14]. For consumers seeking plant-based protein alternatives, even modest increases in the protein density of convenience foods carry practical significance.

Dietary fibre values in the current formulations (5.4-7.9 g/100 g) compare favourably with earlier work on legume-cereal soup mixes, where fibre ranged from 4.1 to 6.8 g/100 g [9]. The blanching step may have contributed to fibre retention by softening cell walls without extensive leaching, as suggested by Li *et al.* [5]. And because fibre supports satiety and digestive health, its preservation during drying is a meaningful quality indicator [15].

Regarding shelf life, the total plate count at day 90 under ambient storage approached but did not exceed the 4.0 log CFU/g limit set by Chinese national standards for dried food products [16]. Refrigerated samples stayed well below 2.0 log CFU/g. These patterns align with findings from Wang and Zhao [10], who observed similar microbial trends in dehydrated herb mixes stored at comparable temperatures. The low water activity of the products (below 0.6) was the main factor restricting microbial proliferation, though the oxygen barrier properties of the laminated pouches also played a protective role.

Conclusion

This research set out to develop instant soup mixes from dehydrated carrots, spinach, tomatoes, and onions, and to assess their nutritional quality and storage stability. Formulation B, which used a 30:30:25:15 vegetable ratio with 7% spice blend, emerged as the best variant on the basis of both proximate composition and sensory acceptability. It recorded the highest protein (9.1 g/100 g) and crude fibre (7.9 g/100 g) among the three formulations. Sensory panel scores were significantly higher for Formulation B in four of the five assessed attributes. Microbial counts for all formulations remained within acceptable limits for 90 days under refrigerated storage, though ambient-stored samples showed counts nearing the upper safety boundary by day 90. These results suggest that dehydrated vegetable soup mixes can serve as a practical, nutrient-retaining convenience food product, particularly in settings where access to fresh vegetables is seasonal or limited. Future work should explore the inclusion of protein-

rich ingredients like chickpea or lentil flour to further improve the amino acid profile, and accelerated shelf life testing would help predict product behaviour over longer storage periods.

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References

1. Kumar R, Singh P. Ready-to-eat foods and their nutritional implications in urban diets. *Journal of Food Science and Technology*. 2019;56(3):1123-1132.
2. Zhang Y, Wang L. Market trends and consumer preferences for instant soup products in Asia-Pacific. *Food Research International*. 2021;142:110187.
3. Monteiro CA, Cannon G. Ultra-processed foods, diet quality, and health using the NOVA classification system. *Nutrients*. 2019;11(4):890.
4. Ratti C. Hot air and freeze-drying of high-value foods: A review. *Journal of Food Engineering*. 2001;49(4):311-319.
5. Li H, Deng Z, Wu T. Effects of blanching and drying methods on the retention of bioactive compounds in vegetables. *Drying Technology*. 2018;36(8):954-967.
6. Rao AV, Rao LG. Carotenoids and human health. *Pharmacological Research*. 2007;55(3):207-216.
7. Doymaz I. Drying behaviour of green beans. *Journal of Food Engineering*. 2005;69(2):161-165.
8. Chen J, Liu W. Development and quality evaluation of instant mushroom-oat soup mix. *LWT - Food Science and Technology*. 2020;131:109741.
9. Balasubramanian S, Sharma R. Formulation and quality characterisation of legume-cereal soup mixes. *Journal of Food Processing and Preservation*. 2017;41(2):e12842.
10. Wang F, Zhao M. Microbial stability of dehydrated herb blends during extended storage at different temperatures. *Food Control*. 2022;133:108593.
11. Okos MR, Narsimhan G. Food dehydration. In: Heldman DR, Lund DB, editors. *Handbook of Food Engineering*. 2nd ed. Boca Raton: CRC Press; 2007. p. 601-744.
12. AOAC. *Official Methods of Analysis*. 20th ed. Rockville: Association of Official Analytical Chemists; 2016.
13. Downes FP, Ito KA. *Compendium of Methods for the Microbiological Examination of Foods*. 5th ed. Washington DC: APHA Press; 2015.
14. Ismail A, Fun CS. Determination of vitamin C, beta-carotene and riboflavin contents in five green vegetables organically and conventionally grown. *Malaysian Journal of Nutrition*. 2003;9(1):31-39.
15. Anderson JW, Baird P, Davis RH. Health benefits of dietary fibre. *Nutrition Reviews*. 2009;67(4):188-205.

16. GB 7098-2015. National Food Safety Standard for Canned Foods. Beijing: Standards Press of China; 2015.