



Original Article



Development of Instant Keto Soup Powder by Incorporating Cauliflower for Weight Loss

Shanza Mukhtar^a, Noor Fatima^b, and Areeba Nazir^c

^a Institute of Home Sciences, University of Agriculture Faisalabad – Pakistan

^b National institute of Food Science and Technology, University of Agriculture Faisalabad – Pakistan

^c Department of Nutrition and Dietetics, The University of Faisalabad - Pakistan

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Abstract

Cauliflower is a cruciferous vegetable and a significant source of nutrients. Along with disease fighting properties, it has several weight loss friendly qualities. Being a superfood, its low caloric and high fiber content makes it worthy of the title. The aim of this study was to develop an instant keto soup powder incorporated with cauliflower in order to reduce the body weight. The proximate analysis evaluated the Moisture, Fat, Total carbohydrates, Crude protein, Energy, fiber content of the soup powder, likewise, TPC, TFC and DPPH tests analyzed the antioxidants activity of the finalized product. Various compositions T₀, T₁, T₂ and T₃ were formulated. The instant powder was obtained after dehydrating cauliflower and combining other essential ingredients that was reconstituted afterwards by boiling water for soup mix preparation. The results indicated that T₃ was the most suitable composition. The findings suggested that 40% cauliflower powder is the best composition for instant soup mix.

Keywords: Cauliflower, Keto Soup, Weight Loss, Antioxidants

Introduction

The Brassicaceae family comprises of significant vegetable crop known as cauliflower. The name cauliflower comprises of two words from Latin, 'caulis' meaning cabbage and 'floris' meaning flowers. It has been originated from 'Cole warts', simply known as the wild cabbage [1]. It is considered that cauliflower was earlier produced in the Mediterranean region particularly in Italy. Cyprus is the place where it emerged, from where it was transferred to places like Syria, Turkey, Egypt, Spain and Northwest Europe. In addition to a large group of white-curbed cultivars, the breeding techniques of cauliflower have resulted in genotypes producing white, orange, purple and green colours worldwide. India has the largest cauliflower production in the world with a wide range of varieties including Dania, Early kunwari, Hisar-1, Improved Japanese, Pant Gobi, Pant Shubra, Punjab Giant, Pusa Afghani, Pusa Deepali and many more.

It is cultivated for its heavily restrained curd or pre-floral fleshy apical meristem branches. The ideal temperature of the young plant is 23°C and in later development stage, 17-20°C is ideal. An optimum moisture supply is very crucial as the plants are extremely sensitive to drought. Cauliflower becomes ready to harvest when it is fully mature with clear white head with

15-20 cm diameter. Temporary storage can be achieved by using cool and high-humidity storage conditions. Among major pests affecting the vegetable include moths, root maggots, aphids and flea beetles [2]. Cauliflower is a great source of antioxidants that fight against free radicals and inflammation in the body. Just like the other cruciferous vegetables, along with these phytochemicals, cauliflower is particularly full of vitamin C, polyphenols and a minor number of carotenoids [3]. It is rich in vitamin B complex with high amounts of B₁, B₂, B₃, B₅ and folic acid as well as vitamin C, E, K and omega-3 fatty acids. Major minerals include potassium, phosphorus, magnesium, manganese and iron [4].

Cauliflower has a few properties that aid in weight loss. Firstly, it has low calories with only 25 kcal/cup that makes it an excellent low-calorie substitute for caloric dense foods for example flour and rice. The intake of fiber has been proven to be inversely proportional with body weight. Consuming high fiber foods reduces the energy intake and amount of energy absorbed from indigested foods. Additionally, it boosts up the bile acids excretion causing increased mobilization of fats stores resulting in driven hepatic synthesis [5]. Being a rich fiber source, cauliflower slows the digestion rate and therefore

promotes satiety, the feeling of fullness. This is one of the most vital characteristics of the vegetable that helps in weight maintenance as it automatically decreases the number of calories a person eats and induces satiety [6]. It is an excellent source of protein (16.1%), cellulose (16%) and hemicellulose (8%). High water content of cauliflower is another weight loss friendly quality, as a fact, 92 percent content of cauliflower is actually water. Consumption of low caloric and high-water content foods is linked with weight loss [7]. The glucosinolates present in this brassica vegetable are proven to be helpful in detoxification and reducing inflammation in the body. It decreases insulin and leptin resistance causing the body to metabolize more amount of carbohydrates and thus reducing fat storage ultimately leading to weight loss [8].

A ketogenic or commonly known as “keto” diet essentially comprises of high fat, moderate proteins and low carbohydrates. The dietary macronutrients are divided into 55-60% fats, 30-35% protein and 5-10% carbohydrates with approximately 20 to 50 grams carbohydrates in a 2000 kcal/day diet [9]. Ketogenic diets have been proven to be successful according to various researches, in fighting against obesity, hyperlipidemia, and some cardiovascular risk factors. In spite of consuming fat to satiety, people on ketogenic diet often experience rapid weight loss as the insulin levels fall and the body switches to a fat-burning mode. Such diet may not affect the body metabolism in the same way other diets do. A study conducted on energy expenditure showed that there was no significant change in the metabolic rate on a low carbohydrate diet whereas the low-fat diet slowed down the metabolism by more than 400 kcal/day [10].

The term soup is derived from two French words “soupe”, meaning “bread soaked in broth” and “sop” which refers to a slice of bread used to absorb soup or a thick stew [11]. Soup is a kind of dish made by adding meat, chicken, fish, beans and vegetables in liquids like milk, stock or water. Soup production is a continuously changing and inventive market on a global scale [12]. The vegetable soups and creams can be considered healthy due to their general composition and the presence of bioactive compounds, both attributed to their main ingredients (vegetables, legumes, cereals, etc., alone or combined). In addition, they are cheap and easy to preserve and prepare at home, so in consequence they are very useful in the modern life rhythms that modify the habits of current consumption [13]. As cauliflower is proven to be a good low caloric vegetable and aids in weight loss, this study is intended to fill the gap by traversing the findings and provide new inventions associated with instant soup mixes. Therefore, this study aims in developing dehydrated instant keto-soup powder incorporated with cauliflower in order to reduce body weight.

Objectives

- To determine the proximate composition of instant soup mixes with cauliflower powder.
- To develop a convenient and ready to consume meal in the form of soup that will fulfill consumer’s satiety.
- To prepare an innovative, nutritious and fibre rich product that will aid in weight loss.

Materials and Methodology

The research was carried out in the nutrition lab of Department of Nutrition and Dietetics in The University of Faisalabad, Punjab, Pakistan and the analytical tests were conducted in the laboratory of Agriculture University and Ayub Research, Faisalabad.

❖ Procurement of raw material

Fresh cauliflower was collected from the local vegetable market and other ingredients such as Chicken powder, Garlic powder, Onion powder, thyme herbs, salt and black pepper powder were obtained from Imtiaz Supermarket in Faisalabad.

❖ Preparation and Formulation of Instant Soup Powder

Firstly, fresh cauliflower was washed with distilled water and cut into small pieces. It was blanched for 3-4 minutes after which 1 glass of water was added and put to boil for 3-4 minutes at medium flame. After blanching, the flowers were spread in a tray after greasing it with ¼ teaspoon oil and air dried at 65°C for 8 hours in order to eliminate the moisture content of the vegetable. After dehydration, the dried cauliflower curds were converted into powder form by using a grinder. A mixture of dry powder was prepared by adding different ratios of obtained cauliflower powder, chicken powder, onion powder, garlic powder, salt, black pepper powder, thyme herbs were added in the powder mixture afterwards. At this stage, an instant soup powder was formulated and ready to be consumed after boiling.

❖ Study Plan

By using different ingredients as mentioned in Table 1, four distinct formulations of soup mixes were prepared. The formulations were taken with separate ingredients to analyze the sensory attributes [14]. T₀ was the control group. The soup was cooked by reconstituting the instant soup mix with boiled water. After passing the sensory and proximate analysis, the most suitable sample will be commercialized in the market as a final product.

Treatment	Cauliflower %	Chicken Powder %	Onion Powder %	Garlic Powder %	Corn Starch %	Egg
T ₀	-	60	10	5	20	1
T ₁	20	30	10	5	20	-
T ₂	30	20	10	5	15	1
T ₃	40	10	10	5	10	1

Table 1: Soup powder study plans

❖ Proximate Analysis

The proximate attributes including moisture, fat, total carbohydrates, crude protein, energy, fiber content of soup powder were analyzed through various methods. Moisture, fat, fiber content was determined by standard AOAC methods [15]. Protein content was examined by Kjeldahl method and by subtraction of measured protein, fat, moisture from 100, the total carbohydrates were determined (16). The protein content of the soup was analyzed using Kjeldahl Method. Fat content of the sample was analyzed by using acid hydrolysis method. For the analysis of fiber, enzymatic gravimetric method was used in which the sample was treated with several enzymes including amylase, protease and alpha amylase. Energy analysis was done to achieve the fuel value of the sample. For the analysis of fiber, enzymatic gravimetric method was used. Energy analysis was done to achieve the fuel value of the sample [17].

❖ Phenolic Content Assessment

The phenolic content of the product was determined by using Folin-Ciocalteu method. For the TFC analysis, colorimetric assay method was utilized. As a means of standard, catechin was used. DPPH assay was used for this procedure. 10 ml of the sample was utilized and 80mM DPPH assay or solution was added and left for 30 minutes for producing reaction. When the reaction occurred, absorbance was measured from the sample by spectrophotometer [18].

❖ Antimicrobial Activity

The analysis of antimicrobial activity of the soup powder was evaluated through the agar well diffusion method, widely used for the determination of microbial extracts and antimicrobial activity of plants [19].

❖ Sensory Evaluation

The sensory assessment of the instant soup mix was performed by using the scoring test [15]. Trained panelists evaluated the sensory attributes of the soup by assessing colour, taste, texture, appearance, consistency, smell and overall acceptability. The most common acceptance scale being used for a food product's sensory analysis is 9-point hedonic scale

[20]. Four prepared soups from the instant soup powder were placed on a tray and were labelled as T₀, T₁, T₂ and T₃ as shown in figure 1. Each expert was asked to give a score for every characteristic by using the hedonic scale score card [21].



Figure 1: Treatment Plans for Instant Soup Powder

Statistical Analysis

These analyses were carried out mainly by using ANOVA and finding out standard deviation and mean value of the results. Values were expressed as percentage and mean $\pm$ SD. The significance/non-significance of the results were analyzed by using one-way ANOVA and the means were separated using t test. ANOVA was particularly used to find the antimicrobial activity of the sample whereas, mean values and SD were applied to the other tests.

Results and Discussion

❖ Chemical Compositions of Soup Powder on Dry Basis

The moisture, protein, fat, ash and fiber of the soup powder were found to be 4.83%, 13.12%, 2.29%, 19.20% and 12.16% respectively in dry weight. According to a study conducted on white cauliflower by-product flour, the proximate results were illustrated as 7.65 ± 0.9 moisture, 22.02 ± 2.1 crude protein, 8.64 ± 1.1 ash and 10.05 ± 0.8 fiber in percentages [22]. However, the current study results as mentioned in Table 2 and figure 2, showed a lower % of moisture and protein content when compared to this previous study and a higher % of ash and fiber.

Parameters	Mean $\pm$ S. D
Moisture %	4.83 ± 0.03
Crude protein %	13.13 ± 0.03
Oil %	2.31 ± 0.03
Ash %	19.19 ± 0.05
Fibre %	12.18 ± 0.02

Table 2: Proximate Analysis of Instant Soup Powder on Dry Basis

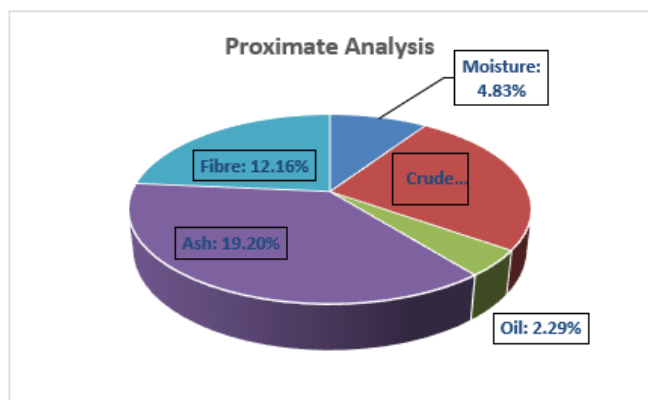


Figure 2 Proximate parameters shown in pie chart

❖ Minerals

The magnesium and sodium contents in this study were found to be 1.23 ± 0.01 and 6.53 ± 0.02 respectively. According to a study conducted on seaweed-based soup mix powder, the results of mineral analysis were demonstrated as 45.8 ± 0.98 Mg and 115.76 ± 0.56 Na [23]. However, the current study results as showed in Figure 3, indicated a lower percentage of magnesium and sodium when compared to the results of Jayasinghe.

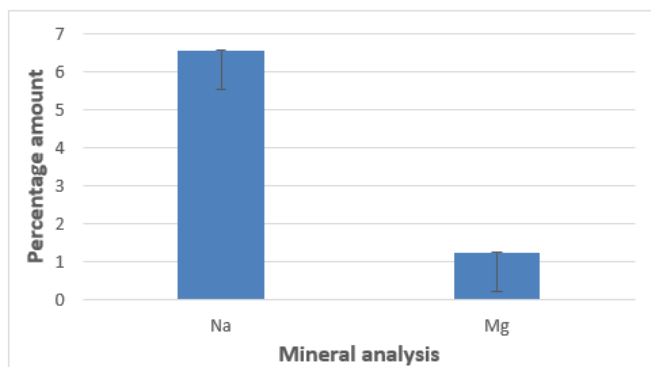


Figure 3: Mineral Contents of Soup Powder

❖ Free Radicals Scavenging Activity

The statistical evaluation of phenolic compounds of the soup powder were summed up as 481.22 ± 0.11 TPC mg GAE/mL, 1000.13 ± 0.32 TFC μ g CE/mL and 19.49 ± 0.33 DPPH Inhibition. A study on instant soups as dietary supplements evaluated the TPC, TFC and DPPH assay results as 1211.60 ± 2.41 , 249.27 ± 1.94 and 72.05 ± 0.98 in percentages respectively (24). The current study results as mentioned in Figure 4 appeared a lower % of TPC and DPPH when compared to this previous study and a higher % of TFC analysis.

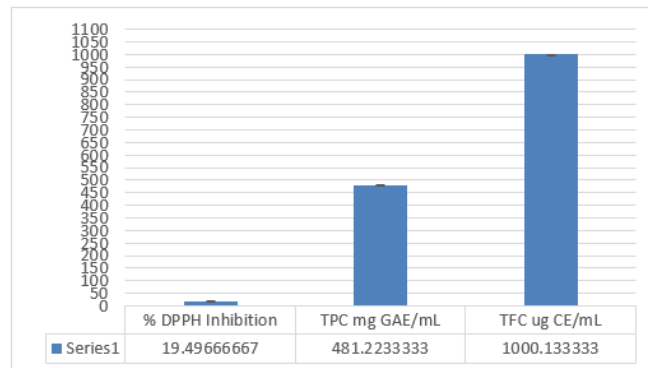


Figure 4: Phenolic Contents of the Soup Powder where, GAE = Galic Acid Equivalent, CE = Catechin equivalent

❖ Caloric Count

The cauliflower soup powder has an energy value of 92 kcal/100g according to the results. A previous study on vegetable soup analyzed the caloric value as 337.42 ± 0.05 or 337 kcal/100g whereas the current study depicts its value to be three times lower [25]. This comparison showed that the caloric evaluation of current study is significantly better than the previous studies mentioned, and is light and weight-loss friendly for one-time meal.

❖ Antimicrobial Activity

In order to find out the antimicrobial activity of the soup powder, one-way ANOVA was used as described below:

	<i>E. coli</i> (Zone in mm $\pm$ S.D)	<i>Bacillus subtilis</i> (Zone in mm $\pm$ S.D)
AF	4.39 ± 0.65	2.08 ± 0.03
Ciprofloxacin (Control+)	37.03 ± 0.29	34.18 ± 0.03

Table 3: Antimicrobial evaluation of soup powder in wet basis

The antimicrobial effects of essential oil of *S. edmondi* and nisin on *Staphylococcus aureus* in commercial soups were previously studied. A t-test was used for statistical evaluation which, on 9th and 21st days showed significant effect of temperature on the treatment. The SD on sampling days were described as 6.44 ± 0.01 and 6.27 ± 0 on 9th and 21st day respectively (26). In comparison to the current study as mentioned in Table 3, these results were significant as shown in figure 5.

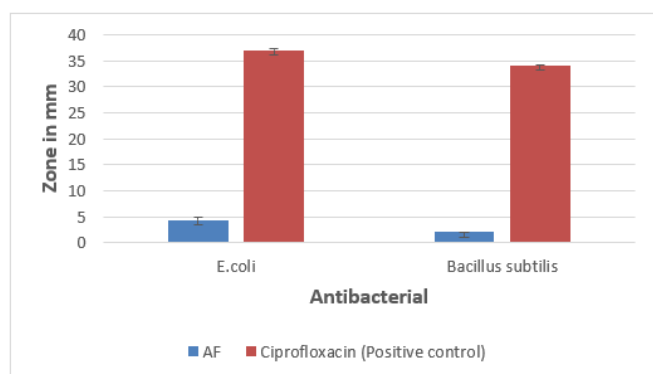


Figure 5: Antimicrobial Efficiency of Soup Powder

❖ Organoleptic Analysis

The study of food acceptance and the evaluation of its sensational and affective attributes are complicated by the fact that foods are often consumed within a context. The technique of evaluating foods using the five senses is commonly referred to as sensory evaluation. It analyses the food to ensure that it is appetizing in its overall appearance, aroma, taste, texture, consistency and flavor. The sensory tests evaluated that the soup sample T₃ with 40% cauliflower addition was more acceptable in overall acceptability than the other soups in all aspects and gets the highest score as “likes very much” by the panelists as shown in Figure 6. Results from the statistical analysis reveals that the p-value is less than (0.05), this shows that all of the sensory parameters results are significant.

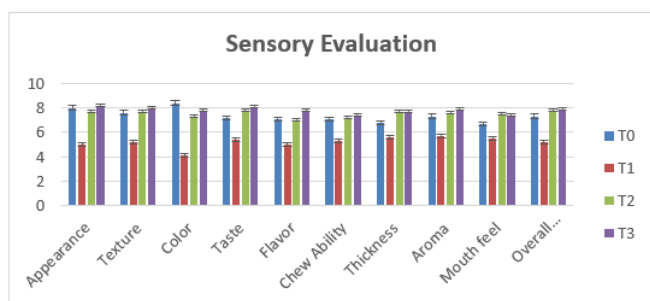


Figure 6: Statistical analysis of Sensory parameters of the Soup Powder

After the evaluation, T₃ was considered to be more acceptable in case of appearance than the other prepared soup samples. The mean value of T₃ was 8.2 ± 0.63 . The organoleptic texture test shows that the soup sample T₃ with 40% cauliflower powder gets the highest score in texture and is classified as “Likes very much” by the panelists. The sensory evaluation for colour concluded that T₃ gets the highest points in the hedonic scale for its bright appealing colour. There was only a slight difference in the tastes of T₂ and T₃. However, T₃ with 40% cauliflower powder gets the highest score and is classified as “likes very much” for taste by the panelists. T₂ gets second highest score with 30% cauliflower powder. The mean value of T₂ and T₃ were 7.8 ± 0.91 and 8.1 ± 0.73 respectively.

For the analysis of thickness, sample T₃ gets the highest score. Results based on statistical analysis show that the mean value of T₃ was 7.4 ± 0.96 , the p-value is less than (0.05) which exhibits that the results are significant. The mouth feels and

aroma tests concede that the T₃ soup sample with the addition of 40% cauliflower was more satisfactory than the other soups and gets the highest score in hedonic scale by the panelists. Data based on statistical analysis indicates that the p-value is less than (0.05) this shows that all of the results of sensory parameters are significant.

Conclusion

The aim of this study was to develop an innovative, ready mixed instant soup powder that provides all the nutrition required for a healthy weight loss journey. To add diversification in the market, this soup mix incorporated with cauliflower, is an excellent low-calorie substitute for caloric dense foods. Not only it saves time but the high fiber content helps in automatically reducing the number of calories individual eats and induces satiety. Several compositions T₀, T₁, T₂ and T₃ were formulated by the utilization of different ingredients in order to standardize the best combination for the development of instant soup mix. Among all, T₃ was selected as the most suitable formula with 40% cauliflower in organoleptic, functional and nutritional qualities.

Conflict of Interest: NIL

Funding Sources: NIL

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Declarations:

Authors' Contribution:

^aConceptualization, and intellectual revisions

^{b-c}Data collection, interpretation, and drafting of manuscript

- The authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed

Correspondence:

Shanza Mukhtar

shanzakhan1@yahoo.com