Food Research 8 (6) : 198 - 202 (December 2024)
Journal homepage: https://www.myfoodresearch.com

FOOD RESEARCH

RESEARCH PAPER

Chemical properties of instant pumpkin soup with the addition of porang flour

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Article history:
Received: 12 December 2022
Received in revised form: 2 March 2023
Accepted: 9 April 2024
Available Online: 6 December 2024

Keywords:
Pumpkin,
Porang flour,
Instant soup,
Chemical properties

DOI:
https://doi.org/10.26656/fr.2017.8(6).617

Abstract

Pumpkin is a source of β-carotene, vitamins, flavonoids, saccharides, water-soluble vitamins, mineral salts, and phenolics which are beneficial for health. Porang flour acts as a thickener and stabilizer from glucomannan content. This study aimed to determine the effect of adding porang flour on antioxidant activity, levels of β-carotene, levels of vitamin C, total phenolic, and dietary fiber of instant pumpkin soup. The experimental research method uses a one-factorial, completely randomized design (CRD) with five treatments and five replications. The research phase began with the preparation of instant pumpkin soup, with the addition of various variations of porang flour (0, 0.5, 1, 1.5 and 2%), then analysis was performed on antioxidant activity, levels of β-carotene, vitamin C, total phenolic and crude fiber. The results showed that increasing the concentration of porang flour caused an increase in antioxidant levels, total phenolic, crude fiber, also a decrease in β-carotene and vitamin C levels of instant pumpkin soup. It was concluded that adding 1.5% (w/w) porang flour produced instant pumpkin soup with the best chemical properties.

1. Introduction

Pumpkin (*Cucurbita moschata*) is a functional vegetable which is also used as a fruit with a distinctive aroma and taste. Pumpkin is known to be rich in phenolics, flavonoids, vitamins (β-carotene, vitamin A, vitamin C, and α-tocopherol), carbohydrates, and amino acids (Różyło *et al*., 2014; Nurrahman and Astuti, 2022). The carotenoid component is the compound responsible for the yellow color of the pumpkin. Fresh pumpkins contain carotenoids around 234.21 to 404.98 µg/g, of which about 60% is β-carotene which is classified as a potent antioxidant (Carvalho *et al*., 2014).

Pumpkin porridge has been developed into various products, one of which is instant soup (Setiawan *et al*., 2021). Instant soup is a dry food product processed with permitted thickening additives (Yulianti *et al*., 2020). Rif'an *et al*. (2017) have observed the effect of various types of dryers in making pumpkin instant soup and concluded that cabinet dryers could be used in making soup, taking into account the thickness of the pulp when dried. Apart from drying, thickening agents are one of the determining factors for the final product of instant soup (Fernández-López *et al*., 2020).

Generally, thickening agents often used in instant soups are gum, nutrient agar and maltodextrin. Recently, a study has developed porang as a thickening agent (Rosida *et al*., 2022). Porang (*Amorphophallus oncophyllus*) is a tuberous plant rich in glucomannan (Harmayani *et al*., 2014). Glucomannan from porang tubers has gelation properties and high viscosity (Yanuriati *et al*., 2017). Glucomannan has been confirmed to be able to increase viscoelasticity and improve noodle elasticity (Meng *et al*., 2021), this is due to its molecular structure which is rich in hydroxyl and carbonyl groups (Yan *et al*., 2012), showing a robust water absorption capacity (Wu and Zhong, 2016).

The addition of porang flour to the dough has been confirmed to improve the rheological and microstructural properties of the resulting product (Gong *et al*., 2019; Meng *et al*., 2021). In addition, the addition of porang flour was expected not to harm the product's functional properties. Therefore, this study investigates the effect of adding porang flour on antioxidant activity, levels of β-carotene, levels of vitamin C, phenolic total, and fiber content of instant pumpkin soup.

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eISSN: 2550-2166
Published by Rynnye Lyan Resources

2. Materials and methods

2.1 Materials

The porang pumpkin variety was collected from farmers in Semarang, Indonesia. Porang flour was obtained from the pilot plant of Brawijaya University, Indonesia. Chemical reagents include ascorbic acid, gallic acid, ethanol, Na_2CO_3, Folin-Ciocalteu solution, H_2SO_4, NaOH, and K_2SO_4 pro analysis were from Sigma -Aldrich.

2.2 Instant pumpkin soup production

The preparation of instant pumpkin soup was based on the method described by Rif'an *et al*. (2017) with modifications. Pumpkin puree (500 g) with 6% skim milk (w/w) is mixed with chicken stock (1:1 w/v), and 40 g of seasoning is added. The mixture was then homogenized. Porang flour (0, 0.5, 1, 1.5 and 2%) was added to the mixture and cooked until boiling for 5 mins. Pumpkin soup that had been processed was then poured into a glass tin, the thickness of the soup was set to 1-2 cm, and then dried in a drying cabinet at 60-70°C for 6 h. After drying, the pumpkin soup was ground with a blender to form a fine powder measuring <60 mesh. The instant pumpkin soup was stored in the freezer until analyzed.

2.3. Antioxidant activities

Antioxidant activity refers to the method described by Xu and Chang (2007). A 0.5 g instant soup was prepared into a test tube containing 10 mL of 96% ethanol and was incubated for 24 hrs at room temperature. The sample was then vortexed, and the extract obtained was stored in a test tube in the dark. A total of 0.2 mL of sample extract was added to 3.9 mL of 1,1-diphenyl-2-pycrylhidrazil (DPPH), then vortexed for 1 min. Then the absorption was measured at a wavelength of 517 nm using a UV-Vis spectrophotometer. The antioxidant activity was calculated as below:

Antioxidant activity (%) = 100 - (Absorbance sample-absorbance blank/absorbance control)×100

2.4 Beta-carotene content

Determination of ß-carotene levels refers to the method described by Carvalho *et al.* (2012), with modifications. A sample of 50 mg was mixed with 50 mL of petroleum ether. Then 2 mL of the diluted sample was pipetted into a 10 mL volumetric flask and adjusted using petroleum ether. The absorption wavelength of the sample was read at 450 nm. The standard solution was prepared using pure ß-carotene reagent (6-14 ppm) with 96% ethanol solvent. The absorbance was measured at a wavelength of 450 nm to obtain the linear regression equation.

2.5 Vitamin C

The vitamin C levels were determined by soaking 200 mg of the sample in 100 mL of distilled water in a volumetric flask (Setiawan *et al*., 2014). The standard serial solution uses ascorbic acid (2-10 ppm) with distilled water as a solvent. The absorbance was read using a UV-Vis spectrophotometer at 265 nm.

2.6 Total phenolics

Determination of the total phenolic content of instant soup refers to the Pedro *et al.* (2016) method. Approximately 1 g of sample was mixed with 1 mL of 96% ethanol. The dissolved was taken at 0.2 mL, then 1 mL of 10% (v/v) Folin-Ciocalteu and 0.8 mL of 7.5% Na_2CO_3 were added. The mixture was stirred for 5 mins and incubated at 25°C for 60 mins. The absorbance was read at a wavelength of 765 nm. To determine total phenolic content using the equation of Gallic acid (10-50 ppm) standard curve.

2.7 Fiber content

Fiber content was determined using the Association of the Official Analytical Collaboration (AOAC) International method (2005). Approximately 1 g of sample was mixed with 50 mL of 1.25% H_2SO_4 and heated for 30 mins using a condenser. Then 50 mL of NaOH was added and heated for 20 mins. The liquid was filtered using a filter paper. The residue on the filter paper was cleaned using 50 mL of hot water, 25 mL of 10% K_2SO_4, and 25 mL of ethanol. Then the filter paper was dried and weighed. The fiber content was calculated as below:

Fiber content (%) = (residue weight/sample weight)×100

2.8. Statistical analysis

The study design used single-factor CRD (completely randomized design) with five treatments. The different treatment test was analyzed using One Way Anova, there is an effect of p-value < 0.05, continue with Duncan's test.

3. Results and discussion

3.1 Antioxidant activities

The antioxidant activity of instant pumpkin soup ranged from 28.80-30.30% RSA (Table 1). The higher addition of porang flour produced instant pumpkin soup with better antioxidant activity. Adding 2% porang flour to the formula produced instant pumpkin soup with the highest antioxidant activity, significantly different from all treatments. Antioxidants are compounds needed to prevent oxidative stress. Oxidative stress is a condition of an imbalance between antioxidants in the body and free radicals. Several factors, including pH influence the stability of antioxidants, porang is neutral, slightly alkaline with a pH of 6-7, while antioxidants are stable at pH 5-6, neutral, slightly acidic (Pasaribu *et al*., 2015; Yanuarti *et al*., 2017). Other factors that affect the stability of antioxidants are increased temperature, sun exposure, and oxidation. Drying time and using temperatures of 60-70°C allow the antioxidant activity to be damaged so that it decreases.

3.2 Beta-carotene content

β-carotene levels of instant pumpkin soup ranged from 46.29-50.41 ppm. The higher the addition of porang flour, the β-carotene content of a product is significantly reduced. Adding 1% porang flour was recommended because, statistically, it was no different from instant pumpkin soup without porang. Pumpkin generally contains β-carotene levels around 141.95 to 244.22 ppm (Carvalho *et al*., 2012). There was a very high decrease in β-carotene when pumpkin was processed into instant soup. This was because ß-Carotene, commonly called pro-vitamin A, is a compound containing retinol was easily damaged when heated to high temperatures (Agustina *et al*., 2019). However, even at low concentrations, the antioxidant activity contributed by β-carotene was quite effective.

3.3 Vitamin C

Vitamin C is a water-soluble vitamin that functions to repair tissues and body metabolism. The average levels of vitamin C in the instant pumpkin soup samples ranged from 160.58 to 189.71 mg/100 g. Vitamin C levels decreased by 29.13% with the addition of porang flour to the formula. The addition of 0.5% porang was recommended, this was because the levels of vitamin C produced are statistically no different from without the addition of porang flour. Porang flour is not a source of Vitamin C, so its addition will not contribute to instant soup's Vitamin C levels. Meanwhile, pumpkin is a food source of Vitamin C (Kulczyński and Gramza-Michałowska, 2019). Vitamin C is found in abundant quantities in many fruits and plays a role in preventing various diseases. This is associated with the ability to scavenge free radicals in biological systems (Block, 1991). It is just that the vitamin C content is sensitive to heat, generally decreasing significantly after drying and high-temperature processing (Ellong *et al*., 2015).

3.4 Total phenolics

The total phenol levels in the instant pumpkin soup samples ranged from 3.37 to 5.98 mg GAE/g. Total phenol levels increased by 2.61% with the addition of porang flour. Pumpkin and porang flour are good sources of phenolics. Pumpkin was known to contain a total phenolic of 24.27 mg GAE/g (Sari and Putri, 2018), while porang flour contains a total phenolic of 7.10 mg GAE/g (Kumar *et al*., 2017). The main phenolic content in pumpkin was the flavonoid group (Valenzuela *et al*., 2014). High temperatures during processing cause the formation of phenolic compounds (Que *et al*., 2008). This condition was quite favourable in the processing of pumpkin into instant soup using high temperatures. Total phenolic generally correlates with antioxidant activity, so the higher the entire phenolic content of a product, the higher the antioxidant activity (Wahyono *et al*., 2020).

3.5 Crude fiber

The average fiber content of instant pumpkin soup ranged from 24.01 to 45.04%. The results in Table 1 explain that the fiber content of instant pumpkin soup increased significantly with the addition of porang flour in the formula. Fiber consumption benefits human health, especially intestinal function (Ismaiel *et al*., 2016). The fiber component in pumpkin is generally part of insoluble dietary fiber, the ratio of which reaches 60.03% of total fiber (Bemfeito *et al*., 2020). Meanwhile, the fiber in porang flour was a component of glucomannan (Nurlela *et al*., 2021). Glucomannan is a part of soluble dietary fiber, which has hydrocolloid properties and high-calorie content (Behera and Ray, 2016). The glucomannan content in porang flour reaches

Table 1. Chemical properties of instant pumpkin soup.

Porang flour (%)	Parameters				
	Antioxidant activities % RSA	β-carotene (ppm)	Vitamin C (mg/100 g)	Total phenolics (mg GAE/g)	Fiber content (%)
0.0	28.80±0.57[e]	50.41±2.05[b]	189.71±0.72[c]	3.37±0.51[a]	24.01±1.92[a]
0.5	29.10±0.51[d]	48.29±2.04[b]	184.88±0.99[c]	4.09±0.18[b]	29.70±1.99[b]
1.0	29.40±0.31[c]	47.81±1.69[b]	176.13±0.48[b]	4.24±0.23[c]	32.12±0.98[bc]
1.5	30.00±0.55[b]	46.17±1.53[ab]	170.25±0.64[b]	5.23±0.94[d]	35.72±1.64[c]
2.0	30.30±0.46[a]	46.29±1.44[a]	160.68±0.18[a]	5.98±0.37[e]	45.04±1.54[d]

Values are presented as mean±SD. Values with different superscripts within the same column are statistically significantly different ($p<0.05$).

https://doi.org/10.26656/fr.2017.8(6).617

67.5% (Bahlawan *et al*., 2021), this condition underlies the increase in the fiber content of instant pumpkin soup along with the addition of porang flour.

4. Conclusion

All treatments significantly affected antioxidant activity, beta-carotene, vitamin C, total phenolics, and fiber. The recommended concentration of porang flour is 1.5%, and it produces the best instant pumpkin soup based on chemical properties.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

The authors are thankful to the Research Institute of the Muhammadiyah University of Semarang which facilitated this research.

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