



Valorization of Garlic Peel as a Potential Ingredient for the Development of ValueAdded Rice Based Snack Product Pukhelein

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Abstract

The present study was designed to develop and evaluate the nutritional, functional, sensory properties and texture profile data of garlic peel powder fortified viz. 2%, 5% and 10% value added pukhelein and compared with control sample. Garlic peel showed crude fiber, carbohydrate and ash content viz. 60.57%, 21.71% and 16.34%, total phenolic content (TPC) of 108.79 µg/ml GAE, total flavonoid content (TFC) of 33.27 mg Quercetin/ml and antioxidant activity (33.38 mg/ml) respectively. 5% formulation exhibited the highest crude fiber, protein content, TPC (326.6 µg/ml GAE), TFC (91.38 mg Quercetin/ml) and total antioxidant content (54.68 µg/ml). Sensory evaluation data showed good result in 5% formulation in terms of appearance, texture and taste. Texture profile analysis showed that a considerable decrease in hardness, springiness, cohesiveness, gumminess and chewiness and resilience. The outcome of the study revealed that 5% garlic peel powder fortified pukhelein exhibited the best result among all formulations.

Keywords: Garlic peel, Utilization, Functional components, Sensory properties, Value addition, Pukhelein.

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Ethical: This study followed all ethical practices during writing.

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Contribution of this paper to the literature

This study contributes to existing literature by emphasizing the development and evaluation of garlic peel powder fortified rice based innovative value-added snack product pukhelein with respect to nutrition, functional, sensorial and textural properties.

1. Introduction

Garlic (*Allium sativum*) is a species of bulbous flowering plant in the genus *Allium* and has been known since the ancient times to have many benefits. It is also used as a food ingredient all around the world because of its characteristic flavor and aroma. Garlic is considered as a medicine in many countries as it is believed to treat and prevent diseases like high blood pressure, coronary heart disease, high attack and cholesterol. It is also used in cancer treatment like breast cancer, prostate cancer colon and bladder cancer. It contains allicin and has high anti-fungal and anti-viral properties [1]. Through various studies, different parts of the plants have been shown to possess many properties which are valuable for functional ingredients for food and promoting health-beneficial effects [2, 3]. However, behind the well-known usefulness of garlic plant, there is one part of it which is still widely considered as waste. The garlic peel/skin is usually discarded directly without any further use [4]. Garlic peel could be used as an alternative for more costly waste water treatment processes. Due to the high consumption of garlic high amount of peels were discard, in the community. In regards to environment this waste was used as an adsorbent to remove methylene blue from aqueous solution [5]. Garlic peels also has high antimicrobial and antioxidant properties and its possibility of using it as a preservative in cooked beef [6]. There have been several efforts to study the potential of garlic peel even though they are still very limited. Rahmawati, et al. [7] was explored the phytochemical activities of garlic peel extract and its potential utilization as a natural food additive and functional ingredient in the future. There studies are of two phases; in the first phase they identify and compares the phytochemical content and their activities between aqueous and ethanolic extract. In the later phase, they focus on their extraction method and it was found that the highest amount of antioxidant activity, flavonoid and phenolic content could be obtained in treatment of raw material-solvent ratio 20gm/100ml. Ifesan, et al. [6] carried out research on the properties of Antioxidant and Antimicrobial garlic peel extract and its possible way of using it as a natural food additive and preservative in cooked beef. Chitsaz, et al. [8] did a study on the effects of garlic peel/peel in biochemical, haematological and digestive enzyme parameters of juvenile belunga species and its uses as feed formulation and there are also studies of which further agrees the effectiveness of garlic peel in marine organism and biochemical digestive enzyme, which was selected as a fish model due to its importance in commercial sturgeon aquaculture. Hameed and Ahmad [5] studied on the potential use of garlic peel for the removal of methylene blue from aqueous solution. Garlic peels a cheap and waste material, was found to be very effective to remove methylene blue from aqueous solution. Kallel, et al. [9] were reported on the phenolic extraction from the disposed garlic husk (GH) using different solvents (water, methanol and ethanol) and the result obtained stated that garlic husk is a potential source of natural antioxidant that can be used in different medicinal, biological and in food industry application. Based on the evidence provided by the studies above, there might be a possibility to utilize garlic peel and garlic peel extract as a natural food additive or even as a functional food or a value addition to any product in the future. This study was to determine the proximate composition, flavonoid content, phenolic content, antioxidant capacity and to investigate the nutritional, functional, textural and sensory qualities of value added garlic peel powder fortified pukhelein. Table 1 represents the availability of phytochemical components in garlic peel with respect to the ethanol and water extraction.

Table 1. List of phytochemical/functional components in garlic peel.

Secondary metabolites	Ethanol extract Garlic peel	Water extract Garlic peel
Alkaloid	-	-
Saponin	+	+
AGI	-	-
Antimicrobial activity (<i>S. cerevisiae</i>)	-	+
Flavonoid	+	+
Antioxidant activity	+	+
Phenolics	+	+

Note: +Indicates presence, - Indicates absences [10].

Table 2 represents the applicability of different categories of garlic waste in various food products and their beneficial activities.

Table 2. Summary table of potential application of different forms of garlic waste.

Form of garlic waste	Application matrix/ final product	Function/ benefits	Reference
Garlic peel powder	Cooking rice	Add vitamins and nutrients	[11]
Garlic peel powder	Wheat bread	Bread with enhance antioxidative properties	[11]
Ginger peel powder	Wheat flour extrudate	Enhance vitamin and antioxidant	[12]
Garlic peel extract	Soup	Enhance soup with flavor and nutritional component	[11]
Garlic peel powder	Beef	Use as a food additive	[13]
Garlic peel ash	Hair	Strengthen the hair	[12]
Garlic extract	Face	Treat against itchy skin	[11]

2. Materials and Methods

2.1 Collection of Samples

Garlic samples were purchased from the local market adjacent to the institute, Kokrajhar, Assam, India. Figure 1 illustrates the manufacturing flow diagram of garlic peel powder.

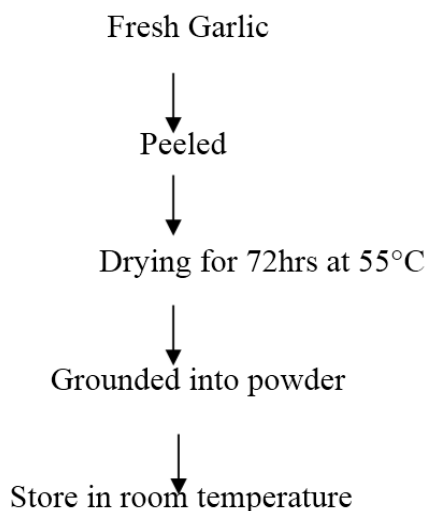


Figure 1. Processing of garlic peel powder.

2.2. Determination of Proximate Composition

2.2.1. Determination of Moisture Content

Moisture content of garlic peel was determined by the following formula according to the description of AOAC [14].

$$\text{Moisture (\%)} = \frac{(W_1 - W_2) \times 100}{W}$$

Where,

W₁ = Weight of the sample and the dish before drying.

W₂ = Weight of the dish after drying.

W = Weight of the sample.

2.2.2. Determination of Ash Content

Ash content of garlic peel was determined by using muffle furnace as described by AOAC [14].

$$\text{Ash (\%)} = \frac{W_2 - W_1 \times 100}{W_s}$$

Where,

W₂ = wt. of the crucible with ash.

W_s = wt. of the sample.

W₁ = Weight of the crucible.

2.2.3. Determination of Protein Content

Protein content of garlic peel was determined as described by Lowry, et al. [15].

2.2.4. Determination of Crude Fiber

Crude fiber of garlic peel was determined by the following formula as described by AOAC [14].

$$\text{Crude fiber \% by wt.} = \frac{(W_1 - W_2) \times 100}{W}$$

Where,

W₁ = wt. after drying.

W₂ = wt. after ashing

W = wt. of the sample

2.2.5. Determination of Crude Fat Content

Crude fat of garlic peel was determined by the following formula as described by AOAC [14].

$$\% \text{ Crude fat} = \frac{(W_2 - W_1) \times 100}{W}$$

Where,

W₁- weight of the flask.

W₂- weight of the flask and extracted fat,

W- weight of the sample

2.2.6. Determination of Carbohydrate Content

Carbohydrate content of garlic peel was determined by using the formula as described in anthrone method [16, 17].

$$\text{Concentration of unknown} = \frac{[(\text{Absorbance of unknown} \times \text{concentration of standard}) / \text{Absorbance of standard}]$$

2.3. Extraction of Sample

Extraction of samples was done by taking 1 g of garlic peel powder suspended in 35 mL of methanol were mixed and kept for 1 hour in a sonication bath. The extract was mixed rapidly by centrifuge for 10 minutes. The extract was filtered using Whatman filter paper and is store in the dark prior further analysis.

2.3.1. Determination of Total Phenolic Content (TPC)

Total phenolic content of garlic peel was estimated spectrophotometrically [18].

2.3.2. Determination of Total Flavonoid Content

Total flavonoids content of garlic peel was estimated by the method described by Malik and Singh [19].

2.3.3. Estimation of Total Antioxidant Capacity by DPPH (Radical Scavenging Activity)

Total antioxidant capacity (radical scavenging activity) was measured by using the free radical, DPPH (2,2-diphenyl-1-picrylhydrazyl) [20].

$$\text{Radical scavenging activity (\%)} = \left[\frac{A_0 - A_s}{A_0} \right] \times 100$$

Where, A₀ is absorbance of control (blank) and A_s is absorbance of sample extract

2.4. Utilization of Garlic Peel Powder in Traditional Food for the Development of Value-Added Product

Garlic peel powder contributes a significant role for the development of value added pukhelein. Figure 2 illustrates the manufacturing flow diagram of garlic peel powder fortified value added pukhelein.

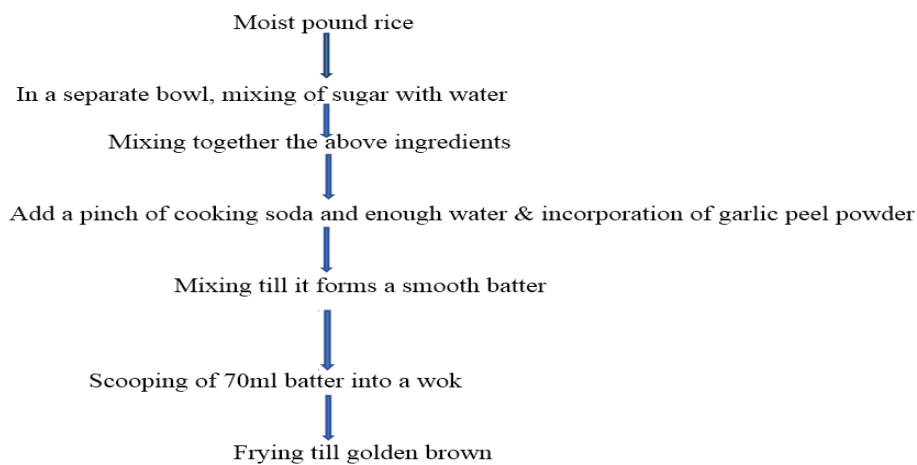


Figure 2. Development of garlic peel powder fortified traditional rice based product (Pukhelein).



Figure 3. Garlic peel powder fortified pukhelein.

Figure 3 illustrates the development of value added garlic peel powder fortified rice based snack product pukhelein.

2.5. Texture Profile Analysis

Texture profile analysis (TPA) was followed by instrumental method in terms of the different textural parameters e.g. hardness, chewiness, cohesiveness, gumminess, resilience and springiness [21].

2.6. Sensory Evaluation

Evaluation of sensory parameters was performed by nine point hedonic rating test as described by Ray [22].

2.7. Development of Value Added Rice Based Snack Pukhelein

Rice-based snack Pukhelein were prepared by incorporating of garlic peel powder in various proportions in rice flour. The product was shown in Figure 4.

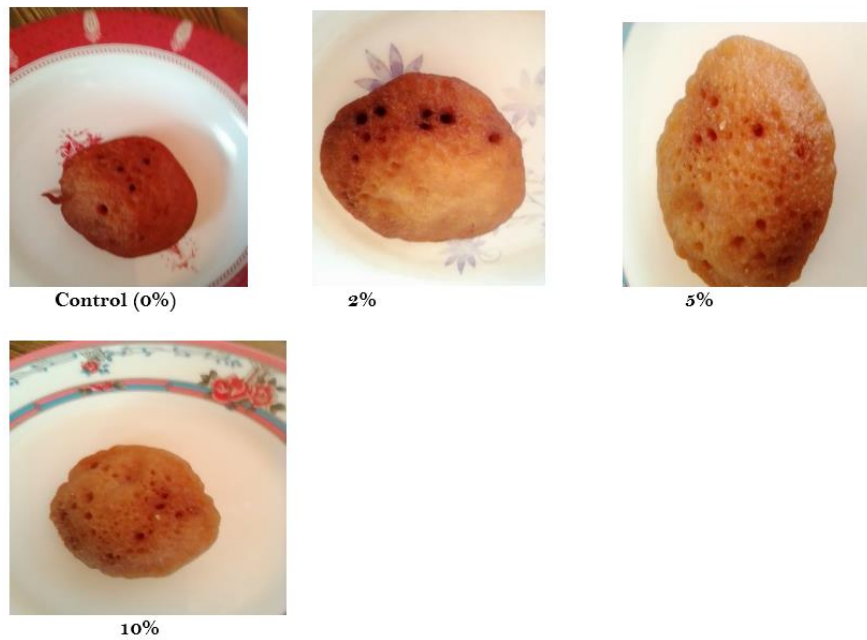


Figure 4. Pukhleins (Control and fortified with different proportions of garlic peel powder).

Table 3. Proximate Composition of Garlic peel.

Parameters (%)	Garlic peel
Ash	16.34
Carbohydrates	21.71
Crude fiber	60.57
Fat	0.83
Moisture content	3.36
Protein	8.24

3. Result and Discussion

3.1. Proximate Composition

Experimental result obtained from Table 3 showed that garlic peel was a very rich source of ash, crude fiber and protein content. However, a very negligible amount of lipid exists. Less moisture content established the profound by product stability. The result was significantly comparable with the result obtained by Kallel, et al. [9]. Significant mineral content of garlic peel indicates its potentiality of fortification and at the same time higher level of crude fiber directs its digestibility.

Table 4. Total phenolic, flavonoid and antioxidant content.

Functional parameters	Result
Total phenolic content (Gallic acid equivalent $\mu\text{g}/\text{ml}$)	108.7961351
Total flavonoid content (mg Quercetin/ml)	33.27
Antioxidant activity (mg/ml)	33.38

3.2. Phytochemical / Functional Composition in Garlic Peel Extract

Experimental result obtained from Table 4 showed that the total phenolic as 108.79 $\mu\text{g}/\text{ml}$ gallic acid equivalent, total flavonoid 33.27 mg/ml quercetin and antioxidant activity of 33.38 mg/ml respectively. TPC value showed higher value as compared with the result of Syeda, et al. [23]. Similarly, total flavonoids content (TFC) exhibited significantly enhanced value than the result obtained from Syeda, et al. [23]. Similarly, antioxidant activity by DPPH radical scavenging assay method exhibited the higher value than the experimental investigation of Syeda, et al. [23]. Moreover, the result revealed that garlic peel has a potential to be regarded as an anticancer as phenolic was used in cancer treatment [1]. Decades of research suggest people who eat more generous amount of antioxidant-rich food have increased protection against disease. Protection of food product was related to antioxidant ability responsible for providing fight against free radicals and reduces oxidative stress. The result of the study showed better result in terms of methanol extracted total antioxidant capacity (TAC) or antioxidant activity than Kotenkova and Kupaeva [24].

3.3. Proximate Composition of Garlic Peel Powder Fortified Pukhleins

The proximate composition of value-added rice-based snack (Pukhleins) will be represented in Table 5.

Table 5. Proximate composition of value added pukhleins.

Parameters	Control	2%	5%	10%
Ash	0.39	0.51	0.56	0.53
Carbohydrates	54.7	55.4	55	55.5
Fats	16.1	15.8	15.3	14.6
Crude fibre	2.39	2.53	5.1	3.8
Protein	4.07	5.9	6.05	5.8
Moisture	20.2	19.8	19.3	18.4

Experimental result revealed that the incorporation of garlic peel powder increases the ash and crude fiber in the value-added product (Pukhleins). Higher ash content means high in mineral content in the garlic peel. Similarly,

the crude fibre is increased as the garlic peel is rich in crude fibre. The incorporation of garlic peels exhibited increasing protein content but decreasing fat content in the valued- added product. Therefore, while comparing all formulations of garlic peel powder fortified value added product, 5% formulation showed better result in terms of increased level of ash, crude fiber and protein content.

3.4. Functional Potential of Value- Added Pukhlelin

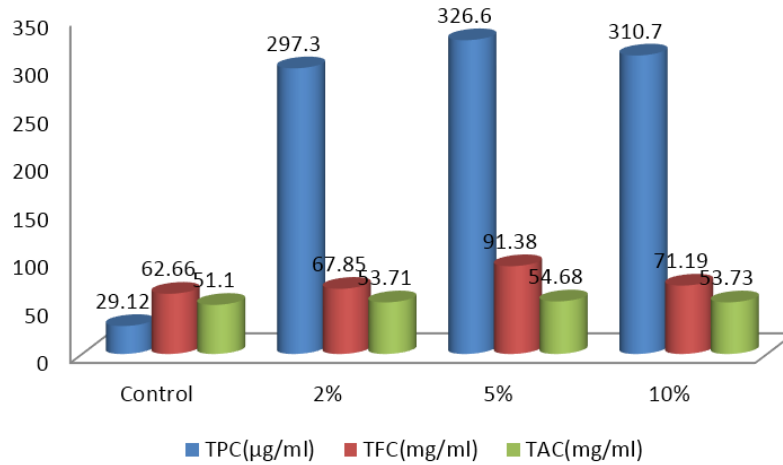


Figure 5. Functional potential of value-added rice based snack (Pukhlelin) with different proportion of garlic peel powder.

Figure 5 showed that 5% garlic peel powder fortified value added pukhelein contains maximum amount of total phenolic content (TPC), total flavonoids content (TFC) and total antioxidant capacity (TAC). In general garlic peel powder addition to pukhelein enhanced the functional potential due to the occurrence of function components in significant level. Moreover, 5% formulation showed the better result due to possibly the release of potential functional components in comparison to other.

3.5. Sensory Evaluation

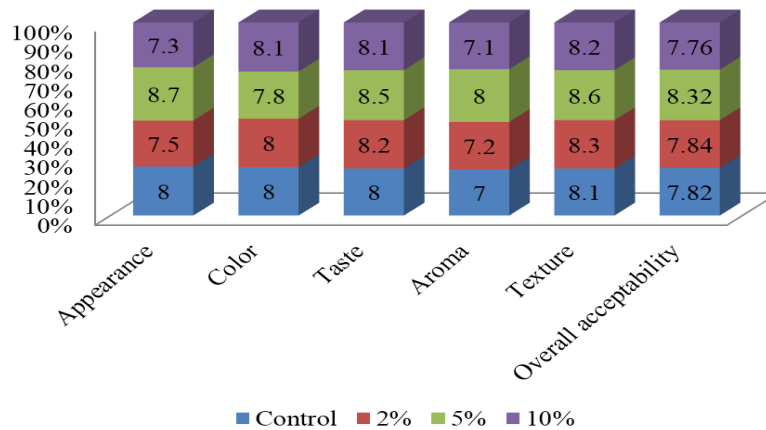


Figure 6. Sensory evaluation of value-added rice snack (Pukhlelin) with different proportion of garlic peel powder

Figure 6 illustrates the evaluation of sensory parameters of formulated garlic peel powder value added pukhelein. Sensory evaluation was done by using nine point hedonic rating test. In this investigation, the sensory panel was constituted by twenty five panellist including faculty members, PG and Ph.D.scholars of the institute. Based on the evaluation of panellist, it was found that 5% garlic peel powder fortified rice based snack pukhelein exhibited the best result in terms of appearance, taste, aroma, texture and overall acceptability in comparison to other formulations. No such comparative data of other researchers were found.

3.6. Textural Characteristics of Value-Added Rice Snack (Pukhlelin) With Different Proportion of Garlic Peel Powder

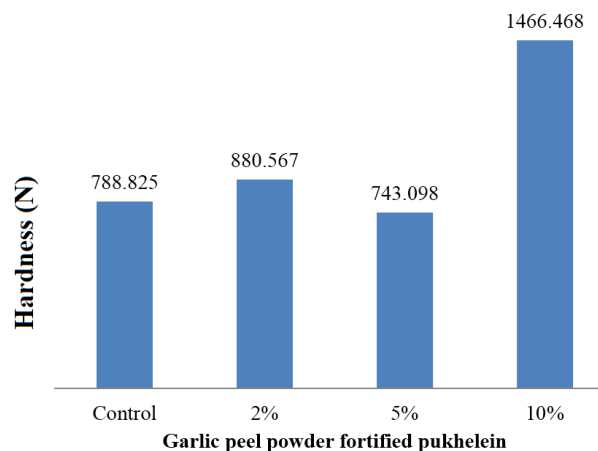


Figure 7. Hardness of fortified pukhelein.

Figure 7 represents the hardness as one of the important textural attribute of value added garlic peel powder rice based snack pukhelein.

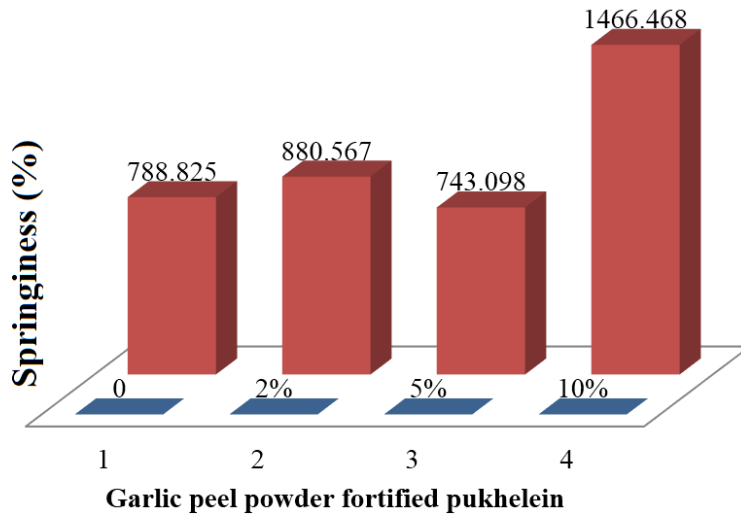


Figure 8. Springiness of fortified pukhelein.

Figure 8 represents the springiness as one of the important textural attribute of value added garlic peel powder rice based snack pukhelein.

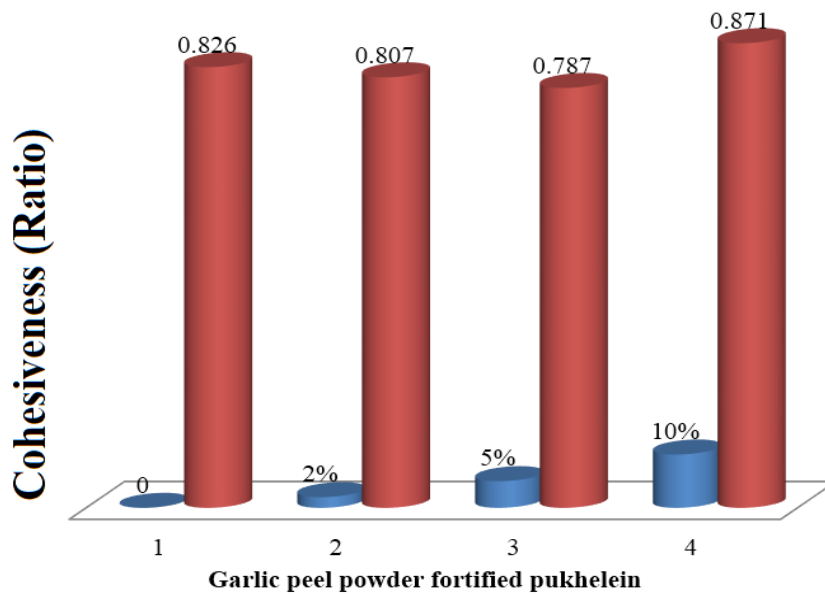


Figure 9. Cohesiveness of fortified pukhelein.

Figure 9 represents the cohesiveness as one of the important textural attribute of value added garlic peel powder rice based snack pukhelein.

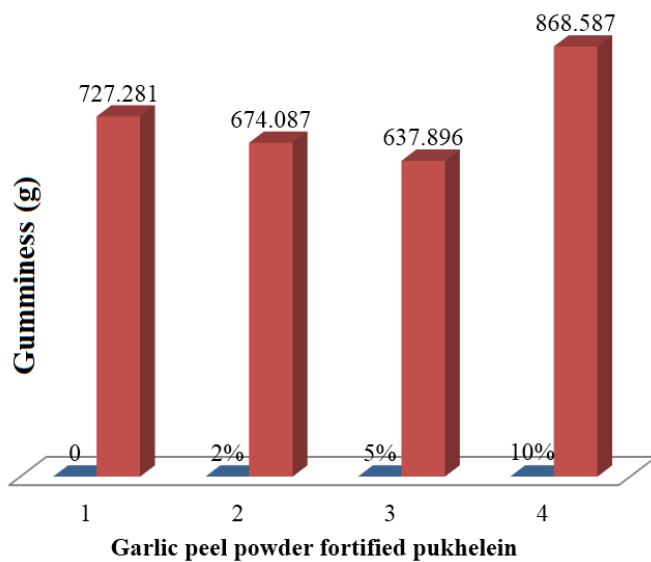


Figure 10. Gumminess of fortified pukhelein.

Figure 10 illustrates the gumminess as one of the important textural attribute of value added garlic peel powder rice based snack pukhelein.

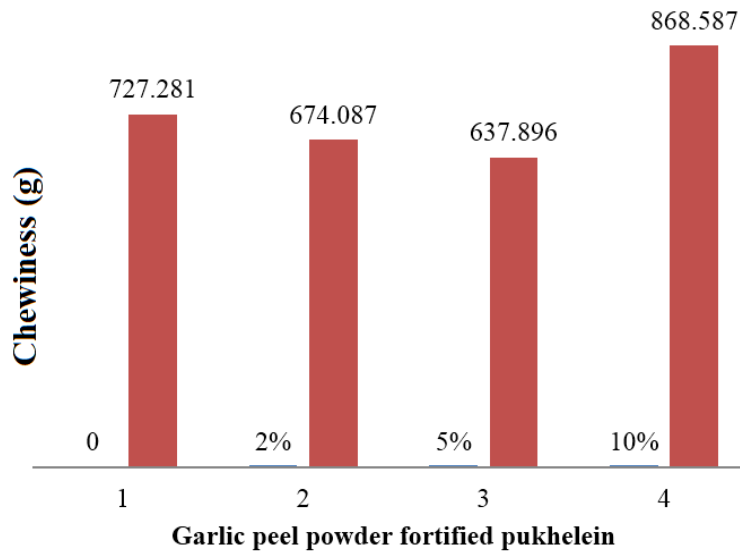


Figure 11. Chewiness of fortified pukhelein.

Figure 11 illustrates the chewiness as one of the important textural attribute of value added garlic peel powder rice based snack pukhelein.

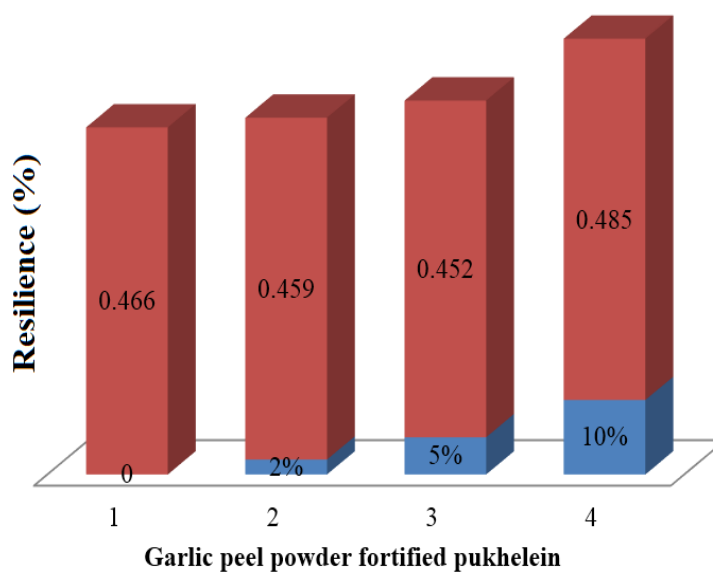


Figure 12. Resilience of fortified pukhelein.

Figure 12 illustrates the resilience as one of the important textural attribute of value added garlic peel powder rice based snack pukhelein.

Experimental investigation based upon various figures viz. hardness, springiness, cohesiveness, chewiness, gumminess and resilience obtained from texture profile analysis (TPA) revealed the significance of 5% garlic peel powder in comparison to other formulations e.g.2%, 10% and even control i.e.0% fortified pukhelein due to decreased value. These characteristics established it as a novel product. No such comparative data of other researchers were found in this endeavour.

4. Conclusion

In this study, garlic peel as a valuable by product was considered for the development of value added product pukhelein. Different properties viz. nutritional, functional, sensory and textural attributes were analyzed for control,2%,5% and 10% garlic peel powder fortified value added product. Finally, after considering all analytical data and sensory perception it was established that 5% formulation was considered to be the best one.

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