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Research Article

Quality attributes of cakes prepared from wheat (*Triticum aestivum* L.) and cowpea flour (*Vigna unguiculata* L.)

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Citation

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Abstract

The demand of the consumer changing for new products due to the high rate of diabetes and obesity disease is causing an unparalleled spike within the bakery production sector. Consumers demand better products that are low in sugar, cholesterol, and incorporate health-promoting components such as protein and fibers. In the present study, a bakery product i.e., cake was developed from wheat flour with the addition of cowpea in different ratios (0%, 20%, 40% and 50%) to evaluate the nutritional as well as sensory properties. Four cake samples were developed with different formulations such as wheat flour 100% as a control (T1), Wheat flour and cowpea flour with ratio of 80:20, 60:40, and 50:50 (T2, T3, T4) respectively. The proximate composition showed that wheat flour (WF) had higher protein content, carbohydrate, and moisture with 15.70%, 79.50%, and 13.55% respectively. Whereas cowpea flour (CPF) had higher fiber, fat, ash content with 75.72%, 3.70%, 0.70% respectively. The proximate composition of the cakes varied significantly with cake produced from cowpea flour having the nutritional composition with the increased ratio of CPF significantly. Moreover, sensory attributes of cake (T3) such as color, texture, taste, and overall acceptability were found significant. It is concluded that the incorporation of cowpea flour in wheat-based cakes can increase nutritional values and consumer preferences to mitigate nutritional deficiencies. Thus, wheat flour fortification with lentil flour might be a good option for controlling protein malnutrition, diabetic disease and iron and zinc deficiency.

Keywords: Cake, Cowpea; Wheat flour; Nutrition

Introduction

Cereals and pulses are good sources of fiber; protein energy are consumed as staple food [1]. Almost all bakery products are made from cereals, but the incorporation of nutrient-dense pulses helps to confer health benefits due to high protein and dietary fiber content [2]. Nowadays, bakery products have become the most important staple food of the world [3] with increasing consumer preference. From the last decay, most of the population have increased in consumption of cereal foods such as biscuits/cookies, bread and cakes particularly between school

children and the importance of the acceptance of bakery product, particularly texture, a key attribute of the product [4-7]. Wheat (Triticum aestivum L.) is one of the major food crops of the world including Pakistan being consumed as the staple food of the one-third world's population. Wheat is considered an indicator of food security in Pakistan, with 9178 thousand hectares of agricultural land covered by wheat crops this year. Despite higher yield potential, Pakistan's average yield is much lower than in most other countries. Wheat is the primary source of food for a large portion of the world's population. It ranks first among cereal crops affected by climate change in Pakistan [8]. It is a staple food for the people of Pakistan and meets most dietary requirements, providing approximately 60% of the calories and protein of the average die [9].

Cowpea (*Vigna unguiculata* L.) is likewise imperative staple nourishment for a huge number of generally destitute individuals in less created nations [10]. Cowpea is a common legume crop planted and used for human and livestock diets all over the world. Cowpeas have obtained more importance recently from consumers and researchers globally because of its exerted health-beneficial properties, comprising anti-diabetic, anti-cancer, anti-hyperlipidemic, anti-inflammatory and anti-hypertensive properties.

Cowpea is a nutritious component in the human diet as well as livestock feed. It is of major importance to the livelihoods of millions of people in developing countries because it is an important source of proteins, minerals and vitamins. The leaves, pods and seeds of cowpea are consumed [11]. Cowpea is a common legume crop planted and used for human and livestock diets all over the world. Cowpeas have obtained more importance recently from consumers and researchers globally because of their exerted health-beneficial properties, comprising anti-diabetic, anti-cancer, anti-hyperlipidemic, anti-inflammatory and anti-hypertensive properties. The use of cowpea flour in the production of gluten-free cake to combat the prevalence of autism and celiac disease (CD), an intolerance of gluten, has been reported to be as high as one in 200 of the world population. The use of wheat-based composite flours in the production of cookies [12].

The flour to produce these products is mainly obtained from wheat or other cereals and availability of adequate supply of wheat flour has been a major political and economic issue [13]. Several cake recipes can be classified based on their complement such as coffee cakes, instance cakes, or based, primarily on ingredients and cooking techniques. Cake may be small and intended for individual consumption such as queen cake while longer cakes are cut, sliced and served as part of a meal or social functions [14]. Besides the nutritional benefits that can be derived from cowpeas, it is one of the drought-resistant food crops, especially in rural settings. The enrichment of cereal-based foods with legume protein has received considerable attention because cereal proteins are generally low in lysine and total protein content although high in sulfur amino acids [15]. There is a demand for less affluent proteins with good nutritional and functional properties, particularly in developing and underdeveloped countries. Keeping in view the above importance of wheat and cowpea the present study was designed to find out the effect of the addition of different proportions of powder for the preparation of cake with cowpea and wheat and to analyze the quality characteristics of the produced cakes which included the physico-chemical and sensory properties of the product.

Materials and Methods

Sample collection

The cowpea sample was collected from the seed section, department of Agronomy, Sindh Agriculture University Tandojam. Wheat flour and other ingredients of cake were procured from supermarket in Hyderabad.

Preparation of cowpea flour

Cowpea sample was brought to the cereal science laboratory and flour was prepared according to the method described by [16] with minor modification. In brief, the cleaned cowpea was soaked for 6 to 12 hours followed by oven drying at 50°C for 18-24 hours and ground in a laboratory mill (3100, Perten Instruments, Sweden) followed by sieving through 100 µm mesh size sieve. The sieved flour was packed in airtight bags and stored at 4°C for further analysis.

Proximate composition of cowpea and wheat flour

The moisture, protein, fat, crude fiber, ash and carbohydrate of the wheat flour, cowpea flour and cakes were carried out using methods described by [17].

Cake formulation

The cowpea flour cake was prepared by following the method of [11], with slight modification (Fig. 1). The cowpea cake was prepared by adding different proportions of wheat and cowpea flour by mixing with cake ingredients 200 g flour, 100 g sugar, 150 g melted butter, 5 g baking powder, 2 eggs, and a half teaspoon of vanilla essence. Initially, sugar was mixed with butter and egg. The mixture was whipped in Kenwood (Chef Premier KMCS 10, China) for 20 min and dissolved granulated sugar, finally flour, baking powder and vanilla essence were added and the batter was mixed at medium speed for 5 min. The batter was poured into greased pans and baked at 180 °C for 20 min.

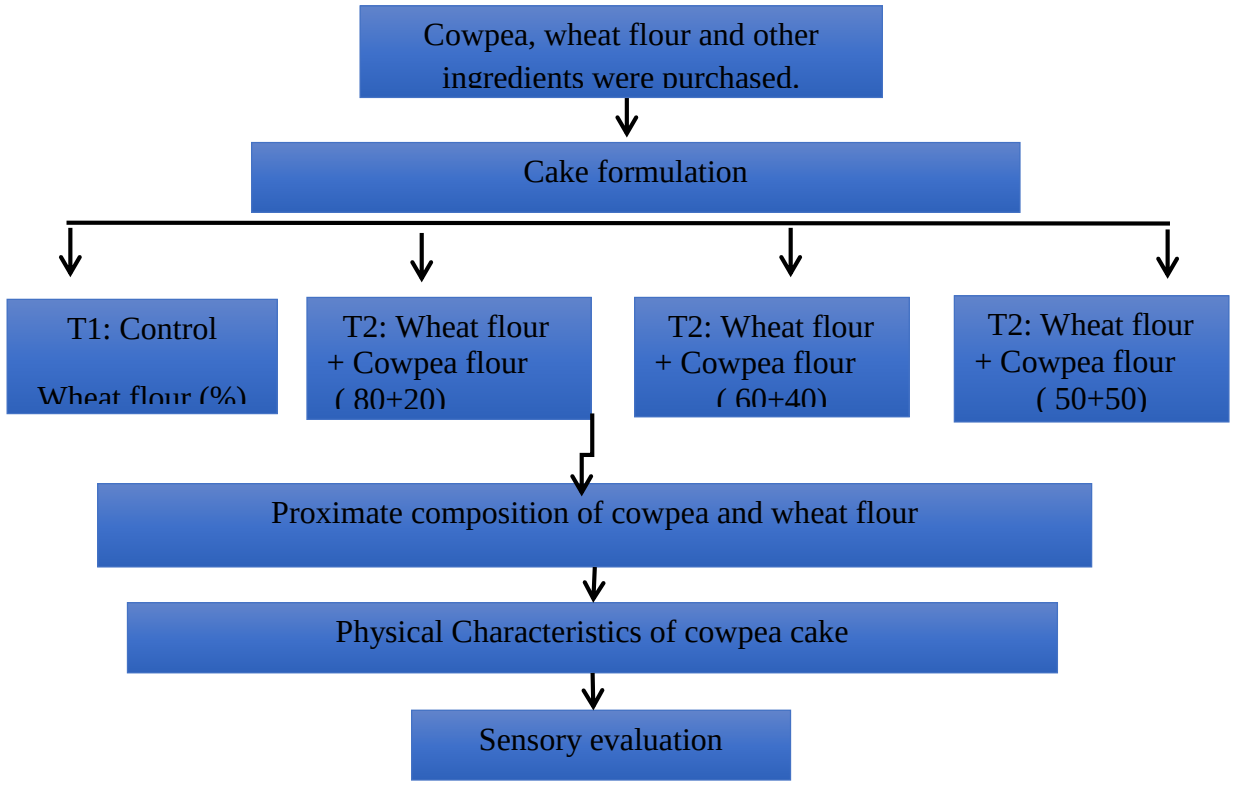


Figure 1. Process flow chart of the prepared cake

Physical characteristics of cowpea cake

The physical characteristics of cowpea cake were measured after 1-hour cooling. The weight of the cake measured on weight balance, height (cm), volume (cm3) and specific volume (cm3/g) was determined by using an vernier caliper by the methods of **[18].**

Sensory evaluation

Oven-baked cakes were allowed to cool at room temperature for 60 min and sensorial analysis was performed on the quality characteristics by a panel of judges of the Institute of Food Sciences and Technology, Sindh Agriculture University, Tandojam. The panel of judges given the score of each tasted sample of cake on the scoring card with selected sensory attributes (taste, colour, flavour, texture and overall acceptability) based on the 9-point hedonic scale with 1 as disliked extremely and 9 as liked extremely according to the method of **[19]**.

Statistical analysis

The data obtained so was tabulated and analyzed according to statistical procedure of analysis of variance (ANOVA) and significant differences of the mean were further computed by the method as described by **[20]** using least significant difference (LSD) at 0.05% level of probability.

Results and Discussion

The present study was conducted to develop a nutrient-rich cake with the incorporation of cowpea flour at different proportions. The proximate analysis showed the moisture content of cake produced from composite flours of wheat/cowpea flour is presented in (Fig. 2). The maximum moisture (16.83%) was recorded with T3 (Wheat flour 60% + cowpea flour 40%). However, the minimum moisture (16.01%) was observed in T4 (Wheat flour + cowpea flour 50%). Whereas the T1 had lower moisture (11.36%). The increase in moisture content with an increase in the levels of cowpea pea flour may be attributed to the water absorption properties of proteins. These results are supported by the result of the **[21-22].** The ash content of cake produced from composite flours of wheat/ cowpea flour is presented in (Fig. 3). The maximum ash (2.37) was recorded from the cake prepared with T4 treatment (Wheat flour+ cowpea flour 50%). However, the minimum ash (1.11% and 0.98%) was observed in T2 and T1 respectively. The results were significantly different ($p \leq 0.05$). Our results are in the agreement with the finding of the **[23]**. The carbohydrate % of cake produced from composite flours of wheat/ cowpea flour are presented in (Fig. 4). The results showed that the maximum carbohydrate (68.00%) was recorded from the cake prepared with T4. However, the minimum carbohydrate (57.91% and 60.44%) was observed in T1 and T2 respectively. The carbohydrate content of the cake increased linearly with the increased level of a cowpea flour blend. Our findings are significantly different from **[23]**.

The Fat % of cake produced from composite flours of wheat/ cowpea flour are presented in (Fig. 5). The results showed that the maximum fat (4.61%) was recorded from the cake prepared with T_4. However, the minimum fat (3.11% and 3.60%) was observed in T_3 = Wheat flour 60% + cowpea flour 40%Wheat flour T_1 had lower fat (3.01%) correspondingly. Our results are supported by the **[24]** indicates that substituting wheat with cowpea can be used to improve the nutritional properties of cakes especially protein, fat and crude fibre which is of health benefits to consumers. The fiber of cake produced from composite flours of wheat/ cowpea flour are presented in (Fig. 6). The crude fiber was (0.25%) recorded from the cake prepared with T_4 = (Wheat flour+ cowpea flour 50%). However, the minimum crude fiber (0.21% and 0.18%) was observed in T_3 = Wheat flour 60% + cowpea flour 40% and T_2 = Wheat flour 80% + cowpea flour 20% as shown in (Fig. 6). Wheat flour T_1 had

lowers crude fiber (0.16%). It is reported by the [21] that crude fibre content of all the flours are not significantly different ($p \leq 0.05$). The protein content of cake produced from composite flours of wheat/ cowpea flour is presented in (Fig. 7). Protein is needed for physiological functioning and reducing protein-energy malnutrition; crude fibre is anti-diabetic while vegetable fat is a good source of energy and helps in absorption of most fat-soluble vitamins and minerals [23-24]**.** It is evident from the results that the maximum protein (15.56%) was recorded from the cake prepared with T_4 = (Wheat flour+ cowpea flour 50%). However, the minimum protein (15.16% and 14.56%) was observed inT_3 = Wheat flour 60% + cowpea flour 40% and T_2 = Wheat flour 80% + cowpea flour 20% as depicted in (Fig. 7). Wheat flour T_1 had lowers protein (14.21%). The protein content of cake increased linearly with the increased level of a cowpea flour blend. Our findings contradict the findings of [21] who concluded that Cowpea flour (100%) had higher protein (15.55%). The higher protein content of cowpea flours is expected since they are rich sources of protein. Although the protein content of cakes increased with the increase in the level a reverse order when plantain flour was substituted to wheat flour for cake production.

The physical properties of the developed cake are given in (Table 1). The maximum specific volume (354.00cm^3) recorded from the cake prepared with T_4= (Wheat flour+ cowpea flour 50%). However, the minimum specific volume (348.52cm^3 and 341.46cm^3) was observed in T_3 = Wheat flour 60% + cowpea flour 40% and T_2 = Wheat flour 80% + cowpea flour 20%. Whereas the wheat flour T_1 had lower specific volume (337.71cm^3). The maximum height of the cake was recorded in T_1 whereas lowest height was recorded in T_4 treatment. Meanwhile, T_1 showed greater weight as compared to other while T_4 showed low weight and same trend was observed in volume of the cake. The results were in accordance with [27] **who** reported that the decrease in specific volume could be due to the presence of bran in the WOF, as other authors detected the same effect after the addition of different kinds of bran [27]. No significant correlations were observed between the specific volume of cakes and specific volume of batters or batter viscosity. The organoleptic properties of the cake were recorded effectively and are given in (Table 2). The maximum color (8.34) recorded from the cake prepared with T_3 = Wheat flour 60% + cowpea flour 40%. However, the minimum color (8.00 and 7.33) was observed in T_4= Wheat flour 50% + cowpea flour 50% and T_2 = Wheat flour 80% + cowpea flour 20%. Wheat flour T_1 had a lower color (6.34). The maximum texture (8.00) was recorded from the cake prepared with T_4= (Wheat flour+ cowpea flour 50%). However, the minimum texture (7.67 and 6.67) was observed in T_3 = Wheat flour 60% + cowpea flour 40% and T_2 = Wheat flour 80% + cowpea flour 20%. Wheat flour T_1 had lower texture (6.00). The maximum taste (8.67) recorded from the cake prepared with T_4= (Wheat flour+ cowpea flour 50%). However, the minimum taste (7.00 and 6.67) was observed in T_3 = Wheat flour 60% + cowpea flour 40% and T_2 = Wheat flour 80% + cowpea flour 20%. Wheat flour T_1 had lower taste (5.34). The maximum overall acceptability (8.34) recorded from the cake prepared with T_4= (Wheat flour+ cowpea flour 50%). However, the minimum overall acceptability (7.00 and 7.00) was observed in T_3 = Wheat flour 60% + cowpea flour 40% and T_2 = Wheat flour 80% + cowpea flour 20%. Wheat flour T_1 had lowers overall acceptability (6.34). It is stated that color and sensory evaluation tests showed that the 100% wheat flour amounts could be replaced by the same amounts of germinated bean and still providing good

quality [11]. But substitution of wheat flour by 50% cowpea flour gave good cake but in the other ratios the taste became unable as a resulted increasing the germinated and ungerminated cowpea flour. The staling rate was reduced in cake made from 100% germinated bean flour compared to control cake. It could be concluded that the resulted products possessed a long shelf-life period with good qualities and could be easier in transportation.

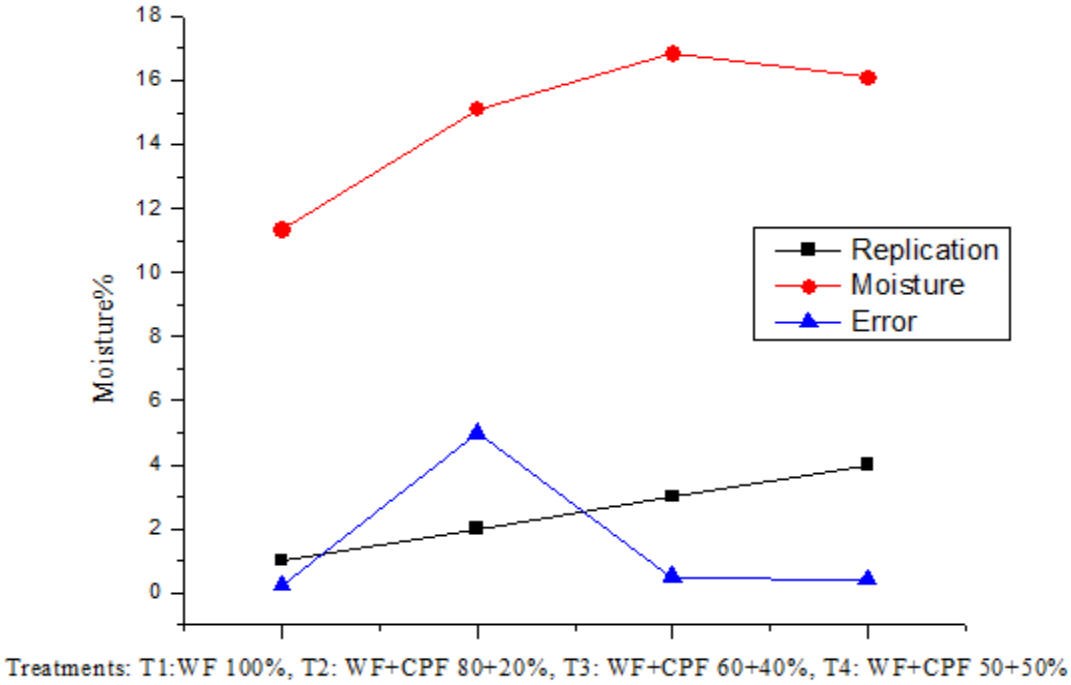


Figure 2. Moisture% of cake incorporated with Wheat and Cowpea flour

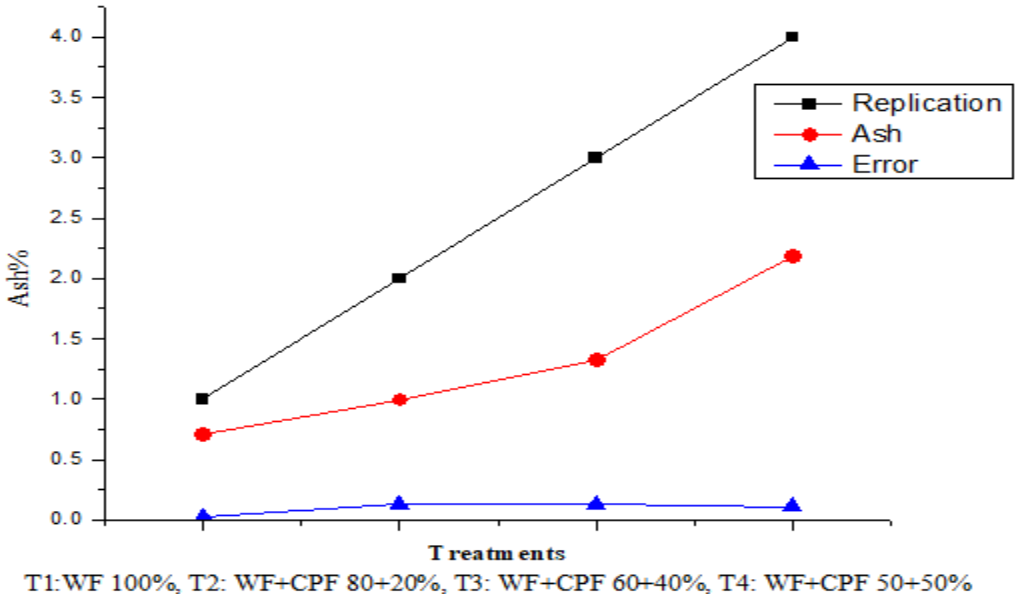


Figure 3. Ash% of cake incorporated with Wheat and Cowpea flour

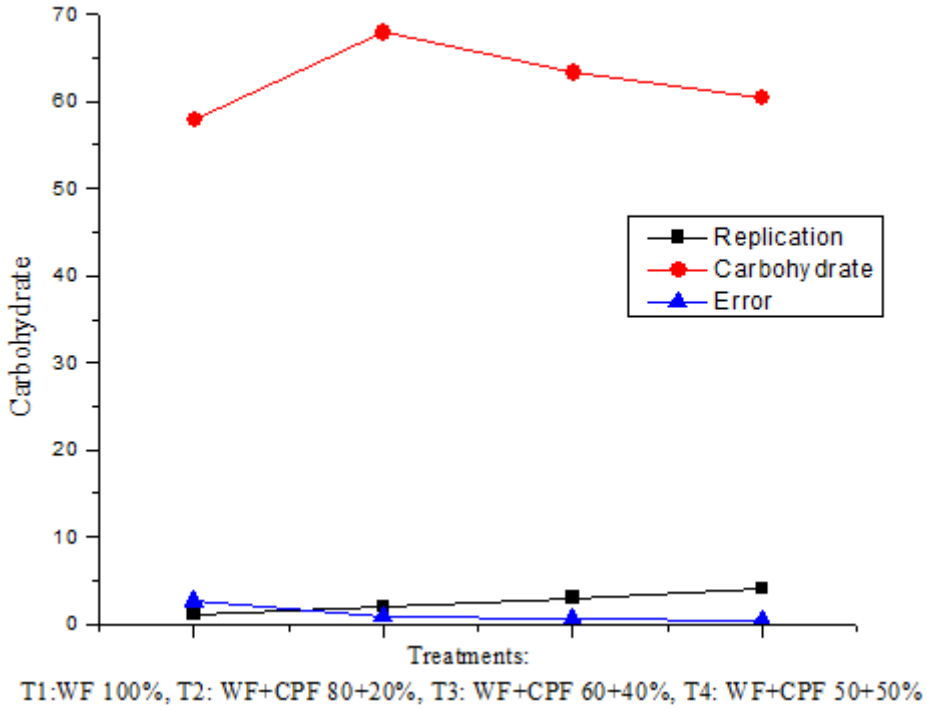


Figure 4. Carbohydrate% of cake incorporated with Wheat and Cowpea flour

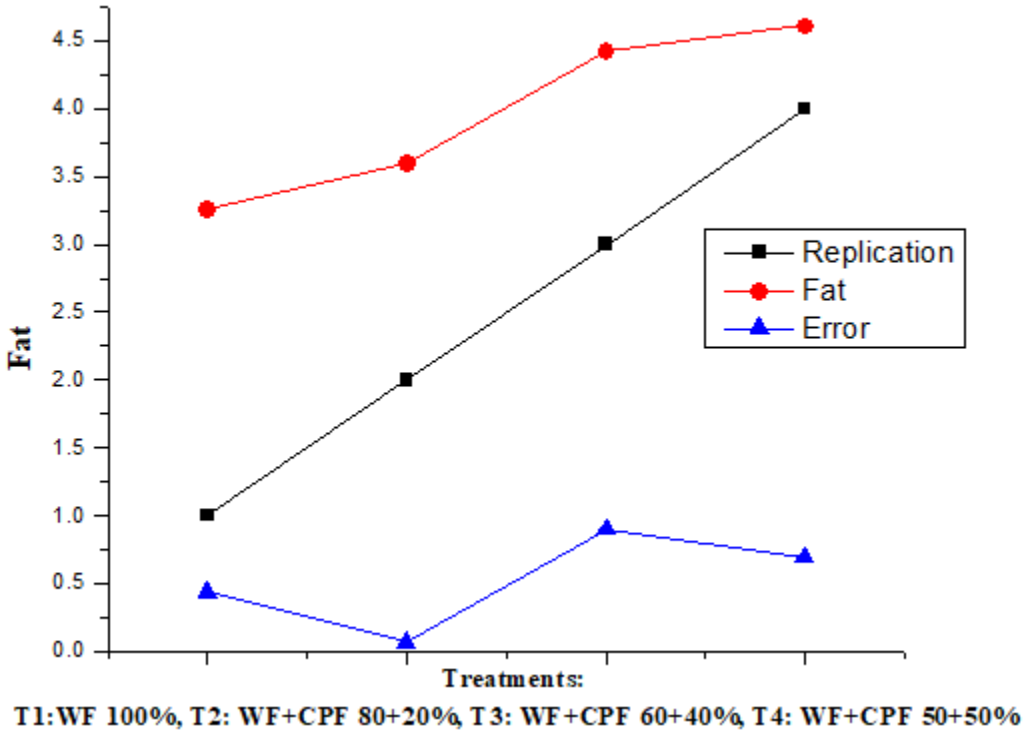
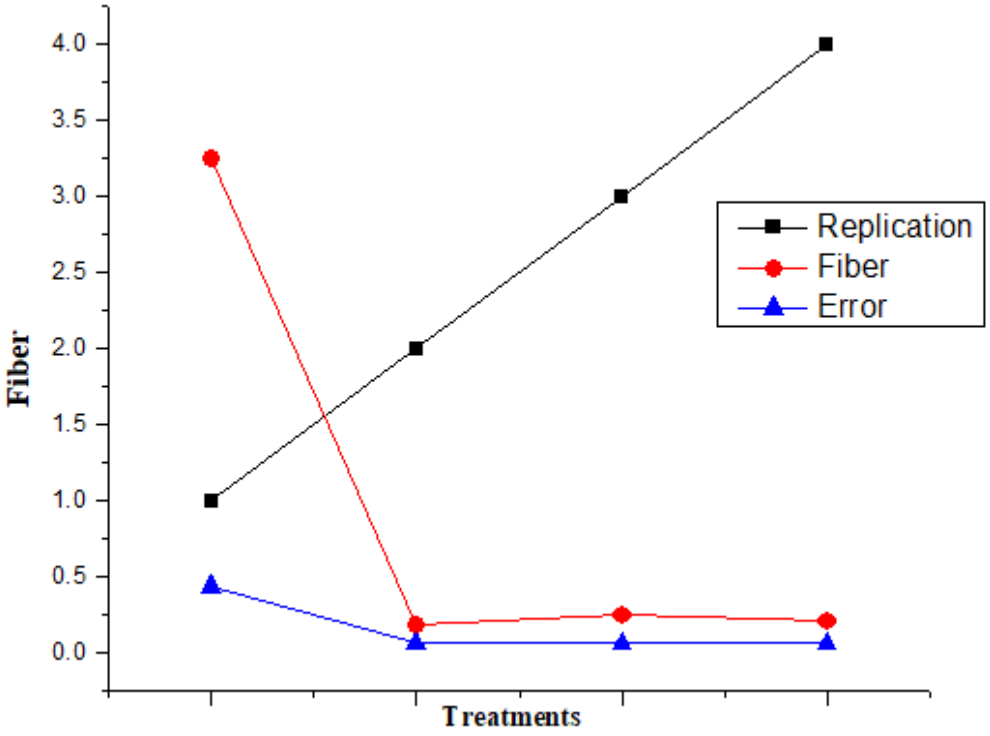
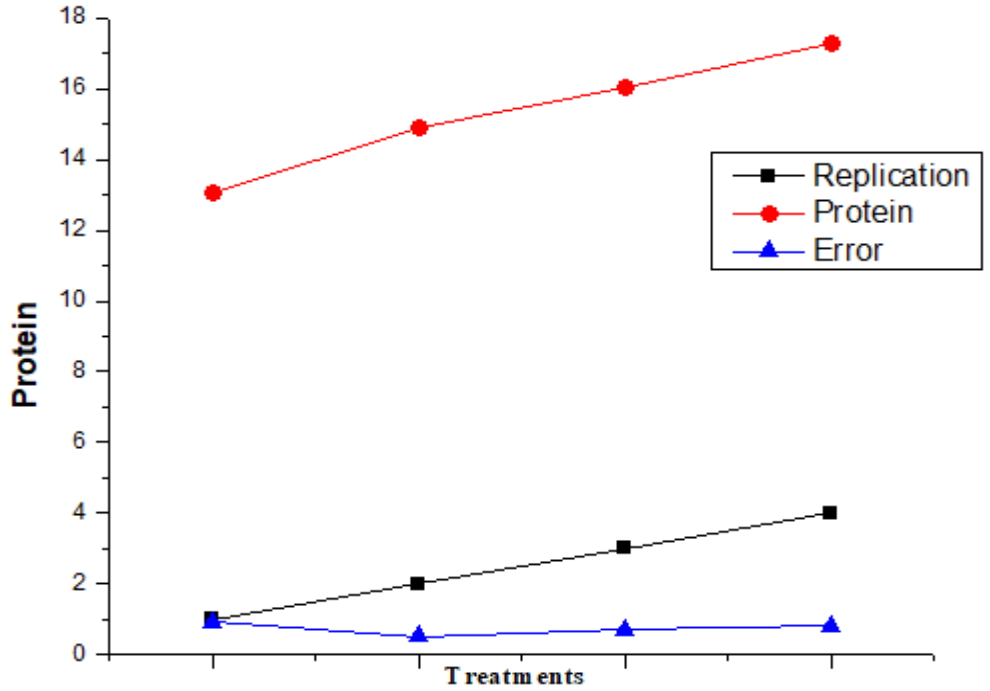


Figure 5. Fat% of cake incorporated with Wheat and Cowpea flour



T1:WF 100%, T2: WF+CPF 80+20%, T3: WF+CPF 60+40%, T4: WF+CPF 50+50%

Figure 6. Fiber% of cake incorporated with Wheat and Cowpea flour



T1:WF 100%, T2: WF+CPF 80+20%, T3: WF+CPF 60+40%, T4: WF+CPF 50+50%

Figure 7. Protein% of cake incorporated with Wheat and Cowpea flour

Table 1. Physical characteristics of cake prepared from different proportions cowpea and wheat flour

Treatments	Height (cm)	Weight (g)	Volume (cm^3)	Specific volume (cm^3/g)
T_1	4.04^a	59.00^a	570.00^a	5.63^a
T_2	3.76^b	50.50^b	565.00^a	4.52^b
T_3	3.54^c	47.75^c	495.00^c	4.20^c
T_4	3.25^d	39.50^d	457.00^d	2.99^d

Table 2. Sensory analysis of cake incorporated with Wheat and Cowpea flour

Treatments	Color	Taste	Texture	Overall acceptability
T_1	6.4533^a	6.2333^b	6.2000^b	6.2500^b
T_2	7.2733^a	5.4900^c	7.5533^a	6.2000^b
T_3	8.1567^b	6.7167^b	6.2000^b	5.8300^c
T_4	7.4800^b	7.5667^a	5.8300^c	7.5533^a

Conclusion

This study showed that it is possible to incorporate Cowpea flour into cake formulations, which increases the nutritional value. It is concluded from the study that the protein and dietary fiber-rich pulses incorporated in bakery products can enhance the nutritional and sensory characteristics of the products. Cake developed with the addition of cowpea flour in an equal ratio showed better results as compared to other treatments. Meanwhile, its dietary fiber will help to prevent several chronic illnesses. The demand of protein and dietary fiber intake will increase with time to meet the nutritional requirements; therefore, more studies should be conducted to incorporate protein-rich flour in bakery products. Thus, wheat flour fortification with lentil flour might be a good option for controlling protein malnutrition, diabetic disease and iron and zinc deficiency.

Authors' contributions

Conceived and designed the experiments: SG Khaskheli, Performed the experiments: RH Juna, Analyzed the data: DK Lohano, AA Khaskheli & AA Panhwar, Contributed reagents/ materials/ analysis tools: AH Soomro, Wrote the paper: SG Khaskheli.

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