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Research Article

Nutritional Profiling of Papaya Peel Incorporated Chapathis

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Abstract

Consumption of natural bioactive compounds such as carotenoids and dietary fiber offers health benefits including protection against cardiovascular diseases, cancer and other degenerative diseases. Colour of papaya peel powder incorporated chapathi (PPC) was more compared to peel paste added chapathi (PSC). The addition of papaya peel to the chapathis decreased the total carbohydrate, protein and energy content and increased the moisture, ash, fat and fiber content. The *in-vitro* protein digestibility content of peel powder incorporated chapathi was 44.45% and peel paste incorporated chapathi was 48.69%. The sodium content of PPC was 4.43 and PSC was 4.08 mg/100g. The potassium content of PPC was 56.03 and PSC was 49.14 mg/100g. A 21-fold increase in the β-carotene content in the PPP chapathis and 0.3-fold increase in PSP chapathis was observed.

Keywords: Total dietary fiber, carbohydrate digestibility, protein digestibility, sodium, potassium and β-carotene

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Introduction

Interest in nutrition and disease prevention is the driving consumer demand for value added foods with higher levels of bioactive compounds and dietary fiber. It is widely accepted that increased consumption of fruits and vegetables can reduce the risk of life style diseases [1].

India is the world's largest producer of papaya (*Carica papaya*) belonging to the family caricaceae and is used as medication against a variety of diseases [2]. The by-products of papaya constitute approximately 20-25% of fruit weight [3]. Currently papaya peel is discarded contributing to environment pollution. The agro-industrial by-products are good sources of bioactive compounds and fruit by-products showed higher levels of β-carotene and lycopene as well as anthocyanins and flavonoids than fruit pulps [4].

Material and Methods

Procurement of raw materials

Ripe papaya fruits and other ingredients were procured from local markets of Hyderabad. Papaya peel paste (PSP) and papaya peel powder (PPP) were prepared as per the procedure given in [5]. Chapathis were prepared by the method as reported by [6].

Physical and nutritional properties chapathis

The thickness and diameter of the samples were measured as per [7] and colour quality of the samples by using Hunter lab colorimeter [8]. Nutritional analysis was carried out using standard AOAC methods. Moisture, ash and protein [9-11], fat [12], carbohydrate and energy [13], crude fiber [14], total dietary fiber [7], *in-vitro* carbohydrate digestibility with α-amylase [15], with α-glucosidase [16] and *in-vitro* protein digestibility [17] were used. Minerals like sodium and potassium in flame photometer [18] and β-carotene content [19] were estimated for the samples.

Results and Discussion

Thickness and diameter

The thickness of chapathis ranged from 1.09 to 1.12 mm. The diameter of the chapathis ranged from 12.86 to 13.23 cm. There was no significant change in thickness and diameter due to the addition of PPP or PSP to the chapathis.

Colour
Food colour is governed by the chemical, biochemical, microbial and physical changes which occur during growth, maturation, post-harvest handling and processing [20]. Colour scores of the developed and control chapathis were presented as ΔL, Δa and Δb values. The papaya peel incorporated chapathi (PSC) was light in colour than the papaya peel powder (PPC) as papaya peel powder contained concentrated coloured components. The colour values ΔL, Δa and Δb ranged from 30.83 to 36.44, 8.22 to 10.82 and 13.29 to 15.89, respectively. Percentage change in colour of developed chapathis compared with control chapathis was given in **Figure 1**.

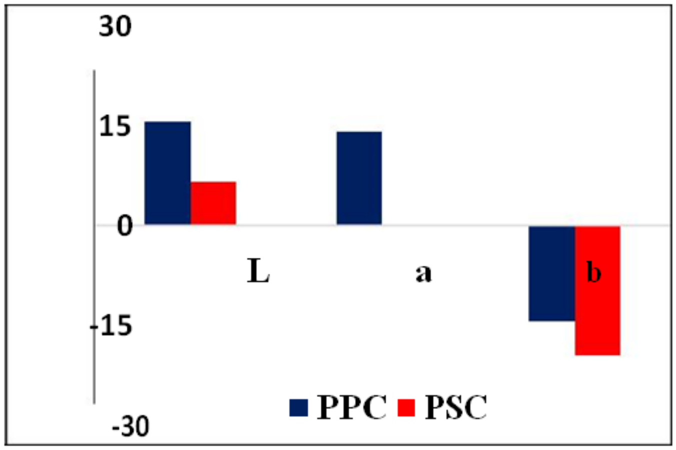

Figure 1 Percentage change in colour of PPC and PSC compared with control chapathi

The cookies developed by incorporating carrot pomace at different percentage to wheat flour. The cookies had the ΔL, Δa and Δb values ranging from 51.56 to 61.21, 11.21 to 15.6 and 31.65 to 35.27 respectively. Maximum change was observed in ΔL value followed by Δa and bΔ with respect to control sample [21].

Proximate and nutritional composition of chapathis

The percentage change in proximate composition of developed chapathis in comparison to control chapathi was given in **Figure 2**.

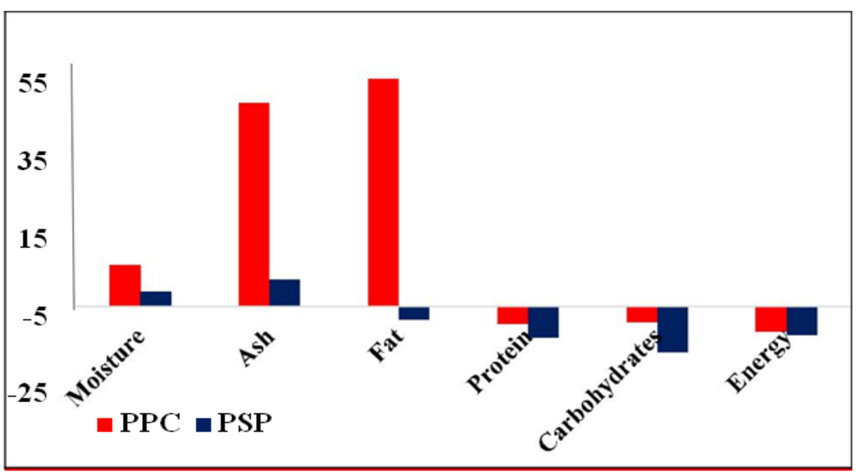

Figure 2 Percentage change in proximate composition of developed chapathis in comparison to control chapathi

Moisture

The moisture content of PPC was 32.77 and PSC was 31.05%. The value added chapathi showed increase in moisture content in comparison with control chapathi. The addition of PPP and PSP to chapathis increased the moisture content may be due to increase in fiber content. The increase in moisture content was 9.62% for PPC and 3.53% for PSC in comparison to control.

The moisture content in control biscuits was 4.5% and increased to 5.20% when added with mango peel powder (MPP) at 20% level. The increases in moisture content of cookies with MPP increased the water absorption in the sample [22].

Ash

The ash content of PPC was 3.07% and PSC was 2.21%. The fruit peels are good source of minerals and addition of PPP and PSP increased the ash content by 47.56% in PPC and 6.25% in PSC. The ash content in guava peel powder (GPF) powder was 11.1% and ash content in the cookies increased with 30, 40 and 50% GPF addition from 3.3 to 4.2% [23].

Fat

The fat content for PPC was 0.98% and for PSC was 0.62%. The PSC had lower fat content in comparison to control and PPC. The PPC showed an increase of 53.12% whereas PSC fat content decreased by 3.13% in comparison to control chapathi. The increase in fat content in PPC may be due to concentration of oils in peel powder.

Protein

The protein content of PPC was 9.10% and PSC was 8.83% with no statistically significant difference between the chapathis at $p<0.05$. The control chapathi had high protein content of 9.53% and lower content in PSC with 8.83%. The PPP and PSP added chapathis had lower protein percentage because fruit peels are composed of lower nitrogenous matter and a decrease of 4.41% for PPC and 7.24% and PSC in comparison with control chapathi was observed.

The proximate composition of orange peel incorporated cookies. Orange peel contained moisture of 9.46%, protein 5.15%, fat 4.53%, ash 2.61% and total dietary fiber 74.87%. In the developed cookies, the protein and carbohydrate contents decreased with increased orange peel content [24].

Carbohydrates

The carbohydrate content of PPC was 52.46% and PSC was 50.32 %. The highest content was for control chapathi where as PPP and PSP chapathis showed a decrease of 3.74 and 10.73% in the carbohydrate content.

Energy

The energy content of PPC was 254 Kcal and PSC was 251 Kcal for 100g weight**.** The highest content was seen in control chapathi than PPC and PSC chapathis. There was no significant difference between energy content in PPC and PSC.

Nutritional quality characteristics of chapathis

Crude and total dietary fiber

The crude fiber content of PPC was 3.46% and PSC was 1.85%. The total dietary fiber of PPC was 9.85 and 7.04% for PSC. The chapathi with highest crude fiber and total dietary fiber was PPP added chapathi. The lowest crude fiber of 1.32% and total dietary fiber of 6.58% was seen for control sample. There was no significant difference between dietary fiber content in control and PSP chapathi.

The biscuits formulated with mango peel powder (MPP) which exhibited increased total dietary fiber content 45.0 to 78.0%. The TDF content in biscuits increased from 6.5 to 20.7% with the incorporation of MPP [25].

In-vitro carbohydrate digestibility

α-glucosidase activity*:* The α-glucosidase inhibitory activity of chapathis was expressed as IC_{50} values. The percentage inhibitory activity for PPC with 50.26 and PSC with 55.15%. The adding of PPP and PSP decreased the requirement of α – glucosidase enzyme as shown with IC_{50} activity for PSC with 24.08 mg/ml and PPC 17.70 mg/ml in comparison with control mainly due to the increased fiber content, resistant starch, presence of tannins, alkaloids and unavailability of starch. The percentage inhibition for various concentrations of developed chapathis was shown in **Figure 3**.

α-amylase activity: The IC_{50} values of samples calculated for control chapathi, PSC and PPC were 29.97, 17.81 and 11.86 mg/ml respectively. There was significant change in the inhibition percentage due to the addition of PPP and PSP in comparison with the control chapathi indicating that carbohydrate availability decreased.

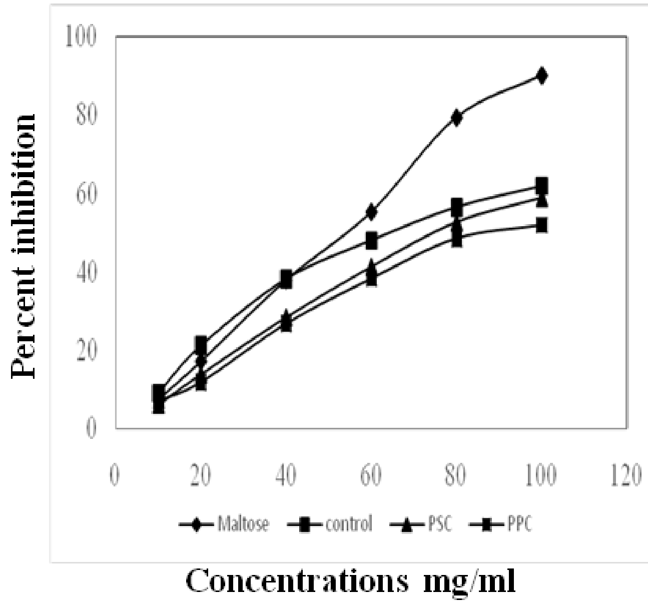

Figure 3 Percent inhibition of *in-vitro* carbohydrate digestibility with α- glucosidase enzyme for developed chapattis

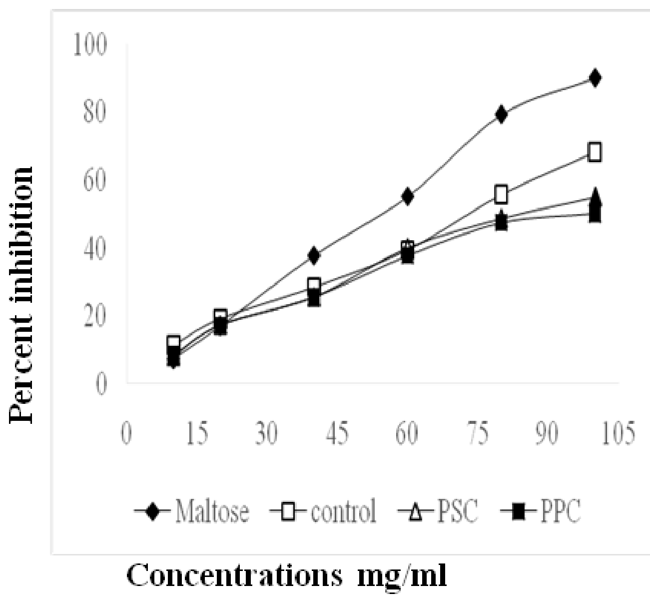

Figure 4 Percent inhibition of *in-vitro* carbohydrate digestibility with α- amylase enzyme for developed chapattis

The *in-vitro* carbohydrate digestibility of cookies was 32.68 to 53.42% with 100% wheat flour cookies having higher value than unripe plantain defatted sesame flour cookies. The decrease in *in-vitro* carbohydrate digestibility of composite cookies was due to reduction in digestibility of trapped starch granules in the viscous protein-fiber-starch network [26].

In-vitro protein digestibility: The *in vitro* protein digestibility content of PPC was 44.45 and PSC was 48.69%. The PPP and PSP added chapathi had lower protein digestibility percentage because papaya peel had lower nitrogenous matter and tannins content in peel as decreased in PPP and PSC chapathis.

The *in-vitro* protein digestibility of bread and bread containing sesame protein. *In vitro* protein digestibility content varied from 71.2 to 80.0%. Protein digestibility of control bread sample was 71.2% and addition of sesame products to wheat flour improved the computation of essential amino acids index and protein efficiency ratio [27].

Mineral content in chapathis: The sodium content in chapathi showed significant difference ($p<0.05$) between control and incorporated chapathi. The sodium content of PPC was 4.43 and PSC was 4.08 mg/100g. The potassium content of PPC was 56.03 and PSC was 49.14 mg/100g. The 10.0% orange peel and lemon peel powder supplemented in wheat biscuits had Na of 0.28 and 0.16% whereas K content was 0.41 and 0.22% respectively [28].

β-carotene content in chapathis: The β-carotene content of PPC was 0.82 and PSC was 0.08 μg/100 g. The value added chapathi showed an increase of 21 fold in β-carotene content in comparison with control chapathi.

The carotenoid content in the biscuits increased from 17.0 to 247.0 mg/g biscuit powder. There was a 14-fold increase in the carotenoid content in the biscuits enriched with MPP [25].

Conclusion

The nutritional composition of PPP and PSP showed that it can be a good source of fiber, minerals and carotenoids. Chapathi incorporated with papaya peel showed higher crude fiber, dietary fiber, minerals and β-carotene. The *in-vitro* carbohydrate and protein digestibility of developed chapathis were low compared to control sample. Thus, papaya peel, a by-product from the fruit processing industry can be utilized for the preparation of chapathis and other food products with improved functional and nutraceutical properties.

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