J Agric. Res., 2018, Vol. 56(1):49-56
www.jar.com.pk
Agriculture Department
Government of Punjab

FOOD TECHNOLOGY

PRODUCTION OF CARROT POMACE POWDER AND ITS UTILIZATION IN DEVELOPMENT OF WHEAT FLOUR COOKIES

Humaira Kausar[*1], *Saima Parveen*[2], *Muhammad Maaz Aziz*[3] *and Shazia Saeed*[4]

[1] Assistant Food Technologist, [2] Assistant Research Officer, Food Technology Section, Post Harvest Research Centre, [3] Assistant Horticulturist, Horticulutral Research Institute, AARI, Faisalabad, [4] Assistant Food Technologist, Oilseeds Research Institute, AARI, Faisalabad, Pakistan
*Corresponding author e-mail: humairakausar353@gmail.com

Article received on: 16/06/2017
Accepted for publication: 12/09/2017

ABSTRACT

This project was undertaken at Food Technology Section, Post Harvest Research Centre, AARI, Faisalabad, Pakistan during 2014-15 to study the production of carrot pomace powder and its utilization in cookies. Carrot pomace powder was prepared by dehydration at 60°C in tunnel dehydrator. Carrot pomace powder and wheat flour were subjected to proximate analysis like moisture content, ash, crude fat and crude fibre. Carrot pomace powder was replaced with plain wheat flour at proportion of 0, 4, 8, 12 and 16%, respectively. The prepared cookies were evaluated for proximate composition, physical parameters and sensory properties for the period of three months at 15 days intervals. It was observed that moisture content of cookies increased from 3.35 to 4.36% within the treatments and 3.78 to 4.04% during storage. Increasing trend was also observed in ash content (0.42% to 1.16%), crude fat content (21.43%-22.64%) and crude fibre content (0.2%-2.35%) within the treatments. However, decreasing trend in these parameters was observed during storage. The physical factors like width of cookies decreased from 50 to 44.65mm among treatments while a decrease in thickness from 11.93 to 10.72 mm was also noted. Resultantly the spread factor value also reduced from 46.7 to 37.3mm by adding more proportion of carrot pomace powder. With respect to storage of physical parameters of cookies, no significant variation was observed. The cookies incorporated with 12% carrot pomace powder with wheat flour scored better (8.03) with respect to overall acceptability which can be commercialized.

KEYWORDS: *Daucus carota;* carrot; pomace powder; wheat flour; cookies; baking characteristics; storage; sensory evaluation; Pakistan.

INTRODUCTION

The bakery sector is thriving rapidly the world over and the people of all groups like these products. Biscuits have many attractive features including wider utilization base, relatively long storage life, additional ease and good eating value among snacks (Hooda and Jood., 2005, Iwegbue 2012 (Hooda and Jood, 2005; Iwegbue, 2012).

The total vegetables production in Pakistan was 7,110, 08 tons during the year 2014-15 (Anon, 2015). Some vegetables are utilized mainly as raw and can be processed into valuable products. Huge amount of waste co-products is produced by food processing industry. The organic and inorganic wastes from fruits and vegetables are relatively cheap in price and also available in huge amounts. Due to relatively high percentage of fibre these possess high water holding capacity and ultimately result in reduction of enzyme digestible organic matter (Serena and Kundsen, 2007). The by-products could be utilized to change diet's physico-chemical properties due to high dietary fibre content and contrasting dietary fibre properties.

Fruits and vegetable by-products have been used by number of researchers as sources of dietary fibre supplements in food such as apple, pear, orange, peach, blackcurrant, cherry, artichoke, asparagus, onion and carrot pomace (Grigelmon - Migvel and Mastin-Belloso, 1999). Vegetables showed a high total dietary fibre content due to dietary fibre concentrates and better insoluble/soluble dietary fibre ratios than cereal bran. These types of food products are not so expensive due to the presence of non-caloric bulking agents used for partially replacing flour, fat or sugar, as moisture enhancer and oil retention, besides improving emulsion or oxidative stabilities (Elleuch *et al.,* 2011).

Carrot *(Daucus carota* L.*)* belongs to the most important Apiaceae family. This root vegetable has distribution all over the world. At first the carrots were used for medical purposes but with the passage of time it started to be used as food. Dietary fibre is present in it in good amounts which is helpful for lowering cholesterol level. It is also a source of trace mineral molybdenum which is rarely found in other vegetables. Molybdenum plays a significant role during metabolism of carbohydrates and fats and is also necessary for absorption of iron.

Magnesium and manganese are also present in it in sufficient amounts (Sharif *et al.,* 2009).

Raw carrots are used as fresh salads, cooked as vegetable dish, and easily converted into juice drink. It can also be used in sweet dishes preparation. Consumption of fresh fruit and vegetable juices has become popular during recent years (Iwegbue, 2012). Carrot juice is a rich source of beta carotene (precursor of vitamin A), B complex vitamins and minerals including calcium, copper, magnesium, potassium, phosphorus, iron and folic acid.

It is estimated that carrot juice yield is about 60-70%, while almost 80% of carotene is lost with surplus carrot pomace (Bohm *et al.,* 1999). Left over carrot pomace contains good residual amount of vitamins, minerals and dietary fibre. So far it does not find proper utilization. Moisture content in carrot pomace reaches upto 80% that shows its highly perishable nature (Goyal, 2004).

The incorporation of carrot pomace powder in bakery products is more beneficial to the people due its wonderful medicinal properties. Thus present study was planned to evaluate the suitability of replacement of refined wheat flour (WF) in different percentage of carrot pomace powder (CPP) in cookies because of its taste, flavour and miraculous properties.

MATERIALS AND METHODS

This study was conducted at Food Technology Section, Post Harvest Research Centre, AARI, Faisalabad, Pakistan during the year 2014-2015. The raw material for the preparation of cookies e.g. carrots, wheat flour, sugar, shortening, baking powder and eggs were procured from local market. Washing of carrots was done with tap water. Trashes were removed with a plane stainless steel knife and trimming was also done. Carrot juice was extracted with the help of mixer grinder-cum-food processor using the method illustrated by Upadhyay *et al.* (2008) as depicted in Fig. 1. and pomace was collected for further studies.

Carrot
↓
Washing
↓
Hand Peeling
↓
Washing
↓
Slicing (2 – 3 cm)
↓
Blanching (5 minutes at 70˚C)
↓
Cooling (on tray)
↓
Extraction of juice (juicer mixer grinder)
↓
Carrot Pomace

Fig. 1. Process of getting carrot pomace.

The carrot pomace obtained after juice extraction was dried in tunnel dehydrator at 60˚C. Pomace was spread over the tray and drying procedure continued till the moisture content of sample was reduced to about 5 ±1% (wet basis). The grinding was done using the food processor. The material was ground to pass through the sieve of 2 mm size. The pomace was stored in sealed polythene bag for further use. Wheat flour and carrot pomace flour were used in different percentage proportions viz. 100:0 (T_1) (control), 96:4 (T_2), 92:8 (T_3), 88:12 (T_4) and 84:16 (T_5). Cookies were prepared with some modifications according to the method as described in AACC (2006) with the formulation as given below:-

Formulation for cookies.

Ingredients	Quantity
Wheat flour	200 g
Sugar	100 g
Shortening	100 g
Baking powder	3 g
Eggs (no.)	1
Water	15-20ml

The ingredients were weighed; fat and sugar were creamed in a mixer with a flat beater for two minutes at slow speed, followed by addition of eggs. Creaming sustained till occurrence of foaming. The creaming mixture was incorporated with composite flour, baking powder and water and mixed to a uniform mixture for five minutes at high speed. The aluminum frame with rolling pin was used for making sheet of dough to a thickness of 3.00 mm. Cookies die having 35 mm diameter was used to shape up the cookies and placed at lightly oiled baking trays at appropriate distance. Baking was done at 218°C in oven for 10-12 minutes. After baking, cookies were cooled at room temperature and packed in air tight polythene bags for further storage studies. The procedure was adopted as described by Saeed *et al.* (2012).

Proximate analysis of carrot pomace powder, wheat flour and cookies

Moisture, protein, ash, fat and crude fibre of carrot pomace powder, plain wheat flour and prepared cookies were analyzed according to the methods described in AACC (2006).

Physical analysis of cookies

The packed cookies, prepared with different levels of carrot pomace flour were stored at room temperature. Physical characteristics of cookies like width, thickness and spread factor were measured fortnightly for 90 days storage according to the methods described in AACC (2006) as given below:-

Width (W): By placing six cookies horizontally (edge to edge) and rotated at 90° angle, width of cookies was measured for duplicate reading.

Thickness (T): The measurement of thickness of cookies was performed by insertion six cookies on one another and reading was noted in duplicate.

Spread* factor *(SF): The formula SF = (W/T x CF) x10 was used to calculate the spread factor where CF=Correction factor at constant atmospheric pressure (10.0 in this case).

Sensory assessment

A panel of five semi-trained judges chosen from Food Technology Section, AARI, Faisalabad evaluated the sensory characteristics like colour, flavour, crispiness, taste and overall acceptability at 15 days interval upto 90 days, according to the method illustrated by Meilgaard *et al.* (1991).

Statistical analysis

According to the method described by Steel *et al*. (1997), the data were analyzed statistically for analysis of variance (ANOVA) by using 2-factorial completely randomized design using LSD at P≤0.05.

RESULTS AND DISCUSSION

Proximate analysis of carrot pomace powder and wheat flour

The proximate analhysis indicated that moisture content of carrot pomace powder was 6.24 % and crude fibre 9.45% (Table 1). The percentage of ash in carrot pomace powder was noted as 5.90 % and fat content content as 1.80%. The present findings are in accordance with results of Shyamala and Prakash (2015) in case of carrot pomace powder who reported 6.54% moisture, 14.75% fibre, 2.12% fat and 5.12% ash. Mebpa *et al.* (2007) reported moisture of 11.31 %, protein 12.86%, fat 1.40%, crude fibre 0.82% and ash contents 0.46% in wheat flour.

Table 1. Proximate composition of plain wheat flour and dry carrot pomace powder.

S. No.	Composition (%)	Carrot pomace powder	Plain wheat flour
1	Moisture	6.24±0.60	11.62±0.1
2	Crude Fat	1.80±0.01	1.76±0.07
3	Crude Fibre	9.45±0.70	0.24±0.08
4	Ash	5.90±0.02	0.65±0.05

Proximate analysis of cookies

Moisture content **:**The moisture content varied significantly in different treatments (p<0.05) (Fig.2). The treatment T_1 (control) exhibited minimum moisture content (3.25%) while T_5 (16% carrot pomace powder) showed maximum moisture content (4.22%) at 0 day which increased with storage time and carrot pomace substitution. The mean value ranged from 3.35 to 4.36% within the treatments and an increase from 3.78 to 4.04% was observed during storage of 90 days due to substitution of wheat flour with carrot pomace powder. Baljeet *et al.* (2014) also reported the increase in moisture content of cookies substituted with powder of carrot pomace and flour of germinated chickpea from 2.8 to 3.1% higher from control cookies.

The increase in moisture content during storage was primarily due to packing material (polythene bags). The packing was not airtight and lack of temperature control resulted in an increased moisture contents of cookies. Moreover, cookies absorbed moisture from surrounding atmosphere due to hygroscopic behaviour of wheat flour. An increase in moisture contents of cookies samples during storage has also been reported by Wade (1988), Leelavathi and Rao (2004), Rao *et al.* (1995), Pasha *et al*. (2002) and Iqbal (2003) either due to atmosphere or packing material.

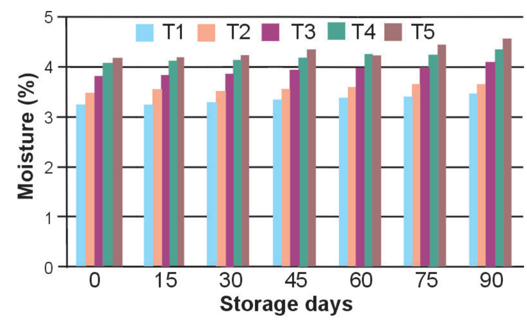

Fig. 2. Effect of treatments and storage on moisture content of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

Ash content: The data indicated significant effect on ash content of supplemented biscuits in different treatments (p < 0.05) (Fig.3).

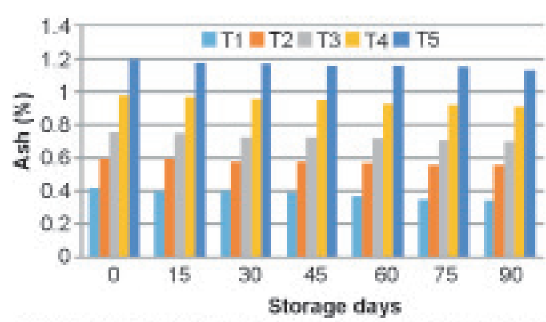

Fig. 3. Effect of treatment and storage on ash content of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

The ash content increased from 0.42 to 1.20% within the treatments and decreased during storage of three months from 0.79 to 0.74 %.The control samples (T_1)

showed 0.42% ash content and cookies prepared from 16% carrot pomace powder (T_5) exhibited 1.20% ash content at zero day which increased with supplementation of carrot pomace powder. Anthaoer study (Goyas *et al.* 2012) also revealed that high percentage of mineral content present in pomace powder resulted in increased ash content with significant effect of storage on ash content of cookies. However, in some other studies ash content decreased from 0.74 to 0.64 percent (Nawirska and Kwasniewska, 2005) 0.74-0.64 percent (Pasha *et al.,* 2002) and 0.64-0.52 percent after 45 days storage (Herchi *et al.,* 2012). This might be owing to uptake of moistness from air.

Fat content: The statistical analysis ($p<0.05$) of fat content of cookies showed an increasing trend The treatment T_1 exhibited minimum fat content (21.48%) while T_5 (16% carrot pomace powder) showed maximum fat content (22.69%) at zero day that increased with carrot pomace substitution. from 21.43 (T_1) to 22.64% T_5 (16% carrot pomace powder) (Fig. 4). With respect to storage of 90 days mean values of fat content decreased from 22.29% to 22.17% (Fig.4).

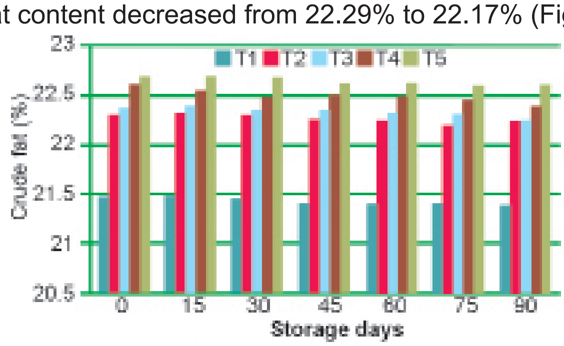

Fig. 4. Effect of treatments and storage on fat content of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

The total fat content of biscuits is due to addition of fat during biscuit preparation as wheat flour and carrot pomace powder had lower fat content. Baljeet *et al.* (2014) also reported the same results in case of incorporation of carrot pomace powder and flour of germinated chickpea for biscuits where fat content increase from 34.6 to 37.1% within the treatments. With increasing extent of substitution, increase in fat content was observed as it might be due to low oil absorption capacity of composite flour cookies in comparison with wheat flour. Masih *et al.* (2004) reported that fat content of cookies decreased from 24.18 to 24.00 percent throughout storage period (45 days). This decline in fat content might be due to moisture uptake by cookies from the surrounding air and break down of fats to different compounds as reported earlier (Hussain *et al.,* 2006; Mahmood *et al.,* 2008; Sharif *et al.,* 2009).

Crude fibre content: An increase in fiber content was observed with the addition of carrot pomace powder to wheat flour in cookies. T_1 showed 0.35% crude fibre and T_5 exhibited 2.90% at zero day. This increase was due to high fibre contents of carrot pomace powder as compared to wheat flour. The content of crude fibre in cookies was significantly (Fig.5) higher ($p < 0.05$), than (control) wheat flour cookies (0.23-2.75%). The mean value of fibre content decreased (1.81%-1.52%) during storage of 90 days. Singh *et al*. (2008) observed an increase in crude fibre values of cookie (1.70 - 1.75%) with addition of orange fleshed sweet potato flour to wheat flour cookies. Masih *et al.* (2014) reported decrease in fibre content (0.26 to 0.46%) in cookies during storage of cookies. An increase in moisture content that was absorbed from air resulted in decrease in crude fibre content during storage as reported by Pasha *et al.* ,(2002), Iqbal (2003) and Sharif *et al.* (2005a).

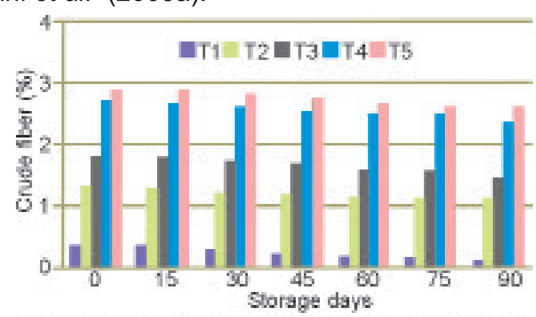

Fig. 5. Effect of treatments and storage on crude fiber content of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

Physical characteristics of cookies

Width (mm): The mean values within treatments ranged from (44.65 to 50.22mm). Addition of carrot pomace powder resulted in decrease in width of cookies (Fig.6).

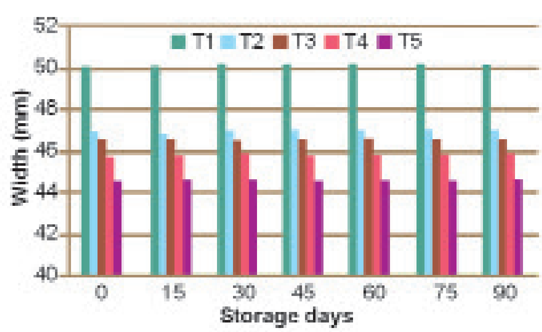

Fig. 6. Effect of treatments and storage on width of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

T_1 showed maximum width (50.2mm) at zero day, while T_5 exhibited the minimum width (44.65mm). It is apparent that enrichment in level of carrot pomace powder resulted in significant reduction in the width of cookies which is attributed to an increase in fibre contents due to addition of carrot pomace.
However, non-significant effect during storage was observed. The mean values during storage ranged from (46.86 to 46.91mm). Developed fibre and mineral enriched de-fatted rice bran supplemented cookies also showed the similar results (Sharif *et al*., 2009). Saeed *et al.* (2012) studied the width of cookies developed from wheat and sweet potato cookies blend flour and reported that width ranged from 26.4 to 32.0 mm which was in sequence with the results of present study.

Thickness (mm): The cookies thickness decreased significantly ($p<0.05$) from 11.93 to10.72mm among treatments with increasing percentage of carrot pomace powder in wheat flour (Fig.7) .The control cookies (T_1) showed maximum thickness 11.93mm while minimum thickness 10.72mm was measured in T_5. This change in thickness might be due to the baking temperature for the development of cookies. Saeed *et al.* (2012) illustrated a decrease in cookies thickness from 6.89 to 6.50 mm developed from sweet potato powder and wheat flour. These results agree to those of Sukhcharn *et al.* (2008). Cookies thickness increased from 11.40mm to 11.45 mm during 90 days storage.

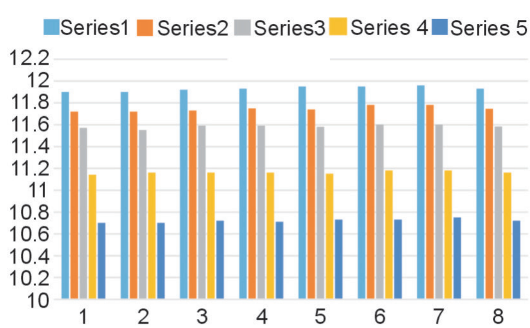

Fig. 7. Effect of treatments and storage on thickness of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

Spread factor (mm): Mean values of spread factor of cookies reduced from 46.7mm (T_1) to 37.3mm (T_5) among treatments with increased the level of carrot pomace powder(Fig. 8). Owing to different combinations of CPP with WF significant decrease in spread factor was observed. However, non-significant effect on cookies spread factor was observed during storage.

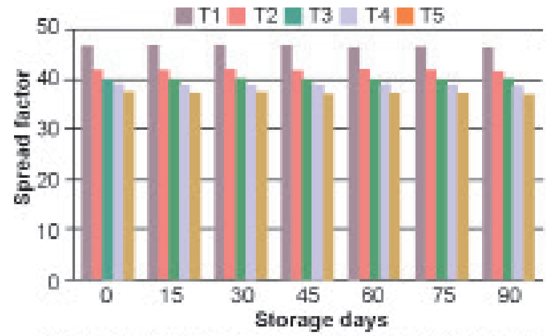

Fig. 8. Effect of treatments and storage on spread factor of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

Decrease in cookie spread (42.35 to 40.00mm) was also reported by Saeed *et al.* (2012) with increasing sweet potato flour percentage during storage. Carrot pomace powder due to higher fibrous content absorbs lesser water than that of plain wheat flour cookies. Shyamala and Prakash, (2015) also reported similar results.

Sensory evaluation

Sensory parameters i.e. colour, flavour, taste, crispiness and overall acceptability were evaluated at 15 days interval upto 90 days by food experts as given below:-

Colour: Statistical data (Fig.9) regarding colour of carrot pomace supplemented cookies showed that treatment T_4 scored the highest (8.20) followed by T_3 (8.00) at zero days which decreased during storage of 90 days. However, all treatments were acceptable with respect to colour. Date regarding storage studies showed a considerable decrease in mean score of cookies. Where change in colour was observed.

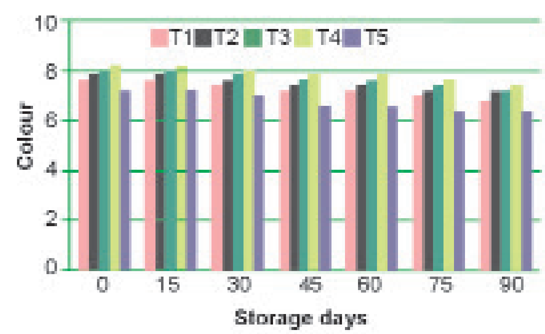

Fig. 9. Effect of treatments and storage on colour of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

Saeed *et al.* (2012) also reported decrease in mean scores of cookies during storage (8.0 to 6.4). However, Shyamala and J Prakash (2015) did not agree who declared that 8% carrot pomace cookies were best with respect to color. Differences in scores may be due to varietal change of carrot and use of other raw material. The cookies color deteriorate because of moisture absorption from the atmosphere and as well as Maillard's reaction, as the biscuits contain higher amount of protein and sugar (Mebpa *et al.,* 2007).

Flavour: The data regarding flavour of cookies showed that treatment T_4 (8.0) containing 12% carrot pomace powder scored higher by panel of judges followed by T_3 (7.80) at zero day which decreased with passage of time (Fig 10). A decreasing trend in flavour of cookies was observed during storage which could be attributed to moisture absorption that resulted in fat oxidation. Sharif *et al*. (2009) recorded similar results. However, storage period did not adversely affect the flavor of cookies.

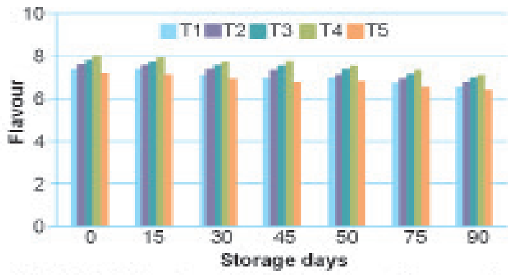

Fig. 10. Effect of treatments and storage on flavour of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

Taste: The data revealed that all treatments gained varied scores for taste (Fig 11).Treatment T_4 exhibited highest score (8.4) followed by T_3 (7.00) at zero day. The scoring decreased within the treatments as percentage of pomace increased. A decreasing value for taste score was also observed by Elahi (1997) in composite flour biscuits i.e., from 6.62 to 5.81 after 90 days storage. The variability in percentage of CPP used in cookies resulted in the deviation of taste, while decline in taste scores may occur due to the fat rancidity during storage.

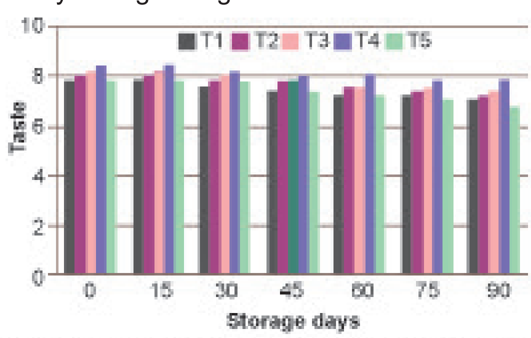

Fig. 11. Effect of treatments and storage on taste of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

Crispiness: Cookies crispiness varied with substitution of carrot pomace powder. However, T_4 explicated highest score (8.20) followed by T_3 (8.00) at zero day (Fig. 12). The scoring decreased within the treatments as percentage of pomace increased and with time due to increase in high fibre pomace and absorption of moisture. Hence, the scores of all cookies was in acceptable range.

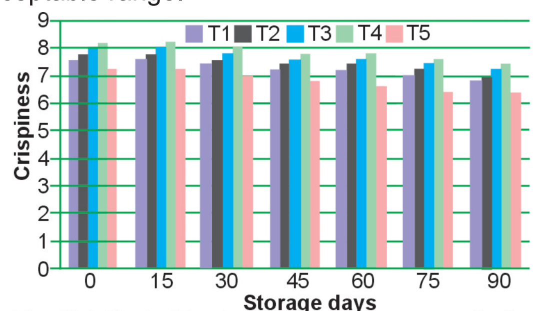

Fig. 12. Effect of treatments and storage on crispiness of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

These results are in contrast to those of Shyamala and Prakash (2015) who declared that 8% carrot pomace cookies scored better with respect to crispiness.

Overall acceptability: Overall acceptability is index of eminence scores acquired for colour, flavour, taste and crispiness of cookies. The results based on the observations of panel of judges indicated that T_4 (12% carrot pomace powder) stood first (8.40) and T_5 was ranked at lowest level (7.80) at zero day. Overall acceptability scores decreased with passage of time in all treatments. The results are in contrast with Baljeet *at al.* (2014) who supplemented cookies with carrot pomace and chickpea. Shyamala and Prakash, (2015) also studied carrot pomace substituted cookies with different results to this study where the panelist. Differences in scores may be due to varietal change of carrot and use of other raw material.

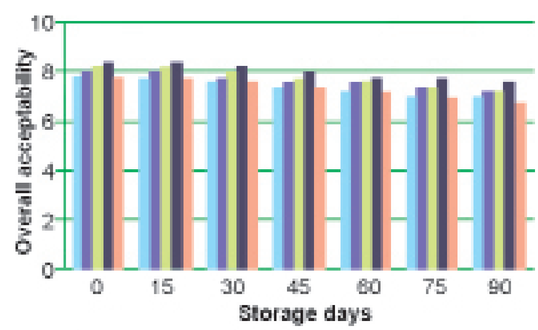

Fig. 13. Effect of treatments and storage on overal acceptability of cookies.

T_1 = 100:0% WF and CPP, T_2 = 96:4% WF and CPP, T_3 = 92:8% WF and CPP, T_4 = 88:12% WF and CPP, T_5 = 84:16% WF and CPP

CONCLUSION

The results of this study indicate that carrot pomace can be utilized as valuable source of fibre for developing highly nutritious cookies. It can be predicted that 12% replacement of wheat flour with carrot pomace powder produced better quality cookies with acceptable physical and sensory characteristics. However, all other treatments were also acceptable with respect to sensory parameters. The findings of this study can further be utilized to develop healthful fibre enriched cookies. It is also recommended that carrot pomace cookies can be commercially prepared for all groups of masses especially children.

REFERENCES

Anon. 2006. Approved Methods of American Association of Cereal Chemists (AACC). The Amer. Assoc. Cereal Chem. Inc., St. Paul. Minnesota.

Anon. 2015. Fruits, Vegetables and Condiments Statistics of Pakistan. Government of Pakistan Ministry of National Food Security & Research Economic Wing, Islamabad.

Baljeet, S. Y., B.Y. Ritika, and K. Reena. 2014. Effect of incorporation of carrot pomace powder and germinated chickpea flour on the quality characteristics of biscuits. Food Res. J. 21(1):217-222.

Bohm, V., K. Otto and F. Weissleder. 1999. Yield of juice and carotenoids of the carrot juice production, *In:* Symposium Jena-Thuringen, Germany. p. 115-119.

Elahi, H. H. 1997. Use of Emulsifiers in the Production of Biscuits from Composite Flour. M.Sc. Thesis. Dept. Food Techol., Univ. Agric., Faisalabad.

Elleuch, M., D. Bedigian, O. Roiseux, S. Besbes, Ch. Blecker and H. Attia. 2011. Dietary fibre and fibre-rich by-products of food processing: Characterization, technological functionality and commercial applications: A review. Food Chem. 124 (2):411-421.

Gayas, B., R. N. Shukla and B. M. Khan. 2012. Physico -chemical and sensory characteristics of carrot pomace powder enriched defatted soy flour fortified biscuits. Int. J. Sci. Res. 2(8):1-5.

Goyal, S., 2004. Carrot Juice Process Development and Studies on Storage Stability. M. Tech. Thesis, Deptt. Foodengin. and Technol., Santlongowal Institute of Engineering and Technology, Longowal, Sangrur, India.

Grigelmo-Miguel, N and O. Martín-Belloso. 1999. Comparison of dietary fibre from by-products of processing fruits and greens and from cereals, LWT – Food Sci. Technol., 32(8):503–508.

Herchi, W., D. Arráez-Román, S. Boukhchina, H. Kallel, A. Segura- Carretero and A. Fernández-Gutierrez. 2012. A review: the methods used in the determination of flaxseed components. Afri. J. Biotechnol. 11(4):724-731.

Hooda, S. and S. Jood. 2005. Organoleptic and nutritional evaluation of wheat biscuits supplemented with untreated and treated fenugreek flour. Food Chem. 90:427-435.

Hussain, S., F. M. Anjum, M. S. Butt, M.I. Khan and A. Asghar. 2006. Physical and sensory attributes of flaxseed flour supplemented cookies. Turk. J. Biol. (30):87-92.

Iqbal, M.T. 2003. Effect of different Shortening on the Quality of Cookies. M.Sc. Thesis. Inst. Food Sci. Techol., Univ. Agric. Faisalabad

Iwegbue, C.M.A. 2012. Metal contents in some brands of biscuits consumed in southern Nigeria. Amer. J. Food Technol. 7:160-167.

Kaur, S., B. C. Sarkar, H. K. Sharma and C. Singh. 2009. Response surface optimization of conditions for the clarification of guava fruit juice using commercial enzyme. J. Food Process Eng. 34(4):1298-1318.

Leelavathi, K. and P.H. Rao. 1993. Development of high fiber biscuits using wheat bran. J. Food Sci. Technol. 30(3):187-90.

Mahmood, S., M.S. Butt, F.M. Anjum and H. Nawaz. 2008. Baking and storage stability of retinyl acetate (vitamin A) fortified cookies. Pak. J. Nutr. 7:586-89.

Masih, S., Z. Iqbal, A. M. Arif, M. Rafiq, G. Rasool and A, Rashid. 2014. Effect of linseed oil substitution on physico-chemical properties of cookies. J. Agric. Res. 52(3):425-437.

Mebpa, H. D., L. Eboh and S. U. Nwaojigwa. 2007. Chemical composition, functional and baking properties of wheat-plantain composite flour. Afri. J. Food Agric. Develop. 7(1):1-22.

Meilgaard, D., G. V. Civille and B. T. Carr. 1991. Sensory Evaluation Techniques. 2nd Ed. CRC Press, Boca Katon FL.

Nawirska, A. and M. Kwasniewska. 2005. Dietary fibre fractions from fruit and vegetable processing waste. Food Chem. 91(2):221-225.

Pasha, I., M. S. Butt, F. M. Anjum and N. Shehzadi. 2002. Effect of dietetic sweeteners on the quality of cookies. Int. J. Agric. Biology. 4:245-248.

Rao, T.S.S, M.N. Rajmanuja, N. Ashok and H. S. Vibhaker. 1995. Storage properties of whole egg powder incorporated biscuits. J. Food Sci. Tech. 32 (6):470-476.

Saeed, S., M, M. Ahmad, H. Kausar, S. Parveen, S. Masih and A. Salam .2012. Effect of sweet potato flour on quality of cookies. J. Agric. Res. 50(4):525 -538.

Serena, A. and B. Kundsen. 2007. Chemical and physicochemical characterization of co-products from vegetable food and agro industries, Animal Feed Sci. Technol. 139:109-124.

Sharif, M. K., M. S. Butt, F. M. Anjum and H. Nawaz. 2009. Preparation of fibre and mineral enriched defatted rice bran supplemented cookies. Pak. J. Nutri. 8(5):571 -577.

Sharif, M. K., M. S. Butt, F. M. Anjum and M. Nasir. 2005a. Improved quality of baked products by rice bran oil. Internet J. Food Safety. 5:1-8.

Shyamala, B .N and J. Prakash. 2015. Nutritional composition, acceptability, and shelf stability of carrot pomace-incorporated cookies with special reference to total and β-careteneretention. J. Cogent Food and Agri. p. 1-10.

Silva, D.J.C. 2014. Nutritional and Health Benefits of Carrots and their Seed Extracts. Food and Nutrition Sciences. 5:2147-2156. http://dx.doi.org/10.4236/fns.2014.522227

Singh, S., C. S. Riar and D. C. Saxena. 2008. Effect of incorporating sweet potato flour to wheat flour on the quality characteristics of cookies. Agri. J. Food Sci. 2:65-72.

Steel, R. G. D, J. H. Torrie and D. A. Dickey. 1997. Principles and Procedures of Statistics. A Biometrical Approach. 3rd Ed. McGraw Hill Book Co. Inc. New York.

Sukhcharn, D. S., C. S. Riar and D. C. Saxena. 2008. Effect of incorporating of SP flour to wheat flour on the quality characteristics of cookies. Afr. J. Food Sci. 2:65-72.

Upadhyay, A., H. K. Sharma and B. C. Sarkar. 2008. Characterization of dehydration kinetics of carrot pomace. Agri. Eng. Int. J. 10:1-9.

Wade, P. 1988. Biscuits, Cookies and Crackers. The Principle of the Craft. Introduction to Biscuit Making. Vol. I. Pub. Elsevier Applied Science. London. Pp.12.

CONTRIBUTION OF AUTHORS

Sr. No.	Name of author	Contribution detail	Signatures
1.	Humaira Kausar	Planed and supervised the research work and finalized the research articles.	
2.	Saima Parveen	Statistically analyzed the collected data	
3.	Muhammad Maaz Aziz	Assisted in literature review and wrote the references	
4.	Shazia Saeed	Assisted in Analytical Laboratory work and write up.	