Utilization of Fruits and Vegetable Waste in Cereal Based Food (Cookies)

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***Abstract*— An experiment entitled "Utilization of fruits and vegetables waste in cereal based food" was conducted in the Department of Horticulture during 2016 -2018. Powder from the mango kernel, pineapple pomace, carrot pomace, banana peel and orange peel was prepared. The wheat flour in the cookies formulation was substituted by MKP (mango kernel powder), PPP (pineapple pomace powder), CPP (carrot pomace powder), BPP (banana peel powder) and OPP (orange peel powder) at the rate of 0, 10, 20 and 30 per cent. Cookies was prepared and were analysed for physical (diameter, thickness and spread ratio), functional (water holding capacity, oil holding capacity and swelling capacity), chemical (moisture, ash, protein, fat, fibre, carbohydrate) and sensorial characteristics (appearance, colour, Flavour, taste, texture, overall acceptability). On the basis of overall sensory attributes, cookies prepared with incorporation of 10 per cent of MKP, PPP, CPP, BPP and OPP recorded higher acceptability scores as compared to other samples.**

Keywords: Utilization of fruits and vegetable waste, Sensory evaluation for acceptability of incorporation level and Nutrition composition of the acceptable cookies.

INTRODUCTION

Food processing industry including fruit and vegetable processing is the second largest generator of wastes into the environment after the household sewage. A massive amount of waste is produced in the fruit and vegetable processing industries, which contains numerous valuable substances of high nutritive value with large economic potential. The processing of fruits and vegetables results in huge amounts of waste materials such as peels, seeds, stones, and unused flesh generated down the processing chain (Gowe, 2015). The new aspects concerning the use of by-products of food processing industries with high nutritional value have gained lot of interest because these are high-value products and their recovery may be economically attractive. India ranks second in the world in the production of vegetables and third in production of fruits. Fruits and vegetables are consumed raw as well as made into various processed products like: jam, jelly, squash, RTS, candy and pickles (Boer and Pandey, 1997). The waste obtained from fruit processing industry is extremely diverse due to the use of wide variety of fruits and vegetables, the broad range of processes and the multiplicity of the product. Vegetables and some fruits yield between 25% and 30% of non-edible products (Ajila *et al*., 2010). The fruit and vegetable wastes are inexpensive, abundantly available and are a good source of dietary fibre. A lot of research has been done on waste utilization of various fruits and vegetables like artichokes, apples, carrots, oranges, cherries, peaches, onions etc. The new aspects concerning the use fruit and vegetable wastes as by-products for exploitation on the production of food additives or supplements with high nutritional value have gained interest because these are high value products and their recovery may be economically attractive. The by-products obtained represent an important source of sugars, minerals, organic acid, dietary fibre and phenolic, which have a wide range of action, which includes antiviral, antibacterial, cardio-protective and anti-mutagenic activities (Jasna *et al*., 2009). The market of bakery products and cereals is worth $ 1 billion in India and is growing day by day (Bhise and Kaur, 2013). At the same time an upcoming demand for bakery products is increasing at the rate of 10 percent per annum. Bakery products mainly consist of wheat, which is a staple grain of the country and around 25% of wheat is used for the preparation of bakery products (Kamaljit *et al*., 2010). The increased demand for consumption of processed foods may be attributed to a number of factors like increased urbanization, rising income, changing lifestyle and increase in the number of working women (Goyal and Singh, 2007). Bakery products are liked by people of all age groups and include a wide variety of products like cakes, breads, and cookies etc. Since demand and acceptability for bakery products is more, they can be used as a vehicle for fortification and enhancing the nutritional quality. Bakery products like cakes and cookies are rich in starch, fat and energy but depleted of fibre. It has been evident with various epidemiological studies that high intake of dietary fibre has been found to be associated with reduced blood pressure, LDL cholesterol and associated cardiovascular diseases (Lupton and Turner, 2003).

Taking into concern the impact and economy of waste generated the present research investigation was carried out to exploit the mango kernel powder, pineapple pomace powder, carrot pomace powder, banana peel powder and orange peel powder, in value added food products *viz*: cookies and also evaluated for their overall quality and acceptability.

MATERIALS AND METHODS

Representative samples of fruit and vegetable wastes like mango kernel, pineapple pomace, carrot pomace banana peel and orange peel were collected from the processing unit of Department of Horticulture, Assam Agricultural University and dried at 60±5 0 C in a simple cabinet drier to 5 per cent moisture content and made in to powder.

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Preparation of cookies

Cookies were prepared by using the standardized recipe and method given by American Association of Cereal Chemists, AACC method (Anon, 1990)

Table I. Standardized Recipe for cookies

Ingredients	Quantity (g)
Flour	100
Sugar	56
Salt	1
Sodium bicarbonate	1.11
Shortening	40
Dextrose	14.5 ml (8.9 glucose in 150 ml water)

Cookies were prepared using AACC method. Various ingredients were weighed accurately. The hydrogenated fat and powdered sugar and salt were creamed until light and fluffy. The composite flour was slowly added to the cream. The traditional creaming method was used for the preparation of cookies. The process for preparation of cookies is given in Fig 1. The dough was thoroughly kneaded by adding required amount of water dissolved with sodium bicarbonate. After kneading the dough was rolled between polyethylene sheet having thickness of 0.5 cm and pieces cut using cookie cutter. The pieces were placed in baking tray smeared with fat and baked at 125-10°C, for 14 minutes in baking oven. The cookies were allowed to cool, packed in various packages and stored at room temperature.

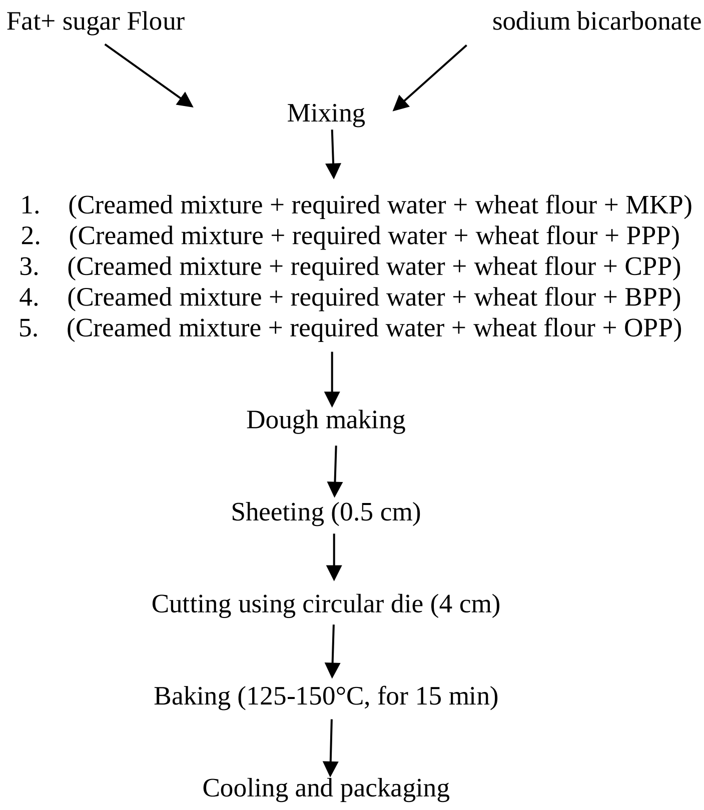

Fig.1. Flow diagram for preparation of cookies

Table II. Levels of incorporation of different waste flour

TREATMENTS	Level of incorporation					
	Refined wheat flour (RWF)	Mango kernel powder (MKP)	Pineapple pomace powder (PPP)	Carrot pomace powder (CPP)	Banana peel powder (BPP)	Orange peel powder (OPP)
WF	100%	-	-	-	-	-
MK10	90%	10%	-	-	-	-
MK20	80%	20%	-	-	-	-
MK30	70%	30%	-	-	-	-
PP10	90%	-	10%	-	-	-
PP20	80%	-	20%	-	-	-
PP30	70%	-	30%	-	-	-
CP10	90%	-	-	10%	-	-
CP20	80%	-	-	20%	-	-
CP30	70%	-	-	30%	-	-
BP10	90%	-	-	-	10%	-
BP20	80%	-	-	-	20%	-
BP30	70%	-	-	-	30%	-
OP10	90%	-	-	-	-	10%
OP20	80%	-	-	-	-	20%
OP10	70%	-	-	-	-	30%

WF=wheat flour, MK = mango kernel powder, PP = pineapple pomace powder, CP = carrot pomace powder, BP=banana peel powder and OP=orange peel powder
10 = 10% incorporation,
20 = 20% incorporation
30 = 30% incorporation

Sensory evaluation for acceptability of developed cookies with various formulation
The sensory evaluation was done on point hedonic scale as per the method given by Hooda and Jood (2005). The sensory evaluation of prepared fruits and vegetable cookies was carried out by a 15 member trained panel comprising of postgraduate students and academic staff members of faculty who had previous experience in sensory evaluation of bakery products. The panel members were requested to measure the terms identifying sensory characteristics and in use of the score. Judgments were made through rating products on a 9 point Hedonic Scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely'. Statistical analysis was done to select the best formulation for cookies preparation. Cookies were scored for texture, colour, flavour, taste, appearance and overall acceptability. Cookies with significant higher acceptability scores prepared by incorporating different levels of mango kernel powder, pineapple pomace powder, carrot pomace powder, banana peel powder and orange peel powder were selected for further studies.

Water and oil holding capacity
Water and oil holding capacity was determined using the method of (Sathe and Salunkhe, 1981) with slight modification. ***Swelling capacity***
Swelling power of WF and flour with different level of substitution was determined by the method suggested by (Appiah *et al*., 2011).

Physical Properties:
The physical properties: width, thickness and spread ratio of the prepared cookies were carried out by the process given by the AACC (2000).

RESULT AND DISCUSSION

Table III. Biochemical analysis of wheat flour and fruits and vegetable waste powder

Products	Nutrients					
	Moisture (%)	*Ash (%)*	*Protein(g/100g)*	*Fat(g/100g)*	*Crude Fibre (%)*	*Carbohydrate (g/100g)*
WF	8.66	1.23	10.86	1.46	0.73	76.06
MKP	8.51	1.74	7.19	9.20	2.86	71.61
PPP	5.78	1.46	2.69	1.03	9.36	70.24
CPP	5.43	4.62	3.56	1.60	16.03	67.74
BPP	3.41	13.31	8.07	8.51	10.32	55.35
OPP	4.72	4.10	5.95	2.66	2.63	78.91
CD (5%)	0.27	0.33	1.07	0.48	1.12	1.71

The dehydrated powder prepared from the mango kernel, pineapple pomace, carrot pomace, banana peel and orange peel, were analysed for their proximate nutritional composition and their values are presented in Table III. Different nutritional compositions of various fruits and vegetable waste powder differ significantly. The moisture content of MKP, PPP, CPP, BPP and OPP were lower than WF. The moisture content of WF was 8.66 percent, but BPP had the lowest (3.41%) moisture content. Among all, banana peel powder contains the highest amount of ash with a value of 13.31per cent. The protein content of the MKP, PPP, CPP, BPP and OPP were lower than WF (wheat flour) .The highest fat content of 9.20 per cent was found in MKP whereas it was lowest in pineapple pomace (1.03%). The crude fibre content differed significantly. CPF had the highest crude fibre (16.03 %) whereas OPP contained the lowest crude fibre (3.63 %). Moreover, the content of carbohydrate of different fruits and vegetable waste powder ranged from 55.35 per cent to 78.91 per cent. The highest carbohydrate content of 78.91 per cent was found in OPP and the lowest carbohydrate content of 55.35 per cent was observed in BPP. The obtained results for the proximate composition content of wheat flour were similar to that of results reported by other scientist (Gopalan *et al.*, 2004). the results of the proximate chemical composition of fruits and vegetables wastes powder are in agreement with results obtained by Sosulski and Wu 1988; Camire and Flint 1991;; Camire, *et al.* 1997; Chantaro, *et al.* 2008; Zakir, *et al.*, 2016;Romelle, *et al.*, 2016; Richa Singh, 2016;Bandyopadhyay, *et al.*, 2014.

Table IV. Mean Sensory Panel Score of cookies prepared from different levels of wheat

Treatment (Wheat flour + levels of substitution)	Texture	colour	Taste	Appearance	Flavour	Over all acceptability
MK10	7.87	7.93	8.06	7.93	7.90	7.93
MK20	7.33	7.33	7.60	7.47	7.53	7.47
MK30	6.87	6.93	7.03	6.90	7.06	6.87
CD (5%)	0.31	0.31	0.40	0.28	0.35	0.29
PP10	7.85	8.00	7.96	7.92	7.60	7.67
PP20	7.35	7.57	7.35	7.46	7.28	7.17
PP30	6.92	6.85	6.85	7.00	6.60	6.75
CD (5%)	0.35	0.41	0.31	0.35	0.34	0.35
CP10	7.65	7.30	7.26	7.26	7.26	7.42
CP20	7.30	6.88	6.73	7.30	6.80	6.92
CP30	6.84	6.69	6.57	6.88	6.53	6.53
CD (5%)	0.36	0.33	0.35	0.23	0.44	0.34
BP10	7.92	7.03	7.50	7.25	7.67	7.25
BP20	7.07	6.53	6.50	6.78	7.14	6.60
BP30	6.85	6.14	6.14	6.28	7.00	5.67
CD (5%)	0.51	NS	0.50	0.48	0.41	0.59
OP10	7.18	7.09	6.36	7.54	7.18	6.27
OP20	6.72	7.18	5.27	6.90	6.63	5.24
OP30	6.72	7.18	4.72	6.54	6.45	4.72
CD (5%)	0.26	NS	0.67	0.44	0.46	0.33

Mean Scores of Sensory evaluation of different cookies prepared with various amount of wheat flour substitution is given in Table IV. Mean scores of texture, colour, taste, appearance, flavour and overall acceptability differed significantly. From the table 4 it is clear that the mean scores of texture, colour, taste, appearance, flavour and overall acceptability were highest in 10 per cent substitution and lowest in 30 % substitution. Therefore, 10 per cent substitution level was selected for final studies.

Table V. Water holding, Oil holding and swelling capacity of different formulations

Products	water holding capacity (ml/g)	oil holding capacity (ml/g)	Swelling capacity (%)
WF	1.10	2.10	7.22
MK10	1.40	2.50	7.28
PP10	1.60	2.56	7.37
CP10	2.66	2.90	8.49
BP10	1.80	2.65	7.86
OP10	2.01	2.26	8.47
CD (5%)	0.30	0.26	0.40

The physical properties of any material are important for developing value added food product. Since the consumer choices for foods are expanding, the food industry increasingly depends upon ingredient which imparts good functional property to the food apart from nutritional quality. Physical properties of foods are very crucial in product development, process design, shelf life and quality. Knowledge of physical properties is important in handling, preparing, processing, preserving, packaging, storing and distribution of foods. In the (Table-V) the water absorption capacity increased significantly with incorporation of fruits and vegetable waste powder to wheat flour. The highest water WAC of 2.66 ml/g was observed in wheat flour substituted with 10% carrot pomace powder. The lowest water absorption capacity was found in wheat flour. The increased in water absorption capacity may be due to the higher fibre content in fruits and vegetable waste powder (Shyamala and Jamuna 2010). High water retention capacity was also previously observed for carrot peel and pulp wastes and tomato peel residue (Chantaro *et al*. 2008; Navarro-González *et al*. 2011; Grigelmo-Miguel and Martín-Belloso, 1999).

Oil holding capacity (OHC) is a prominent factor in food formulations because it improves flavor and increase mouth feel of a product (Aremu *et al*., 2007). Dietary fibres have the greatest effect on functional properties of foods (El-Refai *et al*., 2006). The greater capacity to swell is the most desirable parameter for the physiological functionality of dietary fibre (Lebesi and Tzia, 2011).The oil and swelling capacity of WF increased significantly after incorporation of waste powder. The OHC ranged from 2.1 ml/g to 2.90 ml/g. The highest OHC was observed in CP10. The highest swelling capacity (8.49%) was also found in CP10. The resulting increase in OHC and SWC can be attributed to the increase in fibre content of WF after incorporation of waste powder (Ahmad, *et al*., 2016). They also reported that the oil absorption capacity increased from 1.11% to 1.39 % and swelling capacity from 1.34 to 1.39%, respectively with incorporation of carrot pomace powder to wheat flour. Similar findings have also been reported by Zouari *et al*., 2016 for wheat flour blended with sesame peels flour.

Table VI. Physical properties of formulated cookies

Products	Diameter (cm)	Thickness (cm)	Spread ration
WF	3.46	0.55	6.29
MK10	3.40	0.54	6.24
PP10	3.36	0.51	6.51
CP10	3.45	0.54	6.31
BP10	3.41	0.53	6.45
OP10	3.43	0.53	6.49
CD (5%)	NS	0.12	NS

- The diameter of formulated cookies ranged from 3.36 cm to 3.46 cm. Furthermore, diameter of formulated cookies significantly decreased due to the high fibre content of fruits and vegetable waste powder, which absorbs water, thereby reducing the diameter of the cookies as compared to wheat flour cookies. However, reduction in diameter was found to be statistically non-significant. Similar finding was reported by Mridula (2011) who stated that expansion in diameter of carrot pomace powder incorporated biscuits decreased with increasing levels of carrot pomace powder, which may be due to increased fibre content in the biscuits. (Kumar *et al*., 2010) also reported that with increasing level of kodo flour in biscuits the diameter decreased.
- Form Table-VI, it was revealed that different levels of incorporation of fruits and vegetables waste Powder shows significant effect on thickness. Thickness of cookies ranged from 0.51cm to 0.56 cm, the lowest thickness of cookie was found in PP10 with a valued of 0.51 cm. Increase or decrease in thickness may be due to increase or decrease in diameter of the cookies. Moreover, reduction in thickness might be due to the presence of fibre in the cookies. (Brennan and Samyue 2004) also found that the thickness development during baking of cookies is affected by crude fibre content.
- The effect of incorporation of MKP, PPP, CPP, BPP and OPP on spread ratio of cookies is given in Table-VI. Among all OP10 showed the maximum spread ratio 6.49. Addition of waste powder significantly increased the spread ratio of cookies. Similar results were reported by (Zouari *et al*., 2016) for cookies blended with sesame peels.

Table VII. Biochemical parameters and energy level of formulated cookies

Products	Nutrients						
	Moisture (%)	Ash (%)	Protein(g/100g)	Fat(g/100g)	Crude Fibre (%)	Carbohydrate (g/100g)	Energy (Kcal)
WF	1.98	0.89	6.24	14.63	0.82	74.42	826
MK10	2.24	1.16	5.72	15.03	1.96	72.86	814
PP10	3.07	2.09	5.66	14.28	2.56	71.31	793
CP10	2.44	1.44	5.53	14.67	3.66	71.23	795
BP10	3.06	2.13	5.71	14.64	2.78	70.66	791
OP10	3.05	1.88	5.60	14.91	3.13	70.41	790
CD (5%)	0.17	0.16	NS	0.38	0.40	1.08	12

- The moisture contents of cookies are presented in Table-VII. The moisture content of cookies in which wheat flour was substituted by fruit and vegetable waste powder was significantly higher than WF cookies. The highest moisture content was observed in PP10 cookies with value of 3.07% while WF cookies with a value of 1.98% had least moisture content. Similar observation was reported by (Kuldip *et al.*, 2014).
- From the results presented in Table-VII it can be observed that the incorporation of fruits and vegetable waste powder significantly increased the ash content of cookies. The data revealed that the highest ash content of cookies found in BP10 (wheat flour substituted with 10% banana peel powder as compare to wheat flour cookies (0.89%). The increase in ash content in the developed cookies may be due to the presence of minerals in the fruits and vegetable waste powder. (Thnaa and Hashem, 2017) also reported that an increase in ash content of cookies incorporated with banana peel Powder. It can be explained that the mineral content found in banana peels powder is high enough so that the cookies made with incorporation of banana peel powder might be high (Hernawati *et al.*, 2017).
- The crude protein content of cookies decreased significantly due to incorporation of fruits and vegetable waste powder. The data revealed that the crude protein content of cookies were 6.24%, 5.72%, 5.66%, 5.53%, 5.71% and 5.60% when prepared from WF, MK10, PP10, CP10, BP10 and OP10 respectively. The protein content of all cookies incorporated with fruit and vegetable waste powder were found to be lower than wheat flour cookies. (Nagarajaiah and Prakash 2015) reported that addition of carrot powder significantly lowered the total protein content of cookies, which might be due to lower protein content in carrot powder. Cookies prepare by incorporation of pineapple pulp flour at the level 15g, 30g, 50g /100 g gradually decreases the protein content (Varastegani *et al.*, 2015.)
- Table-VII revealed that the difference in fat content of cookies due to incorporation of fruits and vegetable waste powder was significant. Cookies prepared by incorporation of 10 % mango kernel powder, 10 % carrot pomace powder, 10 % banana peel powder and 10 % orange peel powder showed higher fat content than cookies prepared from wheat flour only. However, the fat content of cookies prepared by incorporation of 10 % pineapple pomace powder was less than cookies prepared from wheat flour. The highest fat content of 15.03 % was recorded in cookies incorporated with 10 percent mango kernel powder. The results of the present study were similar to the finding of Gumte, *et al.* (2018) who reported that the fat content increased from 12.53% of wheat flour biscuit to 14.06 % in 30 % mango kernel Powder incorporated biscuit due to high fat content of mango kernel powder. Also (Varastegani, *et al.*, 2015) reported that fat content of cookies prepared with incorporation of pineapple pomace powder decreased slightly than wheat flour cookies.
- From the Table-VII, it is clear that the crude fibre content of cookies differed significantly. The crude fibre content of cookies prepared by incorporation of fruits and vegetable waste powder was found to be higher than cookies prepared with wheat flour. The highest crude fibre content (3.66%) was recorded in CP10 cookies (wheat flour substituted with 10 % carrot pomace powder). Similar result was reported by (Aglawe and Bobade, 2018) who found that the crude fibre increased significantly in cookies prepared by incorporation of carrot pomace powder to wheat flour. Also, several workers reported that the crude fibre content increased with the increased level of incorporation of fruit/vegetable waste powder (Aslam, *et al.* 2014; Thnaa and Hashem, 2017; Zaker, *et al.*, 2016).
- From the Table-VII, it is clear that the carbohydrate contents of cookies decreased significantly due to incorporation of fruits and vegetable waste powder. The carbohydrate content of cookies prepared from wheat flour was significantly higher than cookies prepared by incorporation of fruit and vegetable waste powder. The highest carbohydrate content (74.42%) was observed in cookies prepared with wheat flour whereas the lowest (70.4%) was observed in OP10 cookies. This may be due to the fact that wheat flour contains mainly the endosperm which is a good source of carbohydrate. Similar result was reported by (Babiker, *et al.*, 2013) who stated that bread made with incorporation of 10% orange peel powder recorded lower carbohydrate value than breads made with only wheat flour.
- The energy observed in fruit and vegetable waste incorporated cookies was less than WF cookies. The higher energy in WF cookies may be attributed to their higher protein and carbohydrate content.

Table VIII. Peroxide value and moisture content of developed cookies during storage

Products	Peroxide value (m moles / kg fat)			Moisture content (%)		
	0 day	*15 days*	*30 days*	*0 day*	*15 days*	*30 days*
WF	3.44	3.44	3.62	1.88	1.92	1.97
MK10	3.47	3.50	3.88	2.11	2.26	2.42
PP10	3.42	3.42	3.80	3.06	3.15	3.25
CP10	3.34	3.44	3.77	2.42	2.53	2.70
BP10	3.21	3.21	3.42	3.08	3.17	3.28
OP10	3.51	3.58	3.98	3.03	3.10	3.20
CD (5%)	0.48	0.30	0.38	0.20	0.29	0.31

- Peroxide value is an indicator of rancidity development during storage. The mean peroxide value of cookies and cakes are presented in Table VIII, respectively. The mean peroxide value of cookies and cakes increased with the progression of storage period. In WF cookies the peroxide value increased from 3.44 m moles / kg fat to 3.62 m moles / kg fat, in MK10 cookies from 3.47 m moles / kg fat to 3.88 m moles / kg fat, in PP10 cookies from 3.42 m moles / kg fat to 3.80 m moles / kg fat, in CP10 cookies from 3.34 m moles / kg fat to 3.77 m moles / kg fat, in BP10 cookies from 3.21 m moles / kg fat to 3.42 m moles / kg fat and in OP10 cookies from 3.51 m moles / kg fat to 3.98 m moles / kg fat, respectively , over storage period of 30 days The increase in peroxide value during storage is probably due to oxidation of double bonds in unsaturated fatty acid which breakdown in order to produce secondary oxidation products that may indicate rancidity (Gahwalal and Sehgal, 1994 ; Ihekoronye and Ngoddy, 1985).
- The moisture content of cookies mean percentage of moisture content gradually increased during period of 30 days of storage. This moisture absorption also might be due to hygroscopic nature of dried product and storage environment (temperature, relative humidity). Similar findings were also reported by Briston, (1980) and Leelavathi and Rao, (1993).

Table IX. Mean Sensory Panel Score for cookies during storage

days	Products	Quality attributes					
		Texture	*Colour*	*Flavour*	*Taste*	*Appearance*	*Over all acceptability*
0 day	WF	8.53	8.16	8.8	8.00	8.16	8.06
	MK10	8.56	8.33	8.30	8.00	8.00	8.02
	PP10	8.50	8.00	8.43	7.83	7.93	7.93
	CP10	8.25	7.50	8.53	7.33	7.73	7.50
	BP10	8.43	8.33	8.59	8.00	8.33	8.00
	OP10	7.95	8.66	8.40	8.00	8.50	7.66
	CD= (5%)	0.29	0.30	0.15	0.13	0.23	0.21
15 days	MK10	8.20	8.16	7.06	7.83	7.83	7.50
	PP10	8.29	8.00	8.03	8.00	7.83	7.23
	CP10	8.40	7.33	8.20	7.66	7.66	7.06
	BP10	8.30	7.00	8.09	7.33	7.63	6.70
	OP10	8.36	7.83	8.16	7.16	7.56	6.16
	MK10	7.80	8.33	8.13	7.16	7.83	7.48
	CD= (5%)	0.30	0.51	0.69	0.21	0.21	0.31
30 days	WF	7.80	6.83	6.83	5.83	7.00	5.83
	MK10	8.00	5.83	6.50	6.16	7.00	5.76
	PP10	7.66	5.83	6.33	5.83	6.16	5.75
	CP10	7.53	5.16	5.66	5.00	5.50	5.66
	BP10	6.96	5.00	5.50	4.83	5.33	5.11
	OP10	6.26	5.33	5.55	4.16	6.16	5.20
	CD= (5%)	0.30	0.36	0.42	0.32	0.23	0.31

Mean sensory panel scores of cookies decreased as storage progress. This is in conformity with the result of (Reddy, *et al.*, 2005) who reported that the mean scores of overall acceptability of biscuits prepared with various plant extract decreased with increase in storage time.

CONCLUSION

Mango kernel, pineapple pomace, carrot pomace, banana peel and orange peel powder can be substituted up to 10 per cent in refined wheat flour to prepare cookies without adversely affecting quality attributes.

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