Shelf stability of biscuits incorporated with pineapple pomace powder

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Abstract

Food processing wastes are promising source of dietary fibre, antioxidants, essential fatty acids, antimicrobials and minerals which may be used due to their favourable technological, nutritional and functional properties. Hence the present study investigated the shelf stability properties of biscuits incorporating pineapple pomace powder. The results showed that the selected T_5 [82.5% all-purpose flour (APF) +12.5% pineapple pomace powder (PPP) + 5% defatted soya flour (DSF) treatment of pineapple pomace enriched biscuits packed in laminated aluminum foil pouch during storage period of 3 months in the ambient condition was found to be superior for moisture, fat, water activity and rancidity over other packages used in the study.

Index Terms: Food processing wastes, Shelf stability properties, Pineapple pomace powder, Defatted soy flour and Enrichment

Introduction

Food processing wastes are promising source of dietary fibre, antioxidants, essential fatty acids, antimicrobials and minerals which may be used due to their favourable technological, nutritional and functional properties (Laufenberg *et al*., 2003). According to Food and Drug Administration to have a product with a "high source of fibre" and "good source of fibre" claim, it must contain, respectively, 20 % or more fibre and 10–19 % of fibre of the recommended daily value for dietary fibre in a serving size (Anon, 2013). About 76 per cent of pineapple by product is fibre, from which 99.2 percent is the insoluble fraction and 0.8 per cent is the soluble fraction. Fibre rich by-products may be incorporated into food products as inexpensive, non-caloriec bulking agents for partial replacement of flour, fat or sugar, as enhancers of water and oil retention and to improve emulsion or oxidative stabilities (Elleuch et al., 2011). All grains and millets are the ideal base for a wholesome diet. This is because all variants of grains and millets are low cost, nutritious and locally available food stuff (Teradal et al., 2017). Even though bakery products provide best structure by which functionality can be provided to the customers in a suitable food. Baked products are most widely consumed food item in the world. So, they can be utilized as nutritional tool to carry the nutrients to body (Younas *et al*., 2015). The bakery industry is growing very fast and the products are increasingly becoming popular among all sections of people. Among ready to-eat snacks, biscuits possess several attractive features including wider consumption base, relatively long shelf-life, more convenience and good eating quality. Most of bakery products are used as a source for incorporation of different nutritionally rich ingredients for their diversification. This approach not only promotes development of diversified and nutrient rich bakery products but also reduces over exploitation and excessive use of wheat for making bakery products. Majority of bakery products are high in carbohydrate, fat and calorie, but low in fibre content (Mishra and Chandra, 2012). These characteristics made them as unhealthy choices for daily consumptions. By-products with rich source of fibre can be used in bakery products, because they are less expensive and non-calorie bulking agents which enhance the oil and water retention and improve the oxidative and emulsion stabilities.

In recent years, foods are not anticipated to only satisfy hunger needs and to deliver essential nutrients to people but also to avoid nutrition-related diseases and enhance physical and mental comfort of the people. Utilization of dried pineapple pomace powder therefore holds a significant promise in improving nutritional quality in general and fibre content of baked products in particular to a greater extent.

Materials and methods:

Materials used in the experiment

Pineapple fruits, wheat flour, sugar, shortenings, baking powder and skimmed milk powder were procured from the local market, Bagalkot and defatted soya bean flour purchased from Ahmed Shopping Centre, Bangalore.

Treatment details and different packaging materials used for shelf life of biscuits for 3 months under ambient condition

Treatment	Package materials
T_1P_1	Aluminum pouch
T_1P_2	Polypropylene box
T_1P_3	Low density polyethylene box
T_5P_1	Aluminum pouch
T_5P_2	Polypropylene box
T_5P_3	Low density polyethylene box

Moisture (%)

Moisture was determined by using moisture balance. Two gram of biscuit was placed in the sample dish and dried in the electric moisture balance until it automatically showed moisture in percentage. The instrument indicates the end point of measurement by a beep and gives the constant value for moisture.

Fat (%)

Fat content was determined by using the Socs plus-SCS-6AS instruments. Initially weight of the beaker was taken (initial weight) and two grams of the powdered nutri-enriched cookies were taken in thimbles and thimbles were placed in thimble holder and the thimble holder was kept in a beaker and to this 80 ml petroleum ether was added. The fat extraction process was carried out for 45 minutes by setting the temperature at 90˚C.After 40 minutes; the beakers were kept in an oven at 100˚C for 10-15 minutes to evaporate the petroleum ether.The beakers were then cooled in a desiccator and weighed again (final weight). The fat content was calculated using the following formula:

$$\text{Fat content (\%)} = \frac{\text{Final Weight (g) - Initial weight (g)}}{\text{Weight of the sample (g)}} \times 100$$

Rancidity (mEq/ml)

One gram of oil or fat of cookies was extracted by boiling in test tubes to this one gram of powdered potassium iodide and 20ml of solvent mixture was added. Transferred the contents transferred to a conical flask contained 20ml of 5% potassium iodide solution. Then to this, 25ml of distilled water was added. The mixture was titrated against N/500 Sodium thiosulphate solutions until yellow colour was almost disappeared. Then again, 0.5ml of starch was added and titrated till the blue colour disappeared.

$$\text{Peroxide value (mEq/kg)} = \frac{\text{Ml } Na_2S_2O_3 \text{ x N of } Na_2S_2O_3}{\text{Weight of sample taken}} \times 1000$$

Where, Ml is mili litre

N is Normality

Results and discussion

Moisture (%)

The data pertaining to the moisture content of pineapple pomace enriched biscuits during the shelf life study is influenced by treatments and packaging materials and their interaction effect are presented in Table 1.

The results indicated that both treatments and packaging material had significant effect on the moisture content. Throughout the storage period (Initial- 4.98 %, 1MAS- 5.30 %, 2MAS- 5.48 %, 3MAS- 5.60 %) the mean moisture content was highest in T_5 (82.5% APF+ 12.5% PPP+ 5% DSF) compared to T_1.

The pineapple pomace enriched biscuits studied under different packaging materials showed that highest mean moisture content was recorded initially (4.99%) was observed in aluminum pouch whereas, 1MAS(5.48 %), 2MAS (5.62 %), 3 MAS (5.82 %) in low density polyethylene pouch. Also the mean moisture content throughout the storage was observed in aluminum pouch (1MAS-5.10 %, 2MAS- 5.29 %, 3MAS-5.48 %).

Among the interaction between treatments and packaging materials minimum moisture content was observed in T_1P_1 (5.31 %) and maximum mean moisture content was noted in T_5P_3 (5.70 %) at the end of third month. Throughout the storage period (Initial- 4.98 %, 1MAS- 5.30 %, 2MAS- 5.48 %, 3MAS- 5.60 %) the mean moisture content was highest in T_5 (82.5% APF+ 12.5% PPP+ 5% DSF) compared to T_1. This may be due to the moisture content of pineapple pomace enriched biscuits increased linearly with increase in concentration of PP this is attributed to high water binding capacity of PPP which retained higher moisture content ultimately in the products.

Table 1: Effect of treatments and packaging on Moisture and Water activity of pineapple pomace enriched biscuits for 3 months under ambient condition

T / P	Moisture (%)															
	Initial				1MAS				2MAS				3MAS			
	P_1	**P_2**	**P_3**	**M**	**P_1**	**P_2**	**P_3**	**M**	**P_1**	**P_2**	**P_3**	**M**	**P_1**	**P_2**	**P_3**	**M**
T_1	4.74	4.53	4.92	4.73	5.09	5.18	5.50	5.26	5.16	5.20	5.68	5.35	5.31	5.37	5.94	5.54
T_5	5.24	4.87	4.82	4.98	5.11	5.32	5.47	5.30	5.42	5.44	5.57	5.48	5.65	5.71	5.70	5.60
Mean	**4.99**	**4.70**	**4.87**		**5.10**	**5.25**	**5.48**		**5.29**	**5.32**	**5.62**		**5.48**	**5.54**	**5.82**	
	SEm±		CD 1 %		SEm±		CD 1%		SEm±		CD 1%		SEm±		CD 1%	
T	0.08		0.32		0.04		0.17		0.028		0.112		0.023		0.092	
P	0.10		0.39		0.05		0.21		0.034		0.137		0.028		0.113	
TXP	0.14		0.56		0.07		0.30		0.049		0.195		0.040		0.159	
	Water activity (a_w)															
T_1	0.31	0.33	0.33	0.32	0.35	0.37	0.40	0.37	0.37	0.41	0.46	0.41	0.41	0.46	0.51	0.46
T_5	0.39	0.39	0.39	0.39	0.42	0.43	0.45	0.43	0.44	0.47	0.50	0.47	0.45	0.50	0.55	0.50
Mean	**0.35**	**0.36**	**0.37**		**0.38**	**0.40**	**0.42**		**0.40**	**0.44**	**0.48**		**0.43**	**0.48**	**0.53**	
	SEm±		CD 1 %		SEm±		CD 1%		SEm±		CD 1%		SEm±		CD 1%	
T	0.004		0.017		0.003		0.012		0.003		0.013		0.003		0.012	
P	0.005		0.021		0.003		0.014		0.004		0.016		0.004		0.015	
TXP	0.007		0.031		0.005		0.021		0.005		0.023		0.005		0.021	

Water activity:

The data pertaining to the water activity content of pineapple pomace enriched biscuits during the shelf life study is influenced by treatments and packaging materials and their interaction effect are presented in Table 2.

The results indicated that both treatments and packaging material had significant effect on the water activity. Throughout the storage period (Initial- 0.39 %, 1MAS-0.43 %, 2MAS- 0.47 %, 3MAS- 0.50 %) the mean water activity was highest in T_5 (82.5 % APF+ 12.5 % PPP+ 5 % DSF) compared to T_1. Among the interaction between treatments and packaging materials minimum water activity was observed in T1P1 (0.41) and maximum mean water activity was noted in T_5P_3 (0.55) at the end of third month. Throughout the storage period (Initial- 0.39 %, 1MAS-0.43 %, 2MAS- 0.47 %, 3MAS- 0.50 %) the mean water activity was highest in T_5 (82.5 % APF+ 12.5 % PPP+ 5 % DSF) compared to T_1. This may be due to the high water binding strength of pineapple pomace powder. Increase in PPP increases moisture content in turn increases water activity of pineapple pomace enriched biscuits. The high water-holding capacity of fiber present in the pomegranate seed is due to more hydroxyl groups of cellulose in the fiber able to bind with free water molecule through hydrogen bonding (Harish *et al*., 2022).

Fat

The data pertaining to the fat content of pineapple pomace enriched biscuits during the shelf life study is influenced by treatments and packaging materials and their interaction effect are presented in Table 2.

The results indicated that both treatments are significantly on par with each other throughout the storage period. Highest was observed in T_5 (22.9 %) compared to T_1 (22.8 %).

Among the interaction between treatments and packaging materials maximum fat content was retained in T_5P_1 and it is on par with T_1P_1 (0.41 %) and minimum fat retention was noted in T_5P_3 and it is on par with T_1P_3 at the end of third month. The pineapple pomace enriched biscuits studied under different packaging materials showed that maximum fat content was retained in aluminum pouch (1MAS- 24.8 %, 2MAS- 24.0 %, 3 MAS- 23.5 %) and maximum reduction was seen in low density poly ethylene pouch at the end of storage. With the advancement of storage period, the fat content was found to be decreased in biscuits packed in different packaging materials but there is decrease in fat content in developed biscuits which may be attributed to the development of rancidity.

Table 2: Effect of treatments and packaging on Fat and Rancidity of pineapple pomace enriched biscuits for 3 months under ambient condition

T / P	Fat (%)															
	Initial				1MAS				2MAS				3MAS			
	P_1	P_2	P_3	M	P_1	P_2	P_3	M	P_1	P_2	P_3	M	P_1	P_2	P_3	M
T_1	25.3	25.7	25.5	25.5	24.7	24.5	24.5	24.6	23.9	23.8	23.5	23.7	23.4	23.1	22.4	22.8
T_5	25.6	25.5	25.3	25.4	24.9	24.5	23.9	24.4	24.3	23.7	23.3	26.8	23.6	22.9	22.2	22.9
Mean	**25.4**	**25.6**	**25.5**		**24.8**	**24.5**	**24.2**		**24.0**	**23.7**	**23.4**		**23.5**	**23.0**	**22.3**	
	SEm±		CD 1 %		SEm±		CD 1%		SEm±		CD 1%		SEm±		CD 1%	
T	0.073		0.289		0.104		0.415		0.008		0.342		0.090		0.359	
P	0.089		0.354		0.128		0.508		0.106		0.419		0.111		0.440	
TXP	0.0126		0.501		0.181		0.718		0.150		0.593		0.157		0.622	
Rancidity (%)																
T_1	0.04	0.04	0.04	0.04	0.64	0.74	0.84	0.74	1.60	2.20	2.52	2.10	1.90	3.12	3.37	2.80
T_5	0.04	0.04	0.04	0.04	0.64	0.73	0.82	0.73	1.61	2.32	2.80	2.23	1.94	3.21	3.50	2.88

Mean	**0.04**	**0.04**	**0.04**		**0.64**	**0.74**	**0.83**		**1.60**	**2.25**	**2.70**		**1.92**	**3.16**	**3.43**	
	SEm±		CD 1 %		SEm±		CD 1%		SEm±		CD 1%		SEm±		CD 1%	
T	-		NS		0.004		0.014		0.021		0.018		0.016		0.065	
P	-		NS		0.004		0.017		0.026		0.103		0.020		0.079	
TXP	-		NS		0.006		0.024		0.036		0.145		0.028		0.112	

Table 3: Effect of treatments and packaging on Fat and Rancidity of pineapple pomace enriched biscuits for 3 months under ambient condition

T / P	Fat (%)															
	Initial				**1MAS**				**2MAS**				**3MAS**			
	P_1	**P_2**	**P_3**	**M**	**P_1**	**P_2**	**P_3**	**M**	**P_1**	**P_2**	**P_3**	**M**	**P_1**	**P_2**	**P_3**	**M**
T_1	25.3	25.7	25.5	25.5	24.7	24.5	24.5	24.6	23.9	23.8	23.5	23.7	23.4	23.1	22.4	22.8
T_5	25.6	25.5	25.3	25.4	24.9	24.5	23.9	24.4	24.3	23.7	23.3	26.8	23.6	22.9	22.2	22.9
Mean	**25.4**	**25.6**	**25.5**		**24.8**	**24.5**	**24.2**		**24.0**	**23.7**	**23.4**		**23.5**	**23.0**	**22.3**	
	SEm±		CD 1 %		SEm±		CD 1%		SEm±		CD 1%		SEm±		CD 1%	
T	0.073		0.289		0.104		0.415		0.008		0.342		0.090		0.359	
P	0.089		0.354		0.128		0.508		0.106		0.419		0.111		0.440	
TXP	0.0126		0.501		0.181		0.718		0.150		0.593		0.157		0.622	
	Rancidity (%)															
T_1	0.04	0.04	0.04	0.04	0.64	0.74	0.84	0.74	1.60	2.20	2.52	2.10	1.90	3.12	3.37	2.80
T_5	0.04	0.04	0.04	0.04	0.64	0.73	0.82	0.73	1.61	2.32	2.80	2.23	1.94	3.21	3.50	2.88
Mean	**0.04**	**0.04**	**0.04**		**0.64**	**0.74**	**0.83**		**1.60**	**2.25**	**2.70**		**1.92**	**3.16**	**3.43**	
	SEm±		CD 1 %		SEm±		CD 1%		SEm±		CD 1%		SEm±		CD 1%	
T	-		NS		0.004		0.014		0.021		0.018		0.016		0.065	
P	-		NS		0.004		0.017		0.026		0.103		0.020		0.079	
TXP	-		NS		0.006		0.024		0.036		0.145		0.028		0.112	

Rancidity

The data on changes in rancidity of pineapple pomace enriched biscuits during the shelf life study is influenced by treatments and packaging materials showed no significant difference initially.

Among the treatments T_5 (2.88 %) showed highest rancidity from 1 MAS to at the end of storage compared to T_1. Among the interaction between treatments and packaging materials maximum rancidity was recorded in T_5P_3 (3.50) and it was on par with T_1P_3 (3.37) and minimum rancidity was seen in T_5P_1 and it is on par with T_1P_1 at the end of third month (Table 3). However, maximum rancidity was observed in biscuits packed in low density poly ethylene pouch (1MAS-0.83, 2MAS-2.70, and 3MAS-3.43) but the minimum rancidity was seen in aluminum pouch (1MAS-0.64, 2MAS-1.60, 3MAS-1.92) from 1MAS to the end of storage period. This might be due to the fact that aluminium laminate pouches protect biscuits against light, as light act as catalyst for oxidation of fat. However, the developed biscuits are in the range of acceptable limits. The results are in conformity with Nagi *et a*l. (2012) in the study of effect of storage period and packaging on shelf life of cereal bran incorporated biscuits. Composite flour prepared by blending wheat and legumes in proper proportions may increase the fiber content of the diet (Teradal et al., 2017). The rancidity level may be low during storage period.

Conclusion:

The results showed that the selected T_5 [82.5% all-purpose flour (APF) +12.5% pineapple pomace powder (PPP) + 5% defatted soya flour (DSF) treatment of pineapple pomace enriched biscuits packed in laminated aluminum foil pouch during storage period of 3 months in the ambient condition found superior with respect to moisture, fat, water activity and rancidity over other packages used in the study.

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