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Shelf Life Evaluation of Biscuits and Cookies Incorporating Germinated Pumpkin Seed Flour

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A B S T R A C T

Value-added whole-wheat flour biscuits and cookies were developed and evaluated for shelf life studies. Three types of biscuits and cookies were developed i.e. Type I, Type II and Type III, respectively, by replacing 10, 20 and 30 per cent of whole wheat flour with germinated pumpkin seed flour. Peroxide value and total plate count of biscuits and cookies increased with storage period of time. Whole wheat flour biscuits were organoleptically acceptable upto 60 days of storage whereas cookies were found to be acceptable upto 75 days of storage.

Introduction

Pumpkin seeds are locally available, underutilized but potential food sources. The most used part of the pumpkin fruit is the flesh, which is used as a vegetable in food preparations. Pumpkin seeds are generally discarded during processing and are generally regarded as a waste. Pumpkin seeds can play important role in food and health industry. They can be consumed regularly without causing any side effects on human health (Maheshwari *et al.,* 2015). Consumption of diets rich in pumpkin seeds also have been associated to lower the chances of occurrence of many types of cancer like colorectal, lung, breast, gastric cancer (Huang *et al.,* 2004). These are loaded with nutrients and medicinal properties. Pumpkin seeds are rich natural source of protein (25 to 37%) and oil (37 to 45%). In addition, they are also good sources of minerals, dietary fibre, health-benefiting vitamins and mono-unsaturated fatty acids, which are good for heart health (Khairi *et al.,* 2014).

Rightly termed as nutritional powerhouse, as these seeds are excellent nutrient source filled with minerals mainly zinc, phosphorous, magnesium, potassium and selenium responsible for fighting diseases and can act as weapon for fighting diseases such as arthritis, inflammation, prostate cancer etc. (Patel and Rauf, 2017). They are also rich source of zinc, lignans, and phytosterols such as delta 7-sterols and delta 5-sterols essential amino acid like as tryptophan and glutamate and are beneficial for maintenance of immune system, cell growth and multiplication, eye and skin health, insulin regulation and male sexual functions such as sperm generation and testosterone metabolism (Montesano *et al.*, 2018; Karrar *et al.*, 2019).

Pumpkin seeds contain 31.48 per cent crude fiber (Nyam *et al.*, 2013). Fiber present in pumpkin seeds can prevent constipation, diabetes, prolong intestinal transit time, lower cholesterol level and provide satiety. Pumpkin seed flour can be used to fortify soups, cookies, pancakes and breads. Moreover, it is also used to fortify wheat flour to produce bakery products like pastries with unique and nutty taste (Lestari and Meiyanto, 2018).

Value addition of existing foods like biscuits and cookies with such ingredients is a simple and feasible way of enhancing nutritional values of foods and add variety to snacking with health.

Materials and Methods

Product development

Present study was carried out in Department of Foods and Nutrition, I.C. College of Home science, Chaudhary Charan Singh Haryana Agricultural University, Hisar. Pumpkins were procured from the local market and seeds were separated from the pulp.

For the preparation of biscuits and cookies the required ingredients namely, whole wheat flour, refined wheat flour, ghee, milk, refined sugar, ammonia and baking powder were purchased in a single lot from the local market of Hisar. Three types of cookies and whole wheat flour biscuits were developed i.e. Type I, Type II and Type III, respectively, by replacing 10, 20 and 30 per cent of flour with germinated pumpkin seed flour (Kumari and Sindhu, 2019; Kumari *et al.*, 2020).

Shelf- life evaluation

Value added products were stored at room temperature in polythene zipper bag (LD-PE, clear zip lock, thickness 0.11mm) and drawn at interval of 15 days of storage for 75 days. These were evaluated for various sensory characteristics i.e. colour, appearance, aroma, texture, taste and overall acceptability using 9 point hedonic scale by a panel of 10 semi-judge from the Department of Foods and Nutrition, I.C. College of Home Science. Peroxide value was determined by the method of AOAC (2010). Total plate count was recorded as per the procedures by APHA (1980). using Nutrient Agar for total plate count.

Results and Discussion

Sensory characteristics

The whole wheat flour biscuits could be stored successfully for 60days whereas cookies were acceptable at 75th day also (Table1&2).

Peroxide value

Table 3 presents the peroxide value (meq peroxide/1000g) of developed value added whole wheat flour biscuits during the storage period. Peroxide value significantly ($P \leq 0.05$) increased with the period of storage from day

15th to 75th day. In Type-I, Type-II and Type-III biscuits, peroxide value ranged from 4.27 to 6.33 (Type-I), 3.20 to 5.03 (Type-II) and 2.81 to 4.47 (Type-III) meq peroxide/1000g.

During storage of cookies (Table 4) peroxide value of control cookies ranged from 3.20 to 5.00 meq peroxide/1000g (15th to 75th days). Peroxide value during the period 15, 30, 45, 60 and 75th days were 2.40, 3.30, 3.40, 4.27 and 4.60 meq peroxide/1000g for Type-I cookies. A significant (P≤0.05) difference was observed after 45th day of storage. The peroxide value of Type-II and Type-III cookies varied from 2.27 (15th day) to 4.13 (75th day) meq peroxide/1000g and 1.80 (15th day) to 3.70 (75th day) meq peroxide/1000g, respectively.

Table.1 Organoleptic acceptability of developed value-added whole-wheat flour biscuits during storage

Level of incorporation	Storage period (days)					
	15	30	45	60	75	C.D (P≤0.05)
Colour						
Control	8.80±0.13	8.20±0.29	8.20±0.29	8.00±0.26	5.90±0.46	0.87
Type-I	8.60±0.16	7.90±0.10	7.90±0.10	7.90±0.10	5.60±0.56	0.78
Type-II	8.10±0.18	7.70±0.16	7.60±0.15	7.60±0.16	4.80±0.59	0.86
Type-III	7.80±0.20	6.80±0.27	6.60±0.25	6.60±0.27	4.20±0.71	1.10
Appearance						
Control	8.70±0.15	8.20±0.29	8.10±0.28	7.60±0.27	5.90±0.46	0.87
Type-I	8.60±0.16	8.00±0.15	7.70±0.21	7.10±0.18	5.50±0.52	0.80
Type-II	8.00±0.21	7.50±0.22	7.50±0.22	7.60±0.22	4.80±0.57	0.93
Type-III	7.60±0.22	6.80±0.39	6.80±0.29	6.80±0.33	4.10±0.66	1.16
Aroma						
Control	8.60±0.22	8.10±0.28	7.80±0.13	7.90±0.31	5.60±0.37	0.78
Type-I	8.40±0.22	7.80±0.13	7.70±0.13	7.60±0.16	4.90±0.38	0.65
Type-II	8.10±0.23	7.20±0.20	7.30±0.21	7.50±0.22	4.20±0.51	0.86
Type-III	7.60±0.27	6.60±0.37	6.60±0.22	6.70±0.37	3.60±0.52	1.04
Texture						
Control	8.60±0.22	8.20±0.29	7.70±0.21	7.30±0.26	5.50±0.37	0.79
Type-I	8.50±0.22	7.80±0.13	7.70±0.15	7.10±0.28	5.00±0.37	0.70
Type-II	8.00±0. 21	7.20±0.20	7.40±0.16	7.10±0.18	4.40±0.50	0.80
Type-III	7.30±0.21	6.20±0.42	6.30±0.30	6.10±0.35	3.80±0.59	1.13
Taste						
Control	8.60±0.22	7.80±0.33	7.30±0.21	6.40±0.27	5.00±0.47	0.90
Type-I	8.50±0.22	7.40±0.16	7.10±0.18	6.70±0.21	4.50±0.45	0.76
Type-II	8.30±0. 30	7.10±0.18	6.70±0.21	6.60±0. 22	3.70±0.47	0.85
Type-III	7.40±0.27	6.00±0.39	5.90±0.41	5.80±0.25	2.50±0.50	1.07
Overall Acceptability						
Control	8.66±0.18	8.10±0.28	7.82±0.17	7.44±0.21	5.58±0.36	0.71
Type-I	8.52±0.17	7.78±0.10	7.62±0.07	7.28±0.07	5.10±0.39	0.57
Type-II	8.10±0.20	7.30±0.17	7.32±0.14	7.28±0.14	4.38±0.47	0.74
Type-III	7.54±0.20	6.44±0.36	6.48±0.24	6.40±0.29	3.64±0.55	0.96

Values are mean ± SE of ten observations
Control=WWF: GPSF:: 100:0, Type-I=WWF: GPSF:: 90:10, Type-II=WWF: GPSF:: 80:20,
Type-III= WWF: GPSF:: 70:30, WWF: Whole wheat flour, GPSF: Germinated pumpkin seed flour

Table.2 Organoleptic acceptability of developed value added cookies during storage

Level of incorporation	Storage (days)					
	15	30	45	60	75	C.D (P≤0.05)
Colour						
Control	8.20±0.20	8.30±0.15	7.80±0.15	7.70±0.13	6.70±0.15	0.46
Type-I	8.10±0.18	8.40±0.16	8.25±0.25	7.60±0.16	6.90±0.18	0.54
Type-II	8.10±0.10	8.10±0.10	8.30±0.26	7.30±0.15	7.50±0.22	0.51
Type-III	8.10±0.28	7.80±0.13	7.80±0.20	6.70±0.26	6.70±0.26	0.66
Appearance						
Control	8.20±0.20	8.00±0.15	7.80±0.15	7.70±0.13	6.00±0.21	0.48
Type-I	8.20±0.13	8.10±0.10	8.20±0.25	7.60±0.16	6.30±0.26	0.55
Type-II	8.00±0.15	7.90±0.10	8.30±0.26	7.20±0.13	7.50±0.17	0.49
Type-III	8.30±0.26	8.30±0.26	7.80±0.20	6.60±0.22	6.80±0.25	0.68
Aroma						
Control	8.20±0.20	8.20±0.20	7.90±0.10	7.70±0.15	6.80±0.25	0.53
Type-I	8.30±0.15	8.30±0.15	8.20±0.25	7.40±0.16	6.80±0.25	0.57
Type-II	8.00±0.15	8.20±0.13	8.20±0.33	7.00±0.15	6.40±0.22	0.59
Type-III	8.30±0.26	8.30±0.26	7.60±0.22	6.30±0.15	6.40±0.16	0.62
Texture						
Control	8.10±0.18	8.10±0.10	7.80±0.13	7.70±0.21	7.00±0.21	0.47
Type-I	8.20±0.13	8.10±0.10	8.20±0.25	7.30±0.15	7.10±0.18	0.49
Type-II	7.90±0.18	7.90±0.18	8.40±0.27	7.20±0.13	7.10±0.23	0.58
Type-III	8.40±0.27	8.00±0.15	7.70±0.26	6.40±0.16	6.70±0.21	0.62
Taste						
Control	8.10±0.18	8.10±0.15	7.70±0.31	7.50±0.17	7.20±0.29	0.64
Type-I	8.30±0.15	8.20±0.15	7.90±0.33	7.40±0.16	7.00±0.30	0.66
Type-II	8.10±0.18	7.80±0.20	7.70±0.33	6.90±0.18	6.90±0.23	0.63
Type-III	8.40±0.27	7.90±0.18	6.90±0.41	6.10±0.18	6.10±0.10	0.71
Overall acceptability						
Control	8.16±0.17	8.06±0.08	7.84±0.15	7.70±0.14	6.74±0.10	0.38
Type-I	8.22±0.12	8.12±0.09	8.20±0.25	7.46±0.10	6.82±0.10	0.42
Type-II	8.02±0.08	7.98±0.07	8.18±0.26	7.12±0.10	7.08±0.10	0.39
Type-III	8.30±0.22	8.06±0.13	7.56±0.22	6.42±0.17	6.54±0.10	0.51

Values are mean ± SE of ten observations.
Control= RWF: GPSF:: 100:0, Type-I=RWF: GPSF:: 90:10, Type-II=RWF: GPSF:: 80:20,
Type-III=RWF: GPSF:: 70:30, RWF: Refined wheat flour, GPSF: Germinated pumpkin seed flour

Table.3 Effect of storage on peroxide value (meq peroxide/kg) of developed value added whole wheat flour biscuits (dry weight basis)

Type of whole wheat flour biscuits	Storage period (days)					
	15	30	45	60	75	CD(P≤0.05)
Control WWF:GPSF::100:0	4.60±0.17	5.17±0.09	5.50±0.12	6.17±0.15	6.73±0.09	0.28
Type-I WWF:GPSF::90:10	4.27±0.11	4.73±0.14	5.18±0.16	5.77±0.09	6.33±0.18	0.42
Type-II WWF:GPSF::80:20	3.20±0.13	3.70±0.14	4.20±0.16	4.69±0.18	5.03±0.09	0.47
Type-III WWF:GPSF::70:30	2.81±0.12	3.13±0.15	3.63±0.09	4.13±0.09	4.47±0.15	0.31

Values are mean ± SE of six independent determinations. WWF: Whole wheat flour, GPSF: Germinated pumpkin seed flour

Table.4 Effect of storage on peroxide value (meq peroxide/1000g) of developed value added cookies (dry weight basis)

Types of cookies	Storage period (days)					
	15	30	45	60	75	CD (P≤0.05)
Control RWF:GPSF::100:0	3.20±0.12	3.63±0.09	4.20±0.18	4.59±0.15	5.00±0.14	0.38
Type-I RWF:GPSF::90:10	2.40±0.17	3.30±0.12	3.40±0.12	4.27±0.13	4.60±0.12	0.17
Type-II RWF:GPSF::80:20	2.27±0.15	2.70±0.16	3.10±0.10	3.60±0.12	4.13±0.09	0.24
Type-III RWF:GPSF::70:30	1.80±0.06	2.40±0.13	2.70±0.11	3.30±0.06	3.70±0.12	0.39

Values are mean ± SE of six independent determinations. RWF: Refined wheat flour, GPSF: Germinated pumpkin seed flour

Table.5 Total plate count (log cfu/g) of developed value added whole wheat flour biscuit during storage

Types of biscuits	Storage period (days)					
	15	30	45	60	75	CD (P≤0.05)
Control WWF:GPSF::100:0	3.20±0.03	3.51±0.06	3.81±0.08	4.11±0.17	4.32±0.29	0.17
Type-I WWF:GPSF::90:10	3.44±0.06	3.73±0.09	3.99±0.12	4.12±0.14	4.25±0.23	0.21
Type-II WWF:GPSF::80:20	3.55±0.08	3.85±0.11	4.11±0.16	4.15±0.20	4.20±0.18	0.12
Type-III WWF:GPSF::70:30	3.67±0.10	3.99±0.12	4.04±0.13	4.16±0.21	4.21±0.22	0.03

Values are mean ± SE of three independent determinations. WWF: Whole wheat flour, GPSF: Germinated pumpkin seed flour

Table.6 Total plate count (log cfu/g) of developed value added cookies during storage

Types of cookies	Storage period (days)					
	15	30	45	60	75	C.D (P≤0.05)
Control RWF:GPSF::100:0	3.33±0.13	3.65±0.15	3.82±0.16	3.95±0.17	4.25±0.18	0.19
Type-I RWF:GPSF::90:10	3.23±0.16	3.57±0.05	3.67±0.05	3.78±0.07	4.15±0.11	0.12
Type-II RWF:GPSF::80:20	3.19±0.14	3.55±0.11	3.69±0.13	3.70±0.16	4.12±0.19	0.31
Type-III RWF:GPSF::70:30	3.16±0.16	3.51±0.08	3.60±0.10	3.71±0.12	4.04±0.21	0.08

Values are mean ± SE of three independent determinations. RWF: Refined wheat flour, GPSF: Germinated pumpkin seed flour

Total plate count

The total plate count of control whole wheat flour biscuits varied from 3.20 to 4.32 log cfu/g during 75 days of storage. The total plate count of Type-I and Type-II whole wheat flour biscuits ranged from 3.44 to 4.25 log cfu/g and 3.55 to 4.20 log cfu/g, respectively while that of Type-III whole wheat flour biscuits ranged from 3.67 to 4.21 log cfu/g of biscuits. Total plate count increased significantly (P≤0.05) with the increase in period of storage.

The total plate count of control refined wheat flour cookies varied from 3.33 to 4.25 log cfu/g from day 15 to 75 (Table 6). The total plate count of Type-I and Type-II refined wheat flour cookies ranged from 3.23 to 4.15 log cfu/g and 3.19 to 4.12 log cfu/g, respectively while that of Type-III refined wheat flour cookies varied from 3.16 to 4.04 log cfu/g of cookies.

Similar work on shelf life of value added products has been reported by a number of coworkers (Peter-Ikechukwu *et al.,* 2018; Goyat *et al.,* 2018). Thivani *et al.,* 2016reported development of wheat flour biscuits incorporated with pineapple powder at the rates of 3, 5, 10, and 15% (w/w basis). They reported that the biscuits prepared with 5% pineapple powder had the highest nutritional and sensory quality, having the overall acceptability score of 7.7 in a 9-point hedonic scale. The shelf life evaluation showed that these biscuits could be stored for 6 weeks at the ambient conditions of average temperature at 30±1ºC and RH at 75-80% with acceptable quality. Duta *et al.,* (2019) studied quality of gluten-free oat biscuits for a storage period up to 3 months in different packages. The highest peroxide value was obtained for biscuits packed in PVC_12, while the lowest was for the PE/EVOH/PP_50, for both storage conditions. The biscuits' colour changed from yellow–brown to light yellow and the change was more pronounced in the light as compared to the dark storage conditions. The electronic nose system showed that the distinct volatile composition of the biscuits stored in the light was correlated with the higher scores of the off-flavour attribute and with the peroxide values.

In conclusion the value added cookies and whole wheat flour biscuits with 30 per cent incorporation of germinated pumpkin seed flour could successfully be stored upto 60 and

75 days respectively. The developed cookies and biscuits therefore have the potential for commercialization. Different packaging materials need to be explored to retain the health benefits of such products.

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