Innovative Cookie Supplemented With Oleaster Flour

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Abstract

Different nutritionally rich ingredients are used in most of bakery products. In this study the oleaster flours (OFs) which have functional propoerties were used to enrich the cookie. OFs were used to replace wheat flour in the cookie formulation (control) at the levels of 5,10,15,20 and 25% (w/w). OFs supplementation increased total dietary fiber contents and decreased caloric values of cookies compared to the control. Cookies with OFs have larger in diameter and their spread ratio values were higher than control. Hardness of cookies tends to increase as the level of OFs increased. According to sensory analysis, the usage of 5% for OFs in cookie formulation gave satisfactory results in terms of acceptability. As a result, oleaster flour supplementation in cookie production improved nutritional and functional properties of cookies.

Key words: Oleaster flour, cookie, fuctional properties

1. Introduction

Oleaster *(Elaeagnus angustifolia* L., Russian olive) belongs to *Elaeagnus* L. genus and *Elaeagnaceae* family. *Elaeagnus angustifolia* L. is a kind of shrub or tree with a height of up to 7 m and a capacity to grow under a wide range of environmental conditions [1]. This species shows a broad geographical range, existing widely in Asia and Europe, particularly in Turkey, Caucasia and Central Asia [2]. Oleaster's fruits are reddish-brown, elliptic, 9-12 mm long and 6-10 mm wide and they ripen in September [3,4]. Although this species grows naturally in most parts of Turkey, its fruits are of limited use in agricultural and food industry.

It is consumed as fresh fruit but may also be dried and is eaten as appetizer. In addition, this fruit is used in alternative medicine. Although it grows almost everywhere in our country, its fruits are used limited. In folk medicines, *E. angustifolia* has been widely used to relax muscles, kill pains, treat inflammation, ease fever and cure ulcers [5,6]. It can be consumed fresh or dried form [3,4]. Oleaster flour may be obtained from dried fruits and its flour may be used as a ingredients to improve functionality of foods such as bakery products, yoghurt, ice cream, infant food, chocolate and confectionery products. The functional properties like dietary fiber, mineral content and phenolic compounds of OF improve structure, taste, nutritive composition of food products.

On the other hand, the use of oleaster flour as a functional ingredient in cookies have not been investigated. To this respect, the aim of this study was to evaluate the physicochemical, sensorial and textural properties of cookies supplemented with various levels and compositions of oleaster flour.

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2. Material and Methods

2.1 Materials

Two different genotypes were used as oleaster fruit samples (two different regions GO1-GO2 of Turkey). The fruits had approximately same maturity (almost reddish) with uniform shape and size and healthy. Mature fruits were harvested and randomly collected. Harvested fruits were dried at 50ºC for 20 hours in a hot air oven dryer.

2.1.2. Preparation of Oleaster Flours

Oleaster flours (OFs) were produced by two different methods. The first preparation method: skin and seeds of dry fruit samples were removed using a plastic knife, and then the fruit pulp was ground in a coffee grinder and than sieved through 60 mm sieve to obtain Peeled Oleaster Flour (POF). In the second preparation method: only seeds of dry samples were removed using a plastic knife, and then the fruit pulp and skin were ground together in a coffee grinder and sieved through 60 mm sieve to obtain Unpeeled Oleaster Flour (UPOF). All flour samples were stored in glass jars and kept in at +4^{o}C prior to analyses. Due to using two different genotypes, samples are named as POF-1 (Genotype 1, Peeled Oleaster Flour), UPOF-1 (Genotype 1, Unpeeled Oleaster Flour), POF-2 (Genotype 2, Peeled Oleaster Flour) and UPOF-2 (Genotype 2, Unpeeled Oleaster Flour).

2.2. Methods

2.2.1. Chemical analysis

Moisture, ash, protein and wet gluten contents of wheat flour were determined according to AACCI Approved Methods 44-15.02, 08-01.01, 46-12.01 and 38-10.01, respectively [7]. Oleaster flours (OFs) were analyzed for moisture (Metod No: 925.40), protein (Metod No:950.48), ash (Metod No: 950.49), and dietary fiber content (Methods 32-05.01) [8]. Fat contents of cookies were also carried out according to AOAC Metod No: 948.22 [8]. The tests were performed at least in triplicate and mean values are reported.

2.2.2. Production of Cookies

Cookies were prepared using the American Association of Cereal Chemists International (AACCI) method 10-54.01 [7]. The dough was formulated in Table 2. All purpose of shortening were added into mixing bowl then added dry ingredients on top of shortening. These ingredients were mixed for 3 min stir speed (Electrolux Ditomix 5, EU), scraping every minute. High-fructose corn syrup, appropriate amount of water, ammonium bicarbonate, sodium bicarbonate were added into 100 ml beaker and swirl to dissolve. Liquid to creamed mass were added and mixed 1 min, scraping every 15 sec. Finally calculated amounts of flour were added and mixed 10 sec while tapping side of bowl, scraped dough from mixer and bowl pins; scraped outer edge and bottom of bowl. Dough was divided into two relatively equal portions and made into oblong shape having approximately 5 cm length.

Both portions were placed on ungreased baking sheet. Dough was cut with cookie cutter, discarded excess dough, and removed cutter. Oleaster flours (OMFs and OMFPs) were used

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to replace wheat flour in the formulation at the levels of 5, 10, 15, 20 and 25% (w/w) (Table 2). Control sample including no oleaster flour was also prepared.

Baking was performed in a convection oven (Inoksan FKE 006, TR) at 175 ^{o}C for 10 min. The baked cookies were left to cool for 30 min and then they were wrapped in aluminum foil and stored for 24 h at room temperature prior to analyses. Each batch yielded 4 cookies.

Table 1. Formulation of cookies

Ingredients'	Proportion (g)
Wheat Flour[2]	100
Sucrose	32
Brownulated granulated sucrose	10
Nonfat dry milk	1.0
Salt	1.25
Sodium bicarbonate	1.0
All-purpose shortening (fat)	40
High-fructose corn syrup	1.5
Ammonium bicarbonate	0.5
Deionized water	Variable

[1]Ingredients at 21±1°C, [2]13% moisture basis.

2.2.3. Physical Evaluation of Cookie

The physical parameters of the cookies were evaluated in terms of diameter (D), thickness (T), and spread ratio (D/T) values. After cooling of the cookies for 30 min, diameter and thickness measurements were taken using a caliper. Spread ratio was calculated from the ratio of diameter and thickness.

2.2.4. Texture Analysis

A texture analyzer (TA-XT PLUS, Stable Microsystems, UK), equipped with a 50 kg load cell was used for cookie texture evaluation 24 h after baking. The fracture force test was conducted on the cookies using a 'measure force in compression' test with 3-point bending jig and heavy duty platform (HDP/90). A force/penetration plot was made for every test. Measurements were conducted three times and results are expressed as mean±S.D values.

2.2.5. Sensory Analysis

The sensory evaluations of the cookies made of OFs were carried out for appearance, taste-flavor, mouthfeel and overall acceptability using a nine-point hedonic scale (1 = extremely dislike, through to 9 = extremely like) with 50 untrained panelists. Samples were served to the panelists in random order to guard against any bias. Water at room temperature was used to clear the mouth before the each test sample. Final judgment was obtained by averaging the scores given by all panelists.

2.2.6. Statistical Analysis

Data were analyzed for variance using the one-way analysis of variance (ANOVA) using the program SPSS 20. When significant differences were found ($P \leq 0.05$), the least significant

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difference (LSD) test was used to determine the differences among means. Paired t-test was carried out to compare the properties POF-1, POF-2, UPOF-1, and UPOF-2.

3. Result and discussion

3.1 Chemical Compositions of Wheat and Oleaster Flours

Chemical compositions of OFs and wheat flour are presented in Table 2. The commercial soft wheat flour used in this study consisted of 13.99% moisture, 0.60% ash, 9.0% protein, 29% wet gluten and 1.69% total dietary fiber (TDF). The moisture contents of the OFs in the present study varied between 18.43-20.20%. The protein contents of the OFs changes 3.74-4.65%. The protein contents of the OFs were significantly (P≤0.05) lower than that of soft wheat flour. The ash contents of the OFs in the present study varied between 1.87-2.57%.

TDF contents of OFs were significantly (P≤0.05) higher than that of the soft wheat flour. Thus, oleaster flour is a good source in TDF, it might be important from the nutrition point of view. The TDF contents of POFs were significantly (P≤0.05) lower than those of UPOFs. The total dietary fiber content of the OFs ranged from 20.67% to 30.65%. These results were lower than pumpkin flour samples (32.15- 36.73%) found by Aydin and Gocmen [9]. The higher TDF levels observed in UPOF samples are possibly related to pericarp contents. OF is a good source in TDF, it might be important from the nutrition point of view.

Table 2. Chemical compositions of OFs [a]*

Samples	Moisture* (g/100g)	Protein* (g/100g, db)	Ash (mg/100g, db)	Total Dietary Fiber (g/100g, db)
Wheat flour	13.99 ±0.95[b]	0.60±0.07[c]	0.60±0.07[c]	1.69±0.07[c]
POF-1	18.99 ±1.05[a]	3.74±0.26[c]	2.46±0.22$_a$	23.55±0.07[c]
UPOF-1	18.43±1.13[a]	4.49±0.17[b]	2.57±0.17$_a$	30.65±0.16[a]
POF-2	19.78±1.11[a]	4.51±0.24[b]	1.87±0.15$_b$	20.67±0.21[d]
UPOF-2	20.20±0.96[a]	4.65±0.19[b]	1.87±0.21[b]	25.44±0.44[b]

[a] Means with different superscripts in columns indicate significant difference ($p \leq 0.05$).
* Data are expressed as means ± standard deviations

3.2 Chemical Properties of Cookies

The chemical composition of cookies made with POFs and UPOFs are shown in Table 3. The dry matter of the cookies containing POFs and UPOFs showed change compared to the control significantly (P≤0.05) (except POF-1 of %5). OF addition reduced protein and fat contents of cookies.

On the contrary, replacement of wheat flour with OF increased dietary fiber contents of cookies compared to the control. In addition to increasing, OFs addition levels significantly enhanced the TDF contents of cookies. Especially G1 samples' cookies have higher levels of TDF contents than other cookies. Therefore, these cookies with POFs and UPOFs can claim to be a source of dietary fiber. When examined the caloric contents of the cookies, control have higher energy values than made with POFs and UPOFs. Oleaster flour supplemantation led to a decrease in caloric content of cookies. In addition to this, UPOFs cookies have lower caloric contents than UPOFs cookies. Thus, supplementiton pericarp has much more impact. The TDF and caloric contents in the cookies with POFs and UPOFs showed a significant change, which is important for the nutritional effects of oleaster flour. Ajila et al. (2008) [10]

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reported a increase in TDF of biscuits upon addition of mango peel powder. Seker et al. (2010) [11] also determined that TDF content of the cookies supplemented with apricot kernel flour (AKF) increased significantly as the AKF concentration increased.

Table 3. Chemical properties of cookies*

Sample Code	OF Level(%)	Dry Matter (g/100g)	Protein (g/100g)	Fat (g/100g)	TDF (g/100g)	Calories (kcal)
Control	0	93.40±0.58a	5.74±0.04a	22.97±0.88a	2.76±0.02i	452.77
POF-1	5	93.06±0.08a	5.51±0.02a	21.20±0.04b	4.75±0.42g	438.48
	10	91.69±0.83b	5.48±0.05a	21.42±0.05b	6.01± 0.42f	429.34
	15	91.39±0.43bc	5.36±0.02ab	21.57±0.02b	6.92± 0.34de	438.72
	20	90.55±027cd	5.05±0.07abc	21.62±0.06b	7.64±0.11c	439.05
	25	90.58±0.30cd	4.63±0.67c	21.74±0.04b	8.42±0.37b	424.60
UPOF-1	5	91.85±0.28b	5.45±0.10a	21.39±0.02b	4.99± 0.30g	427.70
	10	91.57+0.03b	5.41±0.05ab	21.47±0.08b	6.29±0.39ef	411.67
	15	90.54±0.65cd	5.39±0.01 ab	21.62±0.04b	7.17± 0.36cd	412.18
	20	90.62±0.24cd	5.13±0.06abc	21.62±0.0lb	8.41± 0.22b	402.55
	25	90.36±0.05d	4.69±0.85bc	21.72±0.06b	9.34± 0.13a	398.71
POF-2	5	90.93±1.20b	5.60±0.18ab	21.94±0.05bc	3.91± 0.01h	428.63
	10	89.39±0.74bc	5.01±0.15abcd	22.07±0.04bc	4.94± 0.10g	416.93
	15	88.88±0.20c	5.32±0.13bcde	22.19±0.06bc	5.89± 0.09e	418.53
	20	86.62±0.46d	5.25±0.21 cde	22.21±0.06bc	6.84±0.11c	411.93
	25	86.08±1.25d	5.22±0.14de	22.29±0.25bc	7.49± 0.05b	409.50
UPOF-2	5	91.08±0.45b	5.55±0.21abc	21.89±0.04c	4.07± 0.06h	423.42
	10	88.95±1.20c	5.42±0.12bcde	22.02±0.05bc	5.18±0.08f	406.52
	15	86.55±1.02d	5.30±0.13bcde	22.13±0.05bc	6.06± 0.04d	416.28
	20	86.01±0.5d	5.24±0.05de	22.37±0.06abc	6.98± 0.04c	399.30
	25	85.64±0.32d	5.14±0.06e	22.51±0.08ab	7.85± 0.10a	398.93

* Means with different superscripts in columns indicate significant difference ($P \leq 0.05$). Data are expressed as means ± standard deviations.

3.3 Physical Characteristics and Texture Properties of Cookies

Table 4 shows the diameter and spread ratio of cookies supplemented with varying levels of POFs and UPOFs. Spread ratio (diameter/thickness) is one of the most important properties in evaluating the quality of cookies. Greater spread ratios are desirable and indicate a better cookie quality (Seker et al., 2010). Supplemention of all OFs samples increased spread ratio (SR) values significantly ($P \leq 0.05$) in both genotypes (G1, G2) and in both oleaster flour types (POF, UPOF) at all levels. The more supplemention of OFs, the higher spread ratio value in cookies. Namely, control had the lowest SR (3.64) value while the 25% POF-1 and UPOF-1 had the highest SR (6.23 and 6.20%, respectively) values.

Diameter values of the cookies generally followed a similar trend with the SR values. Cookies with oleaster flours were found to be larger in diameter than control cookies. Control had the lowest diameter (5.70 cm) while the 5% UPOF-1 and 5% POF-1 had the highest diameter (6.64 and 6.60 %, respectively). Cookie diameter was found to be significantly ($P \leq 0.05$) affected by adding OFs (Table 4). Cookies of enriched with POFs and UPOFs showed higher diameter and spread ratio values than the control.

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Table 4. Physical characteristics of cookies*

Sample Code	OF Level (%)	Diameter (cm)	Spread Ratio	Hardness (Peak force) (g)
Control	0	5,70±0,15c	3,64±0,35c	39,06±3,41de
POF-1	5	6,60±0.02a	5,14±-0,20b	40,47±1,36cde
	10	6,54±0.02ab	5,34±0,18b	42,06±9,51bcde
	15	6,53±0,02ab	5,60±0,28b	42,07±13,27bcde
	20	6,32±0,07b	6,18±0,23a	45,57±11,58bcde
	25	6,33±0.02b	6,23±0,42a	55,30±11,24abc
UPOF-1	5	6,64±0,16a	5,25±0,28b	39,51±7,02de
	10	6,52±0,12ab	5,48±0,16b	50,86± 10,25bcd
	15	6,30±0.01b	5,55±0,07b	55,72±12,65abc
	20	6,33+0,07b	5,65±0,27ab	56,07±8,43ab
	25	6,34±0.02b	6,20±0,72a	66,98±8,33a
POF-2	5	5,96±0,03b	3,94±0,34c	41,18±14,58bcd
	10	6,01±0,07b	4,46±0,17c	43,95±7,73abc
	15	6,16±0,10a	4,78±0,54b	48,67±9,69bc
	20	6,17±0,03a	4,80±0,43b	50,22±3,52ab
	25	6,28+0,10a	5,53±0,10a	50,92±5,42a
UPOF-2	5	6,05±0,01b	4,26±0,01c	39,31±1,85bcd
	10	6,11+0,036	4,56±0.02c	42,54±4,96abcd
	15	6,27±0,06a	5,08±0,17b	45,42±3,87abc
	20	6,27±0,07a	5,15±0,29ab	47,71±2,74ab
	25	6,33±0,06a	5,77±0,07a	52,47±2,79a

* Means with different superscripts in columns indicate significant difference ($P \leq 0.05$). Data are expressed as means ± standard deviations.

Table 4 shows the hardness of cookies made with different percentages of oleaster flours. Among the POF-1 supplemented samples, only 25% supplementation significantly ($P \leq 0.05$) increased the hardness values of the cookies. Other POF-1 levels had no significant effect on the hardness values of cookies. Cookies made with all UPOF-1 levels except 5 and 10% had significantly ($P \leq 0.05$) higher hardness as compared to control cookie. Cookies prepared from POF-2 containing except 5% level had significantly ($P \leq 0.05$) harder than control. The UPOF-2 levels except 5 and 10% had significant effect on the hardness values of cookies. In general, hardness tends to increase as the amount of POFs and UPOFs increased in the cookies. Since oleaster flour contains dietary fiber, water absorption capacity of dough is high. For this reason, an extensive gluten structure occurs. As a result, doughs provide the harder cookies formation. Similar results were reported by Sudha et al. (2007) [12]. These researchers reported that an increase in diameter and in breaking strength of cookies upon addition of oat bran.

3.4 Sensory Evaluation

The sensorial characteristics of cookies made with POFs and UPOFs are shown in Table 5. Examined all sensorial characteristics of cookies prepared with OFs, except 25% POF-1, were liked moderately and liked slightly by panelists. According to sensory values, %5 POF-1 had the most admirable score in apparence, taste/flavor and overall acceptability, whereas %5 UPOF-1 cookies had the highest moutfell score. In addition %25 POF-1 had the lowest score on appearance, moutfell and overall acceptability.

Oleaster flour addition increased the darkness. Above 20% supplementation of POFs and UPOF in the cookie formulation had dark crumb colour.

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Table 5. Physical characteristics of cookies*

Sample Code	OF Level	Appearence	Taste/Flavor	Mouthfeel	Overall Acceptability
Control	0	7.21±1.62	7.42±2.17	7.00±1.63	7.48±1.51
POF-1	5	7.97±1.22	7.34±1.64	6.37±1.59	7.33±1.18
	10	7.29±1.95	6.26±1.88	5.97±1.96	6.61±1.73
	15	6.31±1.94	6.14±1.96	5.06±1.91	5.98±1.54
	20	5.86±2.34	5.69±2.00	4.89±1.81	5.82±1.85
	25	4.54±2.62	4.66±2.76	5.23±2.26	5.61±1.95
UPOF-1	5	7.80±1.55	7.34±1.41	7.74±1.38	7.29±1.42
	10	7.86±1.40	6.43±1.91	5.63±1.73	6.99±1.81
	15	6.20±2.44	6.77±1.73	6.77±1.73	6.88±1.87
	20	6.71±2.57	6.14±2.29	6.60±2.26	6.76±2.00
	25	5.69±2.78	5.74±2.28	6.09±1.63	6.64±1.99
POF-2	5	7.21±1.62	6.68±1.53	6.05±1.68	7.23±1.59
	10	7.84±1.68	6.58±2.06	6.68±1.92	6.75±1.67
	15	7.21±1.32	6.16±1.80	5.53±1.61	6.30±.66
	20	6.79±1.47	5.53±1.74	4.68±1.67	5:97±1.83
	25	6.26±2.02	3.74±1.91	5.53±1.61	5.88±1.85
UPOF-2	5	7.21±1.88	7.00±1.89	6.47±.47	7.22±1.57
	10	7.42±1.57	7.21±1.89	5.84±.70	6.81±1.92
	15	7.74±1.66	6.58±2.06	6.58±1.71	6.72±2.11
	20	7.32±1.38	6.72±2.06	5.42±1.57	6.59±1.97
	25	6.68±1.38	5.31±2.20	5.95±1.81	6.48±1.81

* Means with different superscripts in columns indicate significant difference (*P≤0.05*). Data are expressed as means ± standard deviations. 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5-neither like or dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much, 1-dislike extremely

Increasing addition levels of OFs slightly decreased taste/flavor score. According to sensory analysis, overall acceptance of cookies were found the best at control sample. All cookies prepared with OFs were liked moderately and like slightly by panelists. Cookies prepared with POFs and UPOFs at 5% substitution levels produced cookies close to the control in overall acceptability, as evaluated by a panel of twenty judges. As a result, the usage of 5% OFs in cookie formulation gave satisfactory results in terms of acceptability.

4. Conclusion

According to the obtained results oleaster flour (OF) supplementation to cookie formulation increased dietary fiber contents of cookies compared to the control. One serving of cookies (=30 g) provided 1.8 g to 2.8 g total dietary fiber including 10-25% OFs, which met the US FDA definition of a 'Good Source' of dietary fiber. Supplemention of OFs decreased fat level. OFs enriched cookies had lower height, higher diameter and higher spread ratio. Thanks to OFs, the physical properties of the cookies were affected positively. Despite the significant differences determined between control and OFs added cookies, our results show that it is possible to use OFs to partially substitute for wheat flour in the production of cookies with acceptable physical characteristics. According to all sensorial characteristics, cookies prepared with OFs, except 25% POF-1, were liked moderately and liked slightly by panelists. Consequently, oleaster, growing almost everywhere naturally in Turkey, could be utilized for the preparation of cookies and other bakery products due to its floury structure, specific taste and functional properties like dietary fibre. As a result, oleaster flour supplementation in cookie production improved nutritional and functional properties of cookies.

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