Technological and sensory studies on gluten-free food products: applications on Cupcakes and Sable biscuits

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Abstract:

With increasing the number of people with gluten sensitivities, need to increase the number of gluten-free products. Therefore, the current study aimed to prepare the cupcake and sablé biscuit from white corn flour (WCF) that replaced with different levels powder of chickpea split roasted (CSRP), red lentil (RLP) and carrot (CP) at 10, 20 %. WCF were recorded the highest content of moisture 11.45% and carbohydrate 71.44. WCF blending with different levels of CP increase the percent of fiber from 2.94% to 3.93%. Substitution of 10, 20% of WCF with CSRP and RLP increasing levels of WCF protein and replacement with 20% of CSRP led to increase protein from 9.03 to 11.59%. Replacement WCF with CSRP, RLP and CP led to increase the levels of iron and replacement with 20% of RLP led to increase Fe from 2.67 to 3.86 mg. RLP (20%) has recorded highest value of total phenol 380.11mg GAE/100g, flavonoids 46.88 mg GAE/100g and antioxidant activity 42.78 compared with all samples. Results appear significantly improved the sensory characteristic of sablé biscuit and cupcake especially formula mix at (20%). In conclusion, it can produce free-gluten cupcake and sablé biscuits by blend white corn flour by powder of chickpea, lentil or carrot at levels (10, 20%) to raise nutritional value and sensory properties.

Keywords:

Celiac disease, composition flour, lentil, chickpea, total phenolic, minerals.

Introduction:

The most known human diseases which related to gluten exposure are wheat allergy (WA) and celiac disease (CD) **(Sapone *et al*., 2012)**. CD patients have genetically susceptible following the dietary ingestion of "gluten", that disease characterized nutrient mal absorption in individuals and small intestinal mucosal injury. The pathogenesis of CD was the interactions between genetic, immunologic and environmental factors **(Kagnoff, 2005)**. Consuming gluten-free diets for the rest of one's life is the only safe and effective treatment for this disease. Altering dietary ingredients is another possible treatment (Tack et al., 2010).

Cupcake and biscuit are consider the most common type of baked goods consumed in Egypt because lower cost, good longer shelf life and availability different types taste in compared to other processed foods **(Gandhi *et al*., 2001 and Sudha *et al*., 2007)**. And often made with wheat flour (WF), as a result, CD patients are unable to consume this sort of product. Also, many gluten-free products in the market are frequently of poor in nutrient compositions and technological quality including (low volume, poor color, low protein and rise fat content) **(Martnez-Cervera *et al*., 2011)**. There should be gluten-free products resemble those made from WF overcoming problems of quality defects and low nutritional value (Matos et al., 2014 and Shevkani et al., 2015).

Legumes are gaining more interest in the field of functional foods and developing healthy **(Faris *et al*., 2012)**. Food legumes including lentils and chickpea are important food crops rich sources of complex carbohydrates, vitamins, minerals and contain approximately three times more proteins than cereals (Wang et al., 2010). They are also a source of high-quality protein and have been known as "a poor man's meat" **(Go´mez *et al*., 2008).**

Chickpea *(Cicer arientum L.)* is the fifth valuable food important legumes in terms of worldwide economic standpoint

(Hefnawy *et al.*, 2012). It has high digestible protein, complex carbohydrate with low glycemic index and is relatively free from anti-nutritional factors **(Muzquiz & Wood, 2007; Wood & Grusak 2007 and Ribeiro *et al.*, 2017)**. The potential for increased use of chickpea is related to its relatively low cost, relatively high protein content (21.9–26.8%), high protein digestibility (76–78%) and other desirable functionalities **(Xu *et al.*, 2014).**

A lentil *(Lens culinaris L.)* belongs to the Leguminoceae family and is one of the most common traditional dietary ingredients **(FAO, 1988)**. Lentils are a substantial dietary supply for low-income people and have been included in a variety of diets **(Hoover *et al.*, 2010 and Satya *et al.*, 2010)**. Carbohydrates are also an important component, the capacity of these carbohydrates to act as selective promoters for the growth of healthy gut microbes gives them functional relevance and a source of physiologically active proteins **(El-Adawy *et al.*, 2003; Padovani *et al.*, 2007 and Faris *et al.*, 2012)**. Lentils are also a good source of total dietary fibre, including insoluble dietary fibre content ranging from 93 to 99.7% **(Bednar *et al.*, 2001).**

The carrot *(Daucus carota L)* is a popular source of dietary carotenoids and vitamins in many countries **(Haq & Prasad, 2015)**. Carrot has been increasingly popular in recent years due to their strong antioxidant content and action of beta carotene (provitamin A) **(Sule *et al.*, 2019).**Carrot flour is a nutrient-dense food that is high in vitamin A and protein **(Roshana & Mahendran, 2019)**. It has been found that the average sensory score was quite good, and it has been employed in numerous items. This means carrot flour can be used to bakery items as a source of dietary fiber, vitamin and to increase the nutritious composition without compromising consumer acceptance **(Maurya & Singh, 2013)**.

With increase the number of people suffering from gluten sensitivities we need to increase the number of naturally gluten-free baking ingredients Composite flour is a good new approach to use uncommon food products with different characteristics and quality, depending on the types and percentage of maize flour used in the formulation.

Due to the current demand of products especially designed for CD patients, this work aim to evaluation the effect of usage legume powder such as powder of (chickpea and lentil), vegetable powder as carrot powder to develop new functional gluten free products with highly nutritional value like sablé biscuit and cupcake for this class of patient.

MATERIALS AND METHODS

Materials

White corn flour (WCF), red lentil (RL), chickpea split roasted (CSR) and rest ingredients such as butter, egg, milk, sugar, vanilla and backing powder were obtained from El- Raia hypermarket, Minia Governorate, Egypt. WCF was transported to the laboratory and stored immediately on the refrigerator until using in preparation free-gluten flour formula and products, while carrot was perched from local market in Minia Governorate, Egypt.

Technological Methods

Preparation of RL and CSR powders

RL washed, dried in oven at 40°C for 2 h, cooling to room temperature, then RL, CSR were ground in a high mixer blender (Toshiba ElAraby, Benha, Egypt) and sieved 750 µm meshes. Powder samples were taken, stored in glass jar at refrigerator for further physical and chemical analyses as well as using in cupcake and sablé biscuit preparation.

Preparation of CP

Fresh carrot was cleaned, washed, peeled and sliced into slices of equal thickness by slicing machine at Faculty of Agriculture Minia University.

According to **Sharma *et al.*, (2014)** samples were dried by solar dryer For 3 days, and then was ground in a high mixer blender. CP was taken, stored in glass jar at refrigerator for further chemical analyses and preparation the products.

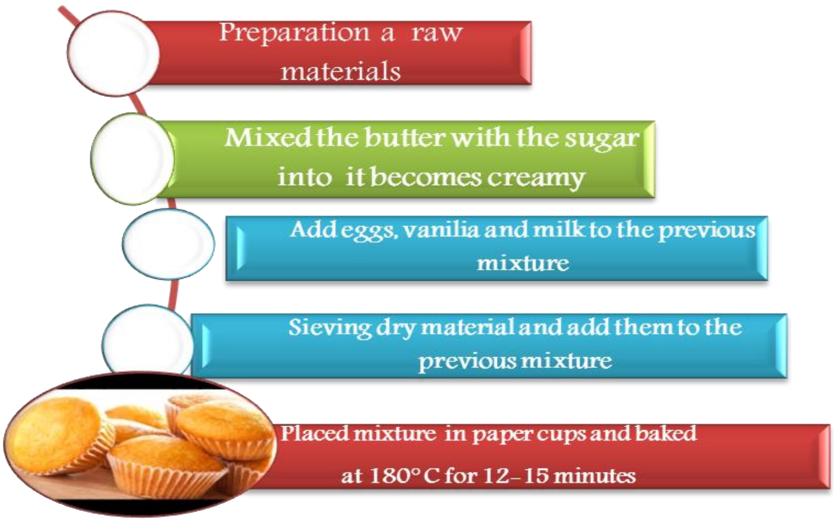
The sablé biscuit was ready prepared according to the essential sablé formula used by **Neveen & Amira, (2018)** with slight modifications as demonstrated in table (1). Also, cupcake was prepared according **Rebecca *et al.*, (2016)** and **Pathan *et al.*, (2019)** with some modifications in the method will clarified in table (2).

Table (1): Formulation of Sablé biscuit

Ingredients	WCF 100:00	CSRP 90:10	CSRP 80:20	RLP 90:10	RLP 80:20	CP 90:10	CP 80:20	Mix 10	Mix 20
WCF	100g	90 g	80 g	90 g	80 g	90 g	80 g	90 g	**80 g**
RLP	—	—	—	10 g	20 g	—	—	3.33 g	**6.66 g**
CSRP	—	10 g	20 g	—	—	—	—	3.33 g	**6.66 g**
CP	—					10 g	20 g	3.33 g	**6.66 g**
Butter	45 g	45 g	45 g	45 g	45 g	45 g	45 g	45 g	**45 g**
Salt	2 g	2 g	2 g	2 g	2 g	2 g	2 g	2 g	**2 g**
Sugar	25 g	25 g	25 g	25 g	25 g	25 g	25 g	25 g	**25 g**
Baking powder	2 g	2 g	2 g	2 g	2 g	2 g	2 g	2 g	**2 g**
Egg yolk	1	1	1	1	1	1	1	1	**1**
Vanilla essence	**2 g**	**2 g**	**2 g**	**2 g**	**2 g**	**2 g**	**2 g**	**2 g**	**2 g**

Table (2): Formulation of Cupcake

Ingredients	WCF 100:00	CSRP 90:10	CSRP 80:20	RLP 90:10	RLP 80:20	CP 90:10	CP 80:20	Mix 10	Mix 20
WCF	130g	120 g	110 g	120 g	110 g	120 g	110 g	117 g	**104 g**
Corn Starch	20 g	20 g	20 g	20 g	20 g	20 g	20 g	20 g	**20 g**
RLP	——	——	——	10 g	20 g	——	——	4.33 g	**8.66 g**
CSRP	——	10 g	20 g	——	——	——	——	4.33 g	**8.66 g**
CP	——					10 g	20 g	4.33 g	**8.66 g**
Butter	45 g	45 g	45 g	45 g	45 g	45 g	45 g	45 g	**45 g**
Milk	45 g	45 g	45 g	45 g	45 g	45 g	45 g	45 g	**45 g**
Salt	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g	**0.5 g**
Sugar	100g	100g	100g	100g	100g	100g	100g	100g	**100g**
Baking powder	8 g	8 g	8 g	8 g	8 g	8 g	8 g	8 g	**8 g**
Egg	2	2	2	2	2	2	2	2	**2**
Vanilla essence	**4 g**	**4 g**	**4 g**	**4 g**	**4 g**	**4 g**	**4 g**	**4 g**	**4 g**



Chemical properties

Moisture, fiber, ash, fat and protein contents were determined according to **AOAC, (2012)**.Carbohydrate content was calculated by the following equation:

Carbohydrate (%) = 100 – (Fat % + Moisture% + Fiber % + Ash % + Protein).

The energy content estimated using the following equation:

Energy (kcal) = 4 (g protein) + 4 (g carbohydrate) + 9 (g fat).

Determination content of total flavonoids, total phenolic and antioxidant activity

Total flavonoids content for RLP, CSRP and CP extracts was determined according to **Zhishen *et al.*, (1999)** method. The reagent folin-Ciocalteu was used to find the total phenolic **Singleton & Rossi, (1965)**. The antioxidant activity of examined extracts was calculated following a refinement of the procedure defined by **Marco, (1968)**.

Determination Minerals Content

The minerals content such as phosphorous, magnesium, calcium, zinc and iron were determined, phosphorus content (g/100g dry weight) was determined calorimetrically according to the method of **Jackson, (1958).**

Magnesium, calcium, zinc and iron were determined by using Atomic Absorption Spectrophotometer, Pyeunican SP1900, according to **Brandifeld & Spincer, (1965)**.

Evaluation of Sensory Characteristics of biscuit and cake

Sensory evaluation was conducted out with 20 panel tests from the Home Economics Department, Faculty of Specific Education, Minia University, Egypt, who included professors and postgraduate students. Prior to testing, the products were coded with a number and each panel tests received 9 (sablé biscuit) samples on a tray, while the cupcakes were individually wrapped in a bag. The samples included a control sample (100% white corn flour) and 6 types of composite flour as 10 and 20% with RLP-CSRP-CP powder and mixture of them as 10 and 20%. For easy of the tasting and performance of sensory evaluation water was provided to panelists. All panelists were evaluating the taste, odor, color and overall acceptance to the products using the scores scale 1-10.

Ethical Approval

All experiments for this study especially the sensory evaluation ones were ethically approved by Ethics Committee the Scientific Research, Faculty of Specific Education, Minia University.

Statistical Analysis

The data was analyses using a statistical analysis method using the GLM (General Linear Model) software **SAS, (2003).** Double range tests **(Duncan, 1955)** compared average value.

Result and Discussion

Chemical analyses of WCF, CSRP, RLP and CP

The proximate analysis of WCF, CSRP, RLP and CP were determinate and the obtained results are showed in table (3). Data indicated that CP had high percentage of moisture, fiber and ash content (12.05, 7.87and 3.71%respectively) than CF, CSRP and RLP. As regard from result the lowest percent of fat content was in RLP (0.79%) compared with other powders. On other hand, CSRP contains relatively minor carbohydrate (58.79%) compare with WCF (71.44%).

Our data are almost in the same line with result by **Faris *et al.*, (2012)** found that the content of protein, ash and carbohydrate were 25.8, 2.7 and 60.1 of lintel powder respectively, and result of **Desalegn *et al*., (2015)** who mentioned that protein, fat, fiber, carbohydrate of chickpea cultivars ranged from 19.57 to 20.92%, 3.77 to 7.01%, 2.97 to 3.43%, 52.61% to 56.30% respectively.

Lentils are considered a good source of protein, which makes them a significant food source for developing countries **(Hoover *et al*., 2010)**. Our results confirm that RLP recorded the highest content of protein (23.56%) more than twice of WCF (9.03%), and about 6 times of CP (3.64%).

Table (3): Proximate chemical and minerals content of WCF، CSRP, RLP and CP

Chemical Composition (100g)	WCF	CSR P	RLP	CP
Moisture (g)	11.45	10.12	11.04	12.05
Protein (g)	9.03	21.75	23.56	3.64
Fat (g)	3.97	3.58	0.79	1.35
Fiber (g)	2.94	2.94	2.11	7.87
Ash (g)	1.17	2.82	2.15	3.71
Carbohydrates (g)	71.44	58.79	60.35	71.38
K (mg)	59	912	659	231
Na (mg)	55	17	44	94
Ca (mg)	14	151	73	2.10
Mg (mg)	152	129	89	14
P (mg)	68	391	341	23
Fe (mg)	2.67	8.5	8.64	2.12
Zn (mg)	0.41	2.6	3.41	0.62

Table (4): Chemical analysis of WCF replaced by different levels of CSRP, RLP and CP

Chemical Composition (100g)	WCF	CSRP		RLP		CP		Mix	
		10%	20 %	10%	20 %	10%	20 %	10%	20 %
Moisture	11.45	11.40	11.09	11.44	11.30	11.48	11.60	11.45	11.33
Total protein	9.03	10.30	11.59	10.39	12.01	8.49	7.95	9.73	10.52
Fat	3.97	3.93	3.89	3.43	3.33	3.71	3.45	3.71	3.56
Fiber	2.94	2.94	2.94	2.86	2.77	3.43	3.93	3.08	3.21
Ash	1.17	1.35	1.52	1.27	1.39	1.41	1.70	1.34	1.54
Carbohydrates	71.44	70.08	68.97	70.55	69.20	71.48	71.37	70.69	69.84

The results in table (4) indicated that substitution of 10-20% white corn flour by CSRP and RLP increasing levels of CF of protein, for example replacement with 20% of CSRP led to increase protein from 9.03to 11.59%. Also results clarified that WCF were recorded the highest content of moisture 11.45% and carbohydrate 71.44. On other hand replaced white corn flour with different levels of CP increase the percent of fiber from 2.94% to 3.93%, this result is agreed with **Alam & Kumar, (2014)** whom reported that carrot have high fiber content, that's led to improve the nutritional value of products.

Table (5): Minerals content of WCF replaced by different levels of CSRP, RLP and CP

Minerals composition	WCF	CSRP		RLP		CP		Mix	
		10%	20 %	10%	20 %	10%	20 %	10%	20 %
K	59	151.64	242.70	121.45	180.78	75.12	94.67	116.07	172.72
Na	55	51.90	47.40	53.90	51.78	60.90	62.80	55.67	54.0
Ca	14	27.70	43.89	19.90	25.80	12.81	11.62	20.14	27.10
Mg	152	150.80	147.40	145.70	137.43	138.20	121.34	144.9	135.39
P	68	100.30	139.90	95.30	130.54	63.50	59.00	86.37	109.81
Fe	2.67	3.13	3.84	3.27	3.86	2.70	2.59	3.03	3.43
Zn	0.41	0.63	0.91	0.71	1.11	0.39	0.45	0.58	0.82

Mineral have an important role in immune function, for example calcium and phosphorus are basic mineral for teeth and bones iron for heart health, zinc is need for metabolism, magnesium is required for maintaining normal nerve and helps to regulate blood glucose levels **(Noah & Adedeji, 2020 and Yankah *et al*., 2020).**

The results in table (5) were presented the mineral content of powders CSRP, RLP and CP. Where's, CSRP 20 % were recorded the higher content of K and P 242.70% and 139.90% respectively, while the highest percent of Na was in CP (20%) about 62.80%. also results shows that replacement of 10-20% corn flour by CSRP, RLP and CP increasing levels of corn flour in iron, for example replacement with 20% of RLP led to increase Fe from 2.67 to 3.86 mg.

Total phenolic, flavonoids and antioxidant activity blends of WCF flour replaced with different levels of CSRP - RLP - CP (10%, 20% and mixture)

The total phenolic, flavonoids and antioxidants activities of CSRP - RLP - CP are shown in table (6). The results appeared that high content of total phenol found in RLP was recorded 812.18 mg GAE/100g, d.b., while the lower content was found in WCF (271.65 mg GAE/100g, d.b.). Data in the same line of result obtained by **Abd El - sattar, (2018)** found that the total phenolic extracted from different Lentil seed varieties were ranged from 625.33 - 720 mg GAE/100g. The CSRP, RLP and CP showed great differences in antioxidant activity was 59.98, 61.14 and 54.97 %.

Table (6): **A**ntioxidant activity of CSRP, RLP and CP

Samples	WCF	CSRP	RLP	CP
Total phenolics (mg GAE/100g, d.b.)	271.65 ± 11.56	638 ± 21.89	812.18 ± 17.98	451.12 ± 20.63
Flavonoids (mg RE/100g, d.b.)	23.81 ± 2.76	102.56 ± 7.98	139.17 ± 11.45	109.98 ± 8.54
AA (%)	37.18 ± 4.78	59.98 ± 2.67	61.14 ± 5.07	54.97 ± 4.08

*Antioxidant activity (AA, percent) = (R control-R sample) / R control x 100 where: R control and R sample were beta-carotene bleaching rates in the non-antioxidant and plant extract reactant mixtures, respectively.
*The mean of three duplicates ±SD is expressed by each e value.

RLP recorded highest antioxidant value while 61.14 compared with corn flour sample was 37.18. Results were disagreed with **Sahu *et al.*, (2020**) whom reported that radical scavenging activity in chickpea ranged from 36.2 to 49.5% and total amino acid significantly correlated with total phenol compound and total flavonoid. Also, the present results disagree with data obtained by **Bozalan & Karadeniz, (2011)** whom found that total phenolic content of carrot cultivars ranged from 159 to 259 mg catechin/kg, and with **Laugks *et al.*, (2013)** whom found total phenolic content of carrot extracts from 1.51 to 7.01 mg/g of dry carrot content expressed by Gallic acid equivalent.

Total phenolic, flavonoids and antioxidants activities of flour blends CSRP - RLP - CP at 10%, 20% and their mixture are shown in table (7). CSRP and CP recorded highest value 39.61, while the mix recorded lowest value 39.40 at antioxidant activity of blending 10%. On other hand blending 20% of CSRP - RLP - CP and their mix at antioxidant activity was 41.65, 42.78, 41.65 and 41.83 respectively. RLP recorded highest score 42.78 followed by the mix 20% of them was 41.83, while 20% of CSRP and CP recorded lowest score 41.65. On another hand **Bembem & Sadana, (2014)** found that all the extracts from the differently cooked carrots were found to possess DPPH-scavenging activity. **Belal *et al*., (2019)** reported that lentil extracts have the DPPH radical scavenging activity

Table (7): Total phenolic, Flavonoids and Antioxidant activity blends of WCF flour replaced by different levels of CSRP - RLP - CP 10%, 20%

Samples	CSRP		RLP		CP		Mix	
	10%	20 %	10%	20 %	10%	20 %	10%	20 %
Total phenolics (mg GAE/100g, d.b.)	310.93 ± 20.67	349.12 ± 15.76	325.70 ± 26.67	380.11 ± 19.56	279.99 ± 18.54	309.56 ± 9.85	305.54 ± 20.67	346.26 ± 31.09
Flavonoids (mg GAE/100g, d.b.)	31.69 ± 2.87	39.56 ± 5.78	35.35 ± 3.98	46.88 ± 5.76	32.43 ± 4.09	41.04 ± 3.09	33.16 ± 7.56	42.49 ± 3.87
AA (%)	39.61 ± 2.12	41.65 ± 1.67	39.58 ± 2.15	42.78 ± 4.65	39.61 ± 3.19	41.65 ± 2.98	39.40 ± 4.11	41.83 ± 5.67

*Antioxidant activity (AA, percent) = (R control-R sample) / R control x 100 where: R control and R sample were beta-carotene bleaching rates in the non-antioxidant and plant extract reactant mixtures, respectively.

*The mean of three duplicates ±SD is expressed by each e value.

Sensory evaluation of gluten free products (Sablé biscuit and Cupcake) prepared by WCF replaced with different levels of CSRP - RLP - CP (10%, 20% and mixture)

Data presented in Table (8) shows the sensory properties (color, texture, odor, taste, shape and overall acceptability) of the fortified cupcake with different levels (10 %- 20%) of CSRP - RLP - CP and their mixture. Results were showed no significant differences ($P \leq 0.05$) in odor of cupcake replaced with 10% and 20% CSRP - RLP - CP and Mix.

In table (8), samples mix 10% and 20% were present significant differences than all sample in sensory assessments, where samples showed pleasant odor and fine texture. On other hand, control sample and sample 20 were got the highest color assess from the samples. Our results are disagreed with **Abd Rabou, (2017)** showed that color and aroma were increased by increasing the level of substitution of chickpea powder and agreed with **Pathan *et al.*, (2019)** showed that replacement flour with lentil powder had decreased the acceptability of taste in all samples. Lowest value in texture found in cupcake formula replased CF with 10% CSRP.

Also, data in table (8), present that increased in levels of CSRP - RLP - CP in cupcake formula led to decrease shape in the sample of cupcakes compared to both of control and mix 20% samples.

Data in Table (9) show the sensory properties (color, texture, odor, taste, shape and overall acceptability) of the fortified sablé biscuit with different levels (10 %- 20%) of CSRP - RLP - CP and their mixture. Results were showed significant differences ($P \leq 0.05$) in shape between all samples of sablé biscuit**.** Sablé biscuit (20% CP) had the highest values of overall acceptability, while Mix 10 % had the lowest values of overall acceptability.

Data in table (9), present that increased in levels of RLP in sablé biscuit formula led to decrease color, odor, taste and shape in the samples compared to control. Our results are agreed with **Pathan *et al.*, (2019)** showed that cupcake with 10% and 20% lentil powder had decreased the values of taste, color and texture in all samples.

Table (8): Sensory evaluation of Cupcake prepared by WCF replaced with different levels of CSRP - RLP - CP (10%, 20% and mixture):-

Samples / Sensory properties	Control CF	10% CSRP	20 % CSRP	10% RLP	20 % RLP	10% CP	20 % CP	10% Mix	20% Mix
Color	**8.85±1.04[ab]**	**8.45±1.1[ab]**	**8.1±1.12[b]**	**8.4±0.75[ab]**	**8.4±1.39[ab]**	**8.35±1.63[ab]**	**8.5±1.15[ab]**	**8.5±1.15[ab]**	**9.05±0.94[a]**
Texture	**8.45±1.1[ab]**	**7.85±1.04[b]**	**8.25±1.12[ab]**	**8.25±0.85[ab]**	**8.05±1.5[b]**	**8.2±1.28[ab]**	**8.25±0.97[ab]**	**8.4±1.05[ab]**	**8.85±0.74[a]**
Odor	**8.5±1.36**	**8.55±0.82**	**8.2±1.2**	**8.55±0.82**	**8.3±1.069**	**8.55±1.23**	**8.55±1.05**	**8.95±0.89**	**9.0±0.79**
Taste	**8.2±1.1**	**7.8±1.32**	**8.1±1.07**	**7.85±1.18**	**7.55±1.82**	**8.15±0.99**	**7.6±1.23**	**8.05±1.57**	**8.3±1.13**
Shape	**9.0±0.86[a]**	**8.4±1.05[ab]**	**7.95±1.47[b]**	**8.88±0.95[a]**	**8.7±1.03[ab]**	**8.65±1.09[ab]**	**8.35±0.93[ab]**	**8.35±1.14[ab]**	**8.5±1.05[ab]**
Overall acceptability	**8.35±0.59[ab]**	**7.95±0.82[b]**	**7.9±0.97[b]**	**8.2±0.69[ab]**	**8.3±1.08[ab]**	**8.3±1.03[ab]**	**8.2±0.95[ab]**	**8.5±0.83[ab]**	**8.65±0.87[a]**

Each value represents the mean of twenty replicates ±SD. Mean values with the different letters in the same column mean significantly different at p≤0.05

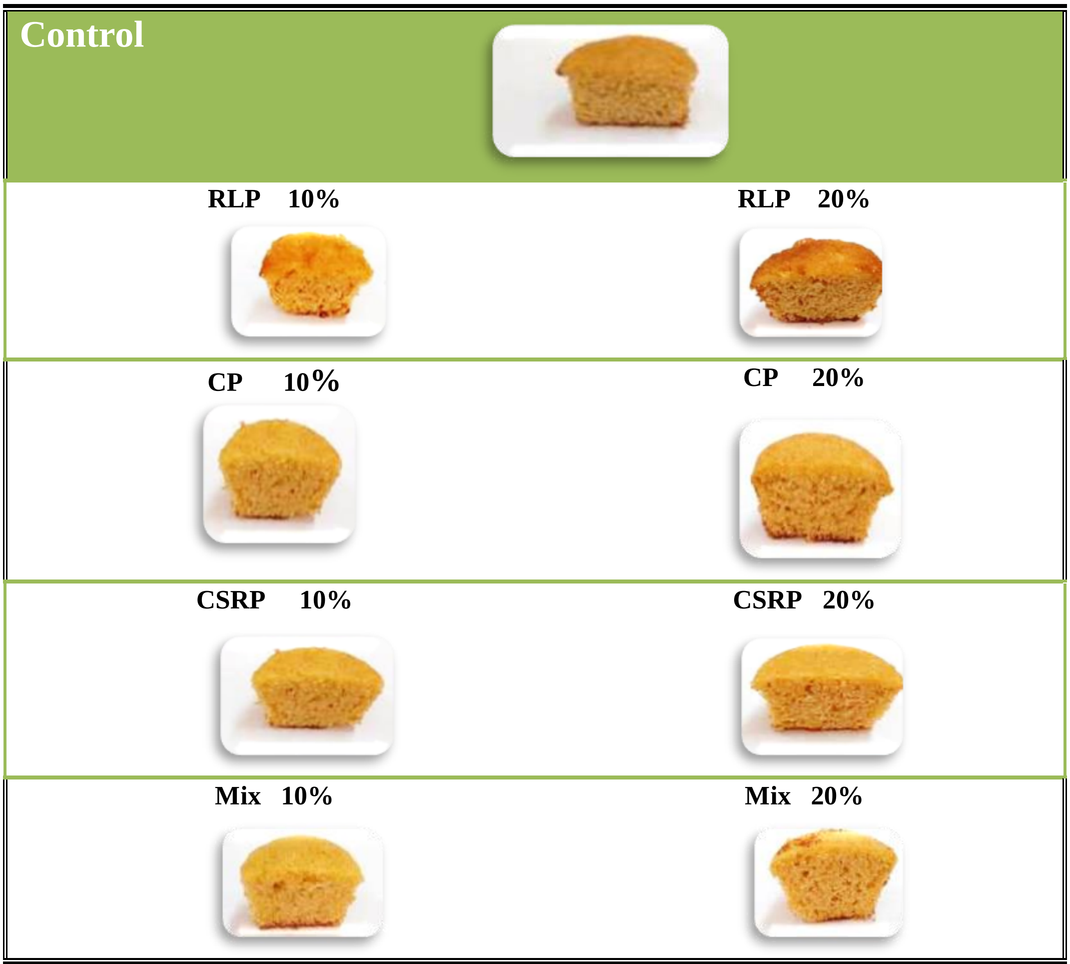
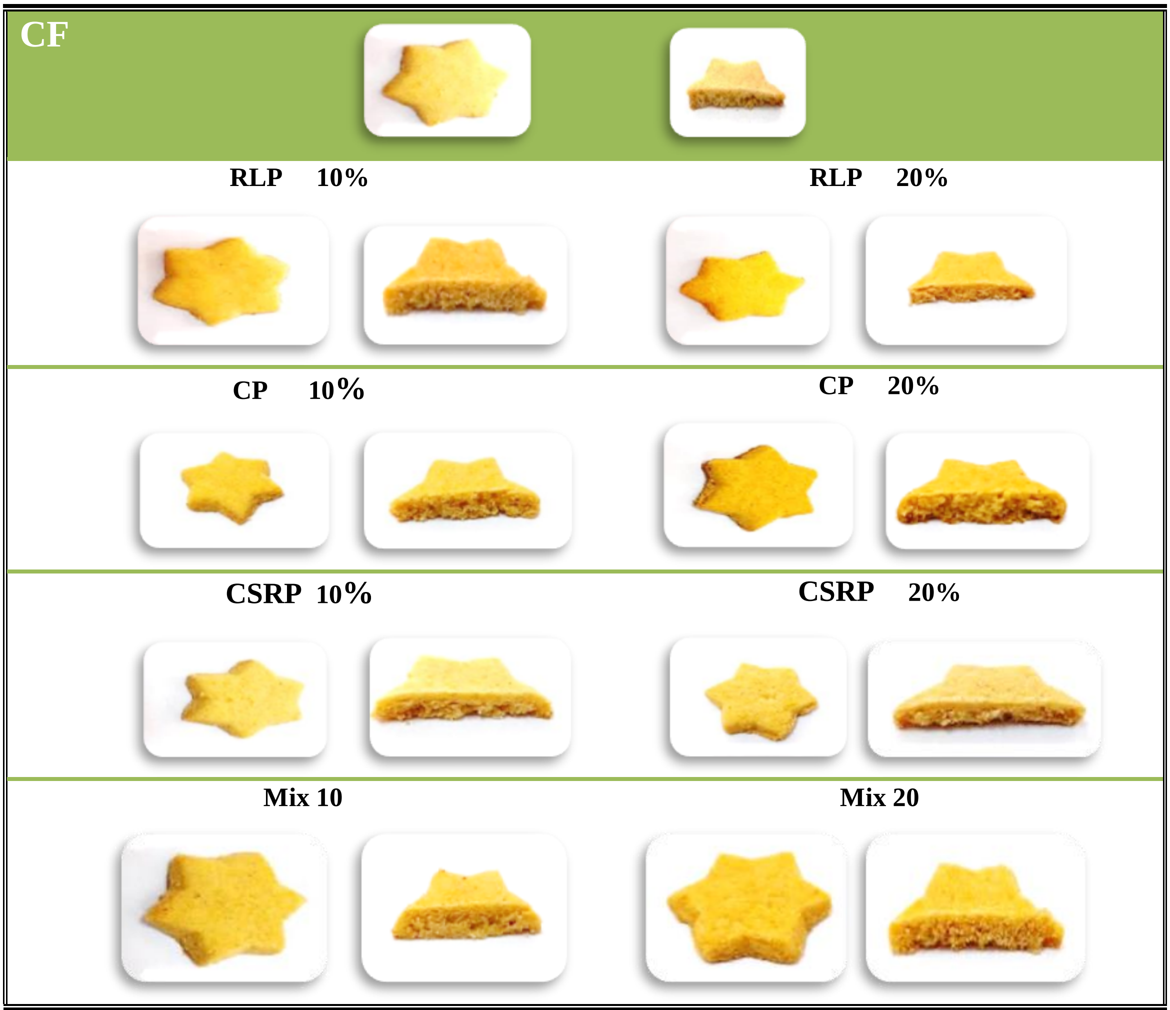


Fig (1): Photo of Cupcake

Table (9): Sensory evaluation of sablé biscuit prepared by WCF replaced with different levels of CSRP - RLP - CP (10%, 20% and mixture)

Samples / Sensory properties	Control CF	10% CSRP	20 % CSRP	10% RLP	20 % RLP	10% CP	20 % CP	10% Mix	20% Mix
Color	8.85 ±1.27^{a}	7.7±1.34^{b}	8.55±1.28^{a}	8.8 ±0.89^{a}	8.7 ±0.86^{a}	8.45 ±1.15^{a}	8.65 ±0.75^{a}	7.6 ±1.39^{b}	8.5 ±0.89^{a}
Texture	7.95±1.5^{ab}	8.3±1.08^{ab}	8.25±1.07^{ab}	8.1 ±1.33^{ab}	7.55 ±1.47^{b}	7.95 ±1.28^{ab}	8.55 ±1.28^{a}	7.5 ±1.19^{b}	8.5 ±1.1^{a}
Odor	8.15±1.39^{a}	8.5±0.89^{a}	8.35±0.59^{a}	8.35 ±1.35^{a}	8.5 ±1.0^{a}	8.05 ±1.32^{a}	8.6 ±0.94^{a}	7.2 ±1.61^{b}	8.5 ±0.83^{a}
Taste	8.35±0.81^{b}	8.0±1.3^{b}	7.9 ±0.85^{b}	8.3 ±1.08^{b}	7.75 ±1.16^{bc}	7.7 ±1.69^{bc}	8.6 ±1.19^{a}	7.55 ±1.43^{c}	8.55 ±1.15^{ab}
Shape	9.1±0.79^{a}	8.25±0.85^{cd}	8.45 ±0.85^{bc}	8.6 ±0.98^{bc}	8.35 ±1.13^{c}	8.05 ±1.0^{d}	8.95 ±0.89^{ab}	8.0 ±1.03^{d}	8.75 ±0.72^{b}
Overall acceptability	8.7±.88^{ab}	8.3±0.98^{b}	8.4 ±0.68^{b}	8.35 ±0.87^{b}	8.1 ±0.97^{bc}	7.95 ±1.19^{c}	8.85 ±0.99^{a}	7.75 ±1.21^{c}	8.75 ±0.71^{ab}

Each value represents the mean of twenty replicates ±SD. Mean values with the different letters in the same column mean significantly different at $p \leq 0.05$.



Fig(2): Photo of Sablé biscuit

Conclusion

By considering all properties of the sablé biscuit and cupcake samples, This study have be concluded that mix white corn flour with powder of (chickpea, lentil and carrot) led to increase in the nutritional values and sensory properties of all products formula. As you confirm that, incorporation of powder of (chickpea, lentil and carrot) is beneficial to sablé biscuit and cupcake production for celiac patient.

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دراسة تكنولوجية وحسية لمنتجات خالية من الجلوتين.

تطبيقات على: (الكب كيك وبسكويت السابلية)

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المستخلص

مع زيادة عدد الأشخاص الذين يعانون من حساسية الجلوتين، نحتاج إلى زيادة عدد منتجات الخبز الخالية من الجلوتين. ويعتبرالدقيق المركب هو نهج جديد لتحضير منتجات ذات خصائص وجودة مختلفة. أجريت هذه الدراسة لتحضير بسكويت السابلية والكب كيك من دقيق الذرة الأبيض بدمجه بمستويات مختلفة (10 ، 20٪ و خليطهما) من العدس، الحمص والجزر. سجل دقيق الذرة الأبيض اعلى محتوى للرطوبة11,45٪ وكربوهيدرات 71,44٪. واستبدال دقيق الذرة الأبيض مع مستويات مختلفة من الجزر أدى إلى زيادة في نسبة الألياف من 2,94٪ إلى 3,93٪. كما أشارت البيانات إلى أن استبدال دقيق الذرة الأبيض بمسحوق الحمص والعدس أدى إلى زيادة مستويات بروتين دقيق الذرة وأدى الاستبدال بـ 20٪ من الحمص إلى زيادة نسبة البروتين (من 9,03 إلى 11,59٪). أظهرت النتائج أيضًا أن الاستبدال بـ10-20٪ من مسحوق (الحمص،العدس والجزر) أدى إلى زيادة مستويات الحديد في دقيق الذرة الأبيض، على سبيل المثال الاستبدال بـ 20٪ بمسحوق العدس أدى إلى زيادة الحديد من 2,67 إلى 3,86 مجم . سجل العدس (20%) اعلى قيمة للفينولات الكليه والفلافونويد والنشاط المضاد للأكسدة(11, 380، 46,88 مجم حامض جاليك/100جرام و42,78%) على التوالي مقارنة بباقي العينات. كما أظهرت النتائج تحسن في الخصائص الحسية لبسكويت السابليه والكب كيك وخاصة التركيبة (خليط20٪).

الكلمات المفتاحية: مرض السيلياك ، الدقيق المركب ، العدس الأحمر ، الحمص ، الفينولات الكلية ، المعادن ، الخصائص الكيميائية والحسية.