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Utilization Of Corncob Silk In Producing Functional Foods

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Abstract: Daily intake of functional foods containing adequate amount of dietary fiber within daily diet has many health benefits. Corncob silk is a by-product of corn processing, is a rich source of dietary fiber and bioactive compounds. The present study aims to investigate the effect of using corncob silk powder (CSP) as a functional ingredient in bakery products. Also, the influence of corncob silk extract (CSE) on cancer cell proliferation was investigated. Four different concentrations (5, 10, 15 and 20% as a substitution of wheat flour) of CSP were used. The chemical composition results showed that corncob silk contains 10.2% moisture, 16.65% total protein, 0.86% crude fat, 5.25% ash and 39.25% total dietary fiber. Also, increasing the level of replacement from 5 % to 20% of CSE induced an improvement in total protein, crude fat, crude fiber and ash content in all cake samples. Cake blends which prepared by substitution of wheat flour (72%) with 5, 10, 15 and 20% CSP showed a significant ($p \leq 0.05$) increase in the cake weights and volumes, while, specific volume was decreased significantly. Texture properties of cake were affected, the hardness, cohesiveness and chewiness values were in the range of 19.07-27.63, 0.57- 0.42 and 75.40- 95.70%, respectively. Sensory evaluation results indicated that replacement of wheat flour with 5 and 10% CSP in the cake mixture didn't impact the general acceptability. Additionally, total scores of sensory evaluation showed that all cake samples recorded 75% higher than the control samples. Inhibitory concentration (IC50) of corncob silk extraction cancer cell proliferation from colon was 18.5 µg/ml. In conclusion, these findings confirm that by-products corncob silk has great potential in food applications especially in development of functional foods.

Key words: Functional foods - corncob silk - physicochemical properties - functional properties - colon cancer

Introduction

Functional Food Center (FFC) defines “functional food” as natural or processed foods that contains an biologically-active compounds; the foods, in defined, effective, and non-toxic amounts, provide a clinically proven and documented health benefit for the prevention, management or treatment of chronic disease (Martirosyan and Singh, 2015). Dietary fiber is one of the components that can be added to foods and liquids to enhance fiber content. In this context, Zhao, 2007 reported that dietary fiber can be considered a functional food when it gives a special function to that food beside the normal expected function. Dietary fiber plays an essential role in bodily health, it is contributes to colonic health, coronary artery health, cholesterol reduction, glucose metabolism, insulin response, blood lipids, cancer etc. (Sharoba *et al.,* 2013). Fiber derived from vegetables and fruits have a frequently higher ration of soluble dietary fiber, whereas cereal fibers contain more insoluble cellulose and hemicellulose (Aydogdu *et al.,* 2018).The insoluble portion of the fiber regulates the intestinal performance, while the soluble fiber reduces the cholesterol levels and the adsorption of intestinal glucose (Sharma *et al.,* 2016). So, King *et al.,* (2012) reported that the recommended intakes of dietary fiber for adults is 25 to 38 g/day (14g/1000 kcal/day). Nevertheless, most people usual intake for dietary fiber is low, which is only 16g/day. In addition, children are not eating enough fruits, vegetables and legumes, which are the main sources of dietary fiber (Timm and Slavin, 2008). Therefore, intake of more other sources of dietary fiber should be encouraged.

Currently, food industry is marked by the high volume of waste produced. Food and Agriculture Organization (FAO) has estimated that the processing procedure operations of fruits and vegetables produce high amounts of wastes/by-products, which constitute about 25% to 30% of a whole commodity group (Sagar *et al.,* 2018). The wastes/ by-products are composed of seed, skin, rind and pomace. They are rich in dietary fibers, vitamins, enzymes and oils (Nilnakara *et al.,* 2009). They are also containing appreciable amounts of colorants, antioxidant compounds and other substances with positive health effects (Sousa *et al.,* 2011).

Maize being the third most planted food crop and one of the essential edible cereals in the world. It is one of the major energy origins (Rahman and Rosli, 2014). All parts of corn are utilized, including strands which commonly known as corn silk (CS). Most of the time, these strands, are thrown away because many people do not realize that it could be used as by-product and designed as new 'functional foods' (Hasanudin *et al.,* 2012). CS consists of proteins, carbohydrates, vitamins, calcium, potassium, magnesium, sodium salts, also an excellent source of dietary fibers and volatile oils (Ng and Rosli, 2013 and Solihah *et al.,* 2015). Furthermore, CS is rich in phenolic compounds such flavonoids and steroids like sitosterol, stigmasterol, alkaloids, and saponins (El-Ghorab *et al.,* 2007; Liu *et al.,* 2011;Vijithaand Saranya, 2017). CS has been reported to have properties of antioxidant by inhibiting lipid peroxidation, treating infection and cystitis, hyperthyroidism, kidney stones and several illnesses related to kidney, hypoglycemia, hepatitis, and tumors (Ebrahimzadeh, 2008; Bhaigyabati 2012; Zhao *et al.,* 2012 and Haslina, 2017). In general, consuming CS tea is safe, and adults and children can take it without major concerns. Recently, study using male and female rats revealed that CS is non-toxic in nature, has no adverse effects and support the safety of CS for humans (Wang *et al.,* 2011). Therefore, the present study aims to investigate the physical characteristics and functional properties of cake fortified with CS as dietary fiber source and examine the effect of corn silk extract (CSE) on cell proliferation of cancer cells.

Materials and Methods

Materials

Wheat flour 72%, baking ingredients (milk, sugar, butter, eggs, vanilla and baking powder) and CS were obtained from local market from Damietta Governorate, Egypt.

Methods

Preparation of CSP

Fresh CS (hairs) were removed from the young corn cob manually; cleaned and washed with water then dried at 50^0C by using an air-oven until brownish strands were obtained. Dried CS was ground into powder by using electrical blender (Moulinex LM 207041, France). The dried CS powder was kept in plastic bag at below 4^0C until analysis.

Supplementation flour

Different batches from wheat flour 72% and corn silk powder (CSP) were prepared to obtain 4 formulas beside the control sample. Replacement material of CSP was used in amounts of 5, 10, 15 and 20%.

Cakes Preparation

Cakes were prepared according to the formula is shown in Table (1), and using the method as described by Hamed (1993) with some modification. The ingredients including sugar, eggs and vanilla were homogenized with an electric mixer at medium speed for 20 min; added the butter for 5 min; and milk was added and mixed well. The blends of wheat flour were mixed manually with baking powder. The batter was placed into Tin mold pans size 30 and baked in a conventional oven pre-heated to 180^0C for 30 min, air cooled at room temperature and packed.

Table (I): Cake formula

Ingredients	Weight (g)
Wheat flour (72%)	400
Sugar	350
Fresh whole egg	170
Butter	100
Milk	200
Baking powder	15
Vanilla	0.5

Physical evaluation of cakes

The cakes were weighed (g) within one hour after cooling and the average was recorded. The samples were taken, and then put in plastic bags, and kept in a freezer at -18^0C for further physical and chemical analysis. The weight was determined with digital weighing balance. The height, length and width of the rectangular shaped cakes were measured. The volume of cake samples was calculated as length × width × height. The specific volume was calculated according to AACC, (2000), using the following equation: Specific volume = Volume (cm^3)/Weight (g).

Determination of chemical composition

Moisture, total protein, crude lipid, ash, total dietary fiber, soluble dietary fiber and insoluble dietary fiber contents of CS were determined by using the method of **AOAC (**2000). A pieces was taken from the same cakes that was used for the texture characteristics; the proximate chemical composition of cake samples were determined; total protein, crude lipid and ash by the AOAC (2000), whereas, carbohydrates were calculated by difference.

Functional properties of by-products corn silk:

Water holding capacity (WHC) and oil holding capacity (OHC) were evaluated according to the methods of Chau and Huang, (2003). In brief, dried sample (0.5 g) was weighed into a centrifuge tube containing 30 mL of distilled water (WHC) or 10 mL of cooking oil (OHC). The suspension was then stirred at room temperature for 24 h (WHC) or 30 min (OHC) and centrifuged at 2,000 rpm for 30 min. The supernatant was then decanted and the residue in the centrifuge tube was weighed. The WHC and OHC of the sample were expressed as g of water per g of dry sample and g of oil per g of dry sample, respectively.

Texture characteristics of cakes:

The texture profile analysis of the cake samples (2.5 × 2.5 × 2.5 cm) from the midsection of the cakes were performed using a texture analyzer (TA-RT-KIT, Stable Micro Systems Ltd, Germany) with a 25 mm diameter cylindrical probe, 40 % compressing and a test speed of 2.50 mm/s. The crust of cake samples was removed in cake texture determination. A double cycle was programmed and the texture profile was determined using Texture Expert 2.5 software (Stable Microsystems). Other parameters were defined as: pre-test speed 2.0 mm/s, post-test speed 2.0 mm/s and trigger load 5.00N. The texture parameters recorded were consistency, hardness, cohesiveness, adhesiveness, springiness, resilience, gumminess, and chewiness

Sensory analysis

Sensory evaluation of cakes was carried out by a 10 panelists of staff members from Damietta University, Damietta, Egypt. Samples of the cake were prepared one day earlier before the evaluation, packed in polypropylene bags and stored at 4°C. Each panelist was asked to evaluate unfortified and fortified cake samples with corn silk, according to color, flavor, taste, texture and general appearance by using method (Abd El-Latif, 1990).

Preparation of CSE

Grinded corn silk (300 g) was macerated in 1000 ml of distilled methanol for five days (three times) with occasional shaking. After maceration, the extract was filtered through Whatman (No.1) filter paper to separate the filtrate from residues. The collected filtrate was dried at 45^0C by using a rotary evaporator. The concentrated extracts were stored in kept at -18^0C until further use.

Cell proliferation assay

The effects of CSE on cell proliferation were evaluated by Vichai and Kirtikara, (2006). The cells were harvested during the logarithmic growth phase and seeded at a density of $3x10^3$ cells/well in 96-well plates. Following overnight growth, the culture medium was replaced with various concentrations (0, 5, 12.5, 25 and 50 µg/ml) of CSE for 24, 48 and 72 h. The dye was solubilized with 100 µl/well of 10M tris base (pH 10.5) and optical density (O.D.) of each well was measured spectrophotometrically at 570 nm with an ELISA microplate reader (Sunrise Tecan reader, Germany). The mean background absorbance was automatically subtracted and means values of each drug concentration was calculated. The experiment was repeated 3 times. The percentage of cell survival was calculated as follows:

Surviving fraction = O.D. (treated cells)/ O.D. (control cells) x 100%.

The 50% inhibitory concentration (IC_{50}) was determined as the anticancer drug concentration causing a 50% reduction in cell viability, and calculated from the cytotoxicity curves.

Statistical analysis

Data obtained were statistically analyzed by SPSS computer software SPSS 2000. The results were expressed as mean ± standard deviation (SD) and tested for significance using one way analysis of variance ANOVA test, according to (Armitage and Berry, 1987).

Results and Discussion

Chemical composition of CS powder

Data in Table (2) represent chemical composition of CS. Moisture, total protein, crude fat, ash and dietary fiber were receded 10.2, 16.65, 0.86, 5.25, 39.25%, respectively. It has contained 37.52 g/100 g as insoluble fiber, whereas, the soluble fiber was 1.73 g/100 g. The importance of food fibers has led to the development of a large and potential market for fiber-rich products and ingredients and in recent years, there is a trend to find new sources of dietary fiber that can be used in the food industry (Chau and Huang 2003). In current study, CS can be used to enhance fiber content in snack foods (cakes) and give excellent organoleptic properties. In addition, improve the health benefits and functional properties of cakes. Results are in agreement with Abdul-Hamid (2000) that revealed; rice bran consists of almost 27% dietary fiber and has been reported to have positive effects, such as laxative and cholesterol-lowering ability.

Table (2): Proximate chemical composition (% on dry weight basis) of CS

Components	Value (%)
Moisture	10.2±0.09
Total Protein	16.65±0.46
Crude Fat	0.86±0.08
Ash	5.25±0.18
Total dietary fiber	39.25± 4.34
Insoluble fiber	37.52±0.47
Soluble fiber	1.73±2.06

Functional properties of CS powder

Finding in Table (3) presented the water holding capacity (WHC) and oil holding capacity (OHC) of CS powder. It could be noticed that WHC was 9.6g water/g fiber. WHC is a property of dietary fiber which is important from a technological point of view that it can be applied in food products as a new ingredient for a low-calorie healthy diet and for modifying the physical properties and texture of food products (McCleary and Prosky, 2001). Dietary fiber binds with water by the interaction between polar and hydrophobic interactions (Chaplin, 2003).

Regarding of OHC, results showed that OHC was 2.3g oil/g fiber. (Kulapichitr *et al.*, 2015) reported that oil OHC is the one of dietary fiber properties that could be affected by the particle size of dietary fiber and the mechanical sheer from grinding process and also related to the content of insoluble dietary fiber. The importance of OHC is that when fiber is added to food products, it can absorb the oil. The absorbed oil can be determined as fat absorption capacity. Study by Sharoba *et al.*, (2013) demonstrated that the correlation between OHC and total quantity of protein and total dietary fiber was very high, that meaning the OHC of the fiber origin might also depend on the total content of protein and total dietary fiber present.

Table (3): Functional properties of CSP

Parameter	Values
WHC (g of water/g of dry matter)	9.6±0.3
OHC (g of oil/g of dry matter)	2.3±0.1

WHC: water holding capacity, OHC: Oil holding capacity

Chemical composition of cakes fortified with CSP

Bakery products are major ready-to-eat processed foods. The nutritional quality of these products is low because of the use of refined flours in their preparations. In present work; chemical and nutritional composition of these products (cake) can be developed by using type sources of grain fibers for product fortification.

Chemical composition of cakes fortified with corn silk powder is presented in Table (4). From the obtained results, control sample containing 7.53% total protein, 11.39% crude fat, 0.42% crude fiber, 0.89% ash and 79.77% carbohydrates. Replacement of wheat flour with different ratios of CSP 5, 10, 15 and 20% induced improvements on total protein, crude fat and ash content for fortified cakes by the ratio of 16.2, 18.3, and 22.2%; 25.2, 1.8 and 4.4%; 7.1, 9.3 and 7.9%; and 30.3, 34.8, 49.4%, respectively. There was an extremely increase in crude fiber content for fortified cakes by about 4.7, 4.4, 3.7 and 2.4 times, respectively as compared to the control sample. Whereas, the same replacement caused gradually slightly decreased of carbohydrates values as compared to the control sample.

Table (4): Chemical composition of cakes fortified with CSP

Component (%)	**Control 0% CSP**	**Cakes + CSP (%)**			
		5% CSP	**10% CSP**	**15% CSP**	**20% CSP**
Total Protein	7.53±0.21	8.75±0.23	8.91±0.28	9.20±0.21	9.43±0.25
Crude Fat	11.39±0.11	11.60±0.30	11.89±0.28	12.20±0.34	12.45±0.37
Crude Fiber	0.42±0.06	1.02±0.27	1.59±0.30	1.85±0.09	2.01±0.07
Ash	0.89±0.03	0.96±0.02	1.16±0.13	1.20±0.11	1.33±0.17
Carbohydrates	79.77±4.19	77.67±4.01	76.45±3.03	75.55±1.56	74.78±2.34

Each value represents the mean±SD.

Physical properties of cakes fortified with CSP

Weight (g), volume (cm^3) and specific volume (cm^3/g) for cake prepared from wheat flour 72% extraction rate at 100% control and blends containing different levels of CSP 5, 10, 15 and 20% are given in Table (5). Results exposed that, the weight (g) of cakes increased significantly with increasing the levels of CSP from 112.1 to 116.6 compared with control, it was may be due to that CSP has high fiber content (39.25%); WHC which effect of water adsorption. Furthermore, the volume (cm^3) of the cake samples was slightly greater than the control cake when replace wheat flour (72%) with different levels of CSP from 5 to 20%; that's mean improved the volume and crumb structure of the cake. On the other hand, data in the same table showed that all cakes containing 5, 10, 15 and 20% CSP had lower specific volume (cm^3/g) than the control one. It could be observed that specific volume of cakes depends on amount of added fibers. Fibers may contradict with gluten network formation and dilute functional gluten proteins. These results are in good agreement with that found by Fu *et al.,* (2015) which indicated that as the lemon fiber concentration increased, specific volume of breads decreased due to the interruption of gluten network. Similarly, Chang *et al.,* (2015) found that lemon fiber enriched breads had lower specific volume than breads with no fiber. Sudha *et al.,* (2007) observed a reduction in volume of cakes when concentration of apple pomace increased. However, specific volumes of cakes containing pea and oat with 5% were non-significantly different from control cakes and this is probably due to the low amount of added fibers. In several previous studies, a negative correlation was found between specific volume and hardness. Smaller cakes were denser and had packed crumb structure which caused in harder cakes (Sabanis *et al.,* 2009; Lebesi and Tzia 2011; Aydogdu *et al.,* 2018). Furthermore, cakes supplemented with lemon fiber had the lowest specific volume and the highest hardness value. Lemon fiber had a high water holding capacity, caused wheat flour could not absorb enough water to develop of gluten–protein network and hard structure occurred (Aydogdu *et al.,* 2018).

Table (5): Physical properties of cakes fortified with CSP

Properties	**Control 0% CSP**	**Cakes + CSP (%)**			
		5% CSP	**10%CSP**	**15%CSP**	**20%CSP**
Weight (g)	102.1^{e}	105.2^{d}	108.5^{c}	112.6^{b}	116.6^{a}
Volume (cm^3)	248.8^{e}	255.2^{d}	261.5^{c}	267.9^{b}	271.2^{a}
Specific Volume (cm^3/g)	2.44^{a}	2.43^{b}	2.41^{c}	2.38^{d}	2.33^{e}

Means with different letter within the same row are significantly different ($P \leq 0.05$)

Texture characteristics of cakes fortified with by-products corn silk powder

The Table (6) summarizes the effect of adding corn silk powder on the mechanical properties of cake. Results revealed that samples contained the different levels of the CSP 5, 10, 15 and 20% led to the hardest with hardness higher than that of the control cake sample, fiber can induce a crumb hardness increase. Study by Ng and Rosli (2013) demonstrated that high dietary fiber content in bread after addition of 4% and 6% corn silk powder contributed to greater hardness because dietary fiber component from CSP could tightly bind appreciable amounts of water, therefore it less ready-made of the gluten network upgrowth. They indicated to another reason could happened; elevated amounts of sugar content contributed by levels of CSP added had direct effect on water migration from other bread component, so causing bread rigidity. Chewiness and gumminess of the cakes increased with increasing amount of CSP added to be 81.00, 89.60, 93.20, 95.70 and 11.70, 12.60, 13.68, 13.76 for substituting wheat flour with corn silk powder, respectively. These results are agreement with Aydogdu *et al.,* (2018) who established that high concentration of lemon and apple fiber creates hardness in cakes. Also, Esteller *et al.,* (2004) showed that chewiness is one of the texture parameters absolutely correlated with sensory evaluation. As well, gumminess and chewiness are parameters dependent on Hardness and their values followed a similar trend than that of hardness. Concerning of cohesiveness; estimates the internal resistance of food structure. Data in the same table (6) observed that cohesiveness of cake depended on the addition of fiber where decreased gradually from 0.57 to 0.42. A similar result was also obtained in Esteller *et al.,* (2004). Also, Sharoba *et al.,* (2013) reported that, springiness is usually assessment by consumers through slightly pressing the piece of food by hand or with the mouth, and verifying how easily it returns to the original size. Also, Present results indicated that springiness and resilience of samples decreased slightly with increasing the corn silk addition, nevertheless, the addition of CSP with 5, 10, and 15% to wheat flour to produced cake improved the texture properties of cake due to high water holding capacity of fiber, these results are in agree with many researchers.

Table (6): Texture characteristics of cakes fortified with CSP

Texture parameter	**Control 0% CSP**	**Cakes + CSP (%)**			
		5%CSP	**10%CSP**	**15%CSP**	**20%CSP**
Hardness(N)	19.07	25.74	27.09	27.46	27.63
Cohesiveness	0.57	0.51	0.46	0.45	0.42
Gumminess (N)	10.78	11.70	12.60	13.68	13.76
Chewiness (mJ)	75.40	81.00	89.60	93.20	95.70
Springiness(mm)	6.99	6.92	6.81	6.32	5.21
Resilience	0.21	0.20	0.17	0.17	0.16

Sensory evaluation of cakes fortified with by-products corn silk powder

Data in Table (7) showed the sensory evaluation of fortified cakes with 5, 10, 15 and 20% of CSP. Cake samples were significantly different from control sample for most sensory characteristics; also, the results indicated that, the wheat flour replaced by corn silk powder from 5% to 20% caused a significant reduction in cake properties total scores. The color and flavor of cake was significantly affected ($p<0.05$) by the replacement of different levels from CSP, as compared to control sample. Concerning of taste; cakes fortified with different ratios of CSP recorded a significant changes when compared with the control, whereas, the two samples of cake fortified with 15 and 20% didn't differ significantly between each other. On the other hand, cake fortified with 5% CSP showed non-significant changes in texture, while other samples supplemented with 10, 15 and 20% were significantly lower than the control. Statistical analysis showed significant changes ($p\leq0.05$) in general acceptability between cakes fortified with all levels of CSP as compared to the control, except the sample fortified with 5% CSP which observed comparable acceptance with control cake. However, each cake samples fortified with 5, 10 and 15% of CSP had similar acceptance between them. In general, results from total score occurred that, all samples obtained higher than 75%. The same trend was observed in a study published by El-Hadidi (2006); Saeed (2010); Sharoba *et al.,*(2013) who reported that statistical analysis of organoleptic evaluation of the control cakes versus cakes containing some fiber powders presented insignificant differences. Also, Lebesi and Tzia (2011) suggested that dietary fiber addition to cakes improved texture and sensory characteristics.

Table (7): Sensory evaluation of cakes fortified with CSP

Samples	Sensory Characteristics					Total Score (100)
	Color (20)	Flavor (20)	Taste (20)	Texture (20)	General Acceptance (20)	
0% CSP (Control)	19.840[a] ±0.306	19.660[a] ±0.386	19.680[a] ±0.388	19.590[a] ±0.435	19.600[a] ±0.459	98.360[a] ±0.811
5% CSP	18.800[b] ±0.402	18.760[b] ±0.819	19.010[b] ±0.472	19.150[a] ±0.562	18.880[ab] ±0.669	94.510[b] ±1.510
10% CSP	17.840[c] ±0.383	17.530[c] ±0.790	18.050[c] ±0.552	18.050[b] ±0.432	18.240[bc] ±0.680	89.700[c] ±1.267
15% CSP	16.650[d] ±0.824	16.230[d] ±1.141	17.110[d] ±0.591	16.550[c] ±0.696	17.500[c] ±0.870	84.040[d] ±1.774
20% CSP	15.640[e] ±0.805	15.920[d] ±0.612	16.700[d] ±0.461	15.290[d] ±0.495	15.980[d] ±1.365	79.530[e] ±2.410

Means with different letters within the same columns are significantly different ($P < 0.05$)

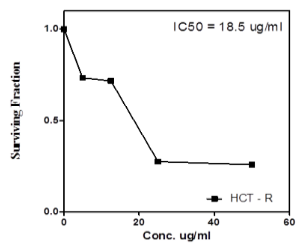
Effects of corn silk extract (CSE) on cell proliferation of colon cancer cells

As shown in Table (8) and Figure (1) results revealed that corn silk extract (CSE) inhibited cell proliferation in a dose dependent manner. The percentage of cells in the HCT-R phase was 1.000, 0.733, 0.717, 0.275 and 0.258% following treatment with 0, 5, 12.5, 25 and 50µg/ml corn silk extract, respectively. Data also observed that the 50% inhibitory concentration (IC50) of CSE was18.5 µg/ml which is lower than the control. Antioxidant compounds are able to scavenge reactive oxygen species (ROS) that may cause various diseases related to oxidative stress such as cancer, hypertension, and cognitive dysfunction. In order to defend humans from oxidative stress, different herbs and plants are being used for their potential benefits in preventing diseases related to oxidative stress and in maintaining health (Hasanudin *et al.*, 2012).

The current results are in agreement with those obtained by Guo *et al.*, (2017) who investigated the anticancer activity of CSE in human colon cancer cells and human gastric cancer cells. The results revealed that CSE inhibited the proliferation of cancer cells and increased the level of apoptosis in a concentration‑dependent manner. Also, experimental finding by Yang, (2014) indicated that corn silk powder (CSP) could promote the immune functions in tumor-bearing mice to increase its antitumor activity and CSP able to be a safe and effective agent for the therapy of hepatocellular carcinoma.

Table (8): Effects of corn silk extract (CSE) on cell proliferation of colon cancer cells

Conc. of CSE (µg /ml)	HCT-R
0.000	1.000
5.000	0.733
12.500	0.717
25.000	0.275
50.000	0.258



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إستخدام حرير كيزان الذرة فى إنتاج أغذية وظيفية

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الملخص:

تعتبرحريرة الذرة من النواتج الثانوية التي تنتج عند تصنيع الذرة، وهي مصدر غني بالألياف الغذائية والمركبات النباتية. تهدف الدراسة إلي التعرف علي تأثير إضافة مسحوق حريرة الذرة (CSP) كعنصر وظيفي إلى منتجات المخابز وتأثير الألياف على خصائصها الفيزيائية والكيميائية والوظيفية، بالاضافة الي دراسة تأثير مستخلص حريرة الذرة (CSE) علي تكاثر الخلايا السرطانية. تم إستخدام أربعة تركيزات مختلفة من حريرة الذرة (٥ ، ١٠ ، ١٥ و ٢٠٪) كبديل لدقيق القمح ٧٢٪. أظهرت نتائج التركيب الكيميائي لحريرة الذرة أنها تحتوي على ١٠.٢٪ رطوبة، ١٦.٦٥٪ بروتين، ٠.٨٦٪ دهون، ٥.٢٥٪ رماد و٣٩.٢٥٪ الألياف الغذائية الكلية، أظهرت خلطات الكيك التي أعدت بإستبدال دقيق القمح ٧٢٪ بنسبة ٥ ، ١٠، ١٥ ، ٢٠٪ من حريرة الذرة زيادة في أوزان الكيك وحجمه، في حين إنخفض الحجم النوعي للكيك. كما أن زيادة مستوى الإستبدال من ٥٪ إلى ٢٠٪ من مسحوق حرير الذرة أدي الي تحسن في محتوي البروتين الكلي والدهون الخام والألياف الخام والرماد في جميع عينات الكيك. أشارت النتائج إلى تأثر خصائص نسيج عينات الكيك حيث كانت قيم الصلابة والتماسك والماضغية في حدود ١٩.٠٧-٢٧.٦٣ ، ٠.٥٧-٠.٤٢ و ٧٥.٤٠-٩٥.٧٠، على التوالي. أشارت نتائج التقييم الحسي إلى أن إستبدال دقيق القمح بنسبة ٥ ٪ و ١٠ ٪ من حريرة الذرة في خلطات الكيك لم يؤثر على القبول العام، كما أن النتائج الإجمالية للتقييم الحسي قد سجلت درجات أعلى من ٧٥ ٪ لجميع العينات. بلغ تركيزمستخلص حريرالذرة ذو التأثير المثبط على تكاثرالخلايا السرطانية من القولون ١٨.٥ ميكروغرام/ مل. أستنتجت الدراسة أن حريرة الذرة - كنواتج ثانوية - لها إمكانات كبيرة في التطبيقات الغذائية، وخاصة في تطوير الأطعمة الوظيفية.

كلمات مفتاحية : أغذية وظيفية - حريرة الذرة- الخصائص الفيزيائية – الخواص الوظيفية – سرطان القولون**.**