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KARKADE AS A MINIRAL AND FIBER ENRICHMENT SOURCE IN DRY BISCUIT AND NOODLE

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ABSTRACT

Karkade (*Hibiscus subdariffa*) powder was used as a fiber and minerals enrichment in dry biscuit and noodle at 0.5, 1, 1.5 and 2 % of wheat flour. Biscuits were evaluated for physical characteristics (weight, thickness, diameter, volume, spread ratio and hardness) and sensory characteristics (such as appearance, color, taste, texture, and overall acceptability). Noodle cooking qualities and sensory attributes (color, flavor, taste, aroma, and overall acceptability) were also evaluated. Results indicated that mineral and fiber contents of biscuit and noodle increased as the level of karkade supplementation increased. Meanwhile, physical and sensory characteristics where decreased by increasing the level of karkade powder substitution. The acceptable karkade levels in wheat flour for biscuit and noodle making were 1.5 and 1.0 %, respectively.

Key words: Karkade, *Hibiscus subdariffa*, Fiber, Mineral, Roselly, Biscuit, Noodl

INTRODUCTION

Karkade (*Hibiscus subdariffa*) or Roselle is cultivated in tropical and subtropical regions. Water extraction of the calyxes results a brilliant red color extract, rich in anthocyanin, ascorbic acid and hibisus acid (**Ibrahim *et al* 1971**). Its thickened calyxes and floral bracts are esteemed for the acid flavor they impart to jams, jellies, sauces and beverages. Utilization of extract in industries may include production of vacuum concentrated extract, emulsion, natural food colorants, frozen roselle extract, pharmaceuticals products, herbal teas, freeze dried roselle particles, and roselle powder (**Esselen & Sammy, 1973; Saeed & Ahmed, 1977; Francis, 1986, Alkahtani & Bakeri, 1990 and Abdou *et al* 1995**). Karkade powder contains high level of minerals such as Fe (188 mg / 100 g), Mg (442 mg / 100 g), Ca (1.28 %) and Se (0.09 ppm) as mentioned by **Hayashi and Seguchi (1998).** Calcium and iron levels are 1342 and 41 mg / 100 g, respectively, based on the dry weight (**FAO, 1973**). Flowers contain gossypectin, anthocyanin, and glycoside hibiscin, which may cause diuretic and choleretic effects, lowering the viscosity and pressure of the blood and stimulating intestinal peristal-

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sis (**Muller & Franz, 1992; Adegunloye *et al* 1996 and Onyenekwe *et al* 1999**).

The daily requirement of iron is 10 and 15 mg / day for males and females, respectively. Iron deficiency is most common single nutrient disorder. It is prevalent in the most developing and underdeveloped countries and is probably the only considerable nutritional deficiency of industrialized countries (**De-Maeyer and Adiels-Tegman, 1985**). Iron deficiency can be prevented by increasing iron intake either by fortifying or supplementing of foods with medical iron. In situation of which high rates of iron deficiency (prevail or during pregnancy) where high rates of iron needs of the latter two trimesters are almost impossible to achieve with diet alone supplementation with medical iron constitutes the best method because it can be targeted and produces rapid changes (**Nadler *et al* 1962**). The products derived from the plant are traditionally used to replace some medicines or preservatives. It has been considered that some karkade products might be useful for the treatment of cough, high blood pressure and wounds (**FAO, 1988**). Although, the nutritional and industrial properties of karkade plant is widely recognized (**Haridi, 1980 and FAO, 1988**), few work has actually been performed on karkade to elucidate its value is a useful nutrient supplement with minerals in bakery products (**Zahran *et al* 2002**). Karkade as an iron source has been investigated in bread making (**Hayashi and Seguchi, 1998**) and karkade flour was used as a fiber, calcium and iron supplement in chocolate cakes (**Almana 2001**).

The objective of this study is to evaluate the suitability of Karkade flour as a minerals supplement in biscuits and noodles production. Chemical compassion, physical properties, cooking quality, and sensory properties of these food products were also evaluated to study the possibility of using such plant on commercial scale in cereal products, c.e. noodle and biscuits.

MATERIAL AND METHODS

Sampling

Commercial karkade (*Hibiscus subbariffa L.*) calyx and floral bracts were purchased from Aswan city, Aswan governorate. It was ground using Food grinder of high speed, Braun and screened with a 0.1 mm screen (Veb Mlw laborattechnik II. Mean Mlw. Germany) the resultant flour was packed in polyethylene bags and stored at -18°C until used. Wheat flour (72 % extraction) that commercially produced by North Cairo Flour Mills Company was used in this study.

Technological process

1- Hard biscuit processing

A standard procedure was applied in this investigation as described by (**Saleh, 2003**). This procedure is used in production of hard biscuit of Egyptian Company of Foods (Bisco Misr), Cairo, Egypt. The recipe consisted of wheat flour (100 g), ground sugar (32 g), high fructose corn syrup (2.9 g), shortening (14.3 g), milk powder (1.4 g), vanillin (0.1 g), sodium bicarbonate (0.1 g), ammonium bicarbonate (1.3 g), and water (22.0 g). Supplemented biscuit was prepared by replacing

0.5, 1, 1.5, and 2 % of flour with karkade. Biscuits were prepared in Food Sci. Dept., Fac. Agric., Ain Shams Univ. The products were packed in polyethylene bags until examination.

2- Noodle's processing

Noodle samples were prepared at the same Dept. from wheat flour (72 % extraction) and karkade was fortified with 0.5, 1, 1.5, and 2 %. The method of **Collins and Pangloli (1997)** with the past Matic 1000 (Simac Machine carporation, Millano, Italy). Noodle was cutted to appropriate length, hardened for 15 min in air and dried at 40 ± 2°C for 24 hr. The product was packed in polyethylene bags for further analysis.

Analytical Methods

Moisture, protein (N % 6.25), ether extract, crude fiber, ash, total carbohydrates and pH (5% solution) of karkade and wheat flour were determined according **AACC (2000)**. Calcium, copper, iron, manganese, zinc, magnesium, sodium, phosphorus, and potassium were measured after ashing according to **AOAC (2000)** using atomic absorption spectrophotometer (Model 3300).

Physical parameters of biscuits

Weight (g), thickness (cm), diameter (cm), and volume (cm^3) were measured as averages of five replicates for each sample and the spread ratio was calculated as the diameter to thickness ratio using **Shrestha and Noomharm (2002)** method. Hardness of samples was determined according to **Sanderson *et al* (1988)** procedure by measuring tension compression (TC^2). A proper of 1 mm diameter was used to penetrate the sample at a crosshead speed of 200 mm / min. The results were calculated as g / cm^2.

Sensory evaluation of biscuits

Appearance, color, taste, texture, and overall acceptability were evaluated according to **Elwasfy (1986).**

Cooking quality of noodles

The increase in noodle volume and weight during cooking were determined according to **Seyam *et al* (1976) and Lorenz *et al* (1979)** methods. Cooking loss and optimal cooking time were carried out according to **AACC (2000)**.

Sensory evaluation of cooked noodles

Color, flavor, taste, aroma, and overall acceptability of cooked noodles were evaluated by ten panelists from the staff of Food Sci. Dept., Fac. Agric., Ain Shams Univ. as described by **Gadallah (2003).**

Statistical analysis

Data were obtained for three replicates and computed for the analysis of variance and the differences among the means were determined by Duncan's multiple range test using SAS programs (**SAS, 1996**) according to procedures reported by **Snedecor and Cochran (1989)**. Treatment mean were compared by least significant difference test (LSD) at 5 % level of probability.

RESULTS AND DISCUSSION

Chemical analysis

The data for chemical analysis of the wheat flour and karkade are shown in Table (1). A general trend of non significantly changes were recorded in fat and protein. On the contrary, moisture, crude fiber, total carbohydrate and ash contents were significantly deferent. When compared with wheat flour, karkade contained about 36 and 27 folds of crude fiber and ash, respectively. Karkade flour is a useful nutrient supplement of wheat flour and supplementation with karkade flour may be important in tropical and subtropical regions (**Almana, 2001 and Zahran *et al* 2002**). As expected, pH value of karkade was lower than that of wheat flour because karkade contains high level of organic acids (**Ibrahim *et al* 1971 and Almana, 2001**). Mineral contents of wheat flour and karkade flour were also given in Table (1). Results indicated that karkade flour was extremely rich in minerals as compared with wheat flour. These results are in agreement with those found by **FAO (1973)**; **Hayashi & Seguchi (1998) and Almana (2001).**

Table 1. pH, chemical and mineral contents (mg/100g) of wheat flour (72 %) and karkade (dry weight basis).

Parameters	Wheat	Karkade
pH (5% solution)	6.63 ± 0.0577	2.53 ± 0.0577
Moisture	13.31 ± 0.0666	10.44 ± 0.0954
Protein	10.61 ± 0.0115	10.73 ± 0.0058
Ether extract	1.56 ± 0.0289	1.10 ± 0.0058
Crude fiber	0.57 ± 0.0200	20.79 ± 0.0058
Carbohydrate	86.83 ± 0.0208	55.38 ± 0.0346
Ash	00.44± 0.0321	11.97 ± 0.0058
Mg	42.073 ± 0.1185	43.540 ± 0.0690
Na	151.340 ± 0.5717	199.040 ± 0.1970
Zn	0.933 ± 0.0153	30.116 ± 0.0289
Mn	0.610 ± 0.0173	6.176 ± 0.0493
Fe	1.510 ± 0.0100	44.750 ± 0.0624
Ca	19.293 ± 0.0252	1283.306 ± 5.5377
K	105.136 ± 0.1185	557.873 ± 0.0462
Cu	0.156 ± 0.0058	1.583 ± 0.0115
P	108.043 ± 0.1498	132.760 ± 0.0557

* The mean ± SD

Karkade flour contained about 66 times of Ca, more than 32 times of Fe and Zn; and 10 times of Mg, Mn and Cu compared with those in wheat flour. The high content of Mg, Zn, Fe, Ca, and K in karkade are expected to raise the nutritive value of wheat flour used for biscuit and noodle.

Hard biscuits prepared using different substitute levels of karkade were analyzed for its moisture content and chemical composition including crude protein, lipids, ash, crude fiber, and total carbohydrates. Data in Table (2) showed that no significant differences in moisture, protein and carbohydrate contents between the biscuit sample made from wheat flour (control) and biscuit samples prepared using wheat flour replaced with karkade flour mixtures (0.5, 1, 1.5, and 2 %). The levels of ash and crud fiber in biscuit were significantly increased by increasing the substitution level of karkade. These results agree with those found by **Zahran *et al*** (2002).

Mineral contents of unsupplemented and supplemented biscuits were determined and shown in Table (2).

Table 2. Chemical and mineral contents (mg/100g) of biscuit fortified with karkade (dry weight basis).

Parameters	Karkade level %				
	0.0	0.5	1.0	1.5	2.0
Moisture	6.66^{a}	6.82^{a}	6.97^{a}	7.23^{a}	7.36^{a}
Protein	7.74^{a}	7.70^{a}	7.73^{a}	7.72^{a}	7.75^{a}
Ether extract	15.95^{a}	15.95^{a}	15.96^{a}	15.91^{a}	15.92^{a}
Crude fiber	0.47^{e}	0.60^{d}	0.70^{c}	0.87^{b}	1.07^{a}
Carbohydrate	74.94^{a}	75.00^{a}	74.92^{a}	74.69^{a}	74.43^{a}
Ash	0.40^{e}	0.57^{d}	0.68^{c}	0.73^{b}	0.97^{a}
Mg	46.810^{a}	47.900^{a}	49.790^{a}	52.630^{a}	59.210^{a}
Na	369.06^{c}	371.92^{c}	379.515^{b}	382.520^{ab}	386.320^{a}
Zn	0.815^{e}	0.920^{d}	1.295^{c}	1.680^{b}	1.960^{a}
Mn	0.625^{c}	0.620^{c}	0.665^{b}	0.680^{b}	0.830^{a}
Fe	1.220^{e}	1.540^{d}	1.985^{c}	2.700^{b}	3.220^{a}
Ca	27.750^{e}	39.170^{d}	46.715^{c}	67.950^{b}	90.840^{a}
K	96.505^{d}	103.970^{c}	106.675^{cb}	108.930^{ab}	112.030^{a}
Cu	0.110^{b}	0.120^{b}	0.135^{b}	0.170^{a}	0.170^{a}
P	86.67^{e}	92.04^{d}	98.17^{c}	103.34^{b}	108.02^{a}

* The mean values of the same letter or letters are not significantly different at level of 5%

Results indicated significant increases in mineral contents by increasing the level of supplementation. The high content of Mg, Zn, Fe, and Ca in karkade is expected to raise the nutritive value of wheat flour used for biscuit. These obtained results indicated that karkade is a good source and suitable for enrichment biscuit with mineral.

The chemical composition of mineral content of noodle substituted with different levels of karkade (0.5, 1, 1.5 and 2 %) compared with noodle made from 100 % wheat flour(control) was presented in Table (3). It could be noticed no significant differences in moisture, protein, and lipid between control noodles and replaced samples with karkade. On the other hand crude fiber and ash contents were significantly increased with increasing the supplementation level of karkade. On the contrary, total carbohydrate was significantly decreased with increasing the level of supplementation. At the same time, the mineral contents were significantly increased as the levels of substitution increased.

These results indicate that mineral contents of biscuits and noodles increased with raise in the level of supplementation. Hence, biscuits and noodles supplemented with karkade are favorable than unsupplemented ones, because of its high contents of important minerals. In addition, these reveled the products are rich in minerals and fibers.

Table 3. Chemical and mineral contents (mg/100g) of noodles fortified with karkade (dry weight basis).

Parameters	Karkade level %				
	0.0	0.5	1.0	1.5	2.0
Moisture	9.94^{a}	10.21^{a}	10.54^{a}	10.62^{a}	10.65^{a}
Protein	10.62^{a}	10.63^{a}	10.67^{a}	10.69^{a}	10.66^{a}
Ether extract	1.40^{a}	1.43^{a}	1.40^{a}	1.40^{a}	1.36^{a}
Crude fiber	0.54^{e}	0.60^{d}	0.73^{c}	1.08^{b}	1.12^{a}
Carbohydrate	86.94^{a}	86.65^{b}	86.42^{c}	85.89^{d}	85.81^{d}
Ash	0.44^{e}	0.71^{d}	0.86^{c}	0.96^{b}	1.10^{a}
Mg	43.495^{e}	46.010^{d}	49.750^{c}	52.540^{b}	61.020^{a}
Na	151.005^{b}	151.320^{b}	152.690^{b}	155.810^{ab}	158.820^{a}
Zn	0.855^{d}	1.230^{c}	1.370^{c}	1.680^{b}	2.040^{a}
Mn	0.640^{c}	0.660^{c}	0.670^{c}	0.760^{b}	0.860^{a}
Fe	1.7300^{d}	1.8200^{d}	2.1300^{c}	3.1000^{b}	3.9300^{a}
Ca	19.145^{e}	30.580^{d}	36.125^{c}	50.980^{b}	68.400^{a}
K	104.260^{d}	109.980^{c}	111.550^{c}	118.100^{b}	127.770^{a}
Cu	0.1550^{c}	0.160^{c}	0.1750^{bc}	0.200^{ab}	0.230^{a}
P	103.48^{e}	108.44^{d}	109.93^{c}	111.35^{b}	113.40^{a}

* The mean values of the same letter or letters are not significantly different at level of 5%

Physical characterization of biscuit

The mean values of weight, diameter, thickness, spread ratio, volume, and hardiness of biscuit made from wheat flour substituted with different levels of karkade flour (0.5, 1, 1.5, and 2%) are given in Table (4). The weight of biscuits did not significantly differ except control sample. On the other hand, a significant decrease in diameter was noticed, while an increase was recorded in thickness with increasing karkade replacement. It was observed that the spread ratio (an indicator of density) was significantly decreased with addition of karkade. **Zahran *et al* (2002)** studied the effect of substitution of wheat flour with different levels of karkade on the physical and sensory characteristics of biscuits, they observed that the substitution of wheat flour with karkade has slightly affected the studied physical properties (diameter, thickness and spread ratio).

The mechanical characteristics of biscuits are important for determining the perception of biscuits in the mouth and play an important role in the acceptability of product. The break force required to cause the total breakdown of biscuits was significant affected by hardness resulted from increases of karkade replacement ratio (Table 4). The replacement of wheat flour with karkade gave more hardness to biscuit. The increase was attributed to the increase in biscuit hardness and the gradual loss of crispiness.

Table 4. Mean values of physical characteristics of biscuit fortified with karkade flour

Karkade level %	Weight (g)	Diameter (cm)	Thickness (cm)	Spread ratio (%)	Volume (cm^3)	Hardness gm/cm^2
0.0	8.230^{b}	5.766^{a}	0.466^{c}	12.50^{a}	15.000^{b}	2716.7^{c}
0.5	9.683^{a}	5.666^{b}	0.600^{b}	9.443^{b}	15.000^{b}	3083.3^{bc}
1.0	9.590^{a}	5.500^{c}	0.633^{b}	8.733^{b}	15.667^{b}	4120.0^{ab}
1.5	9.750^{a}	5.466^{c}	0.633^{b}	8.677^{b}	17.000^{a}	4743.3^{a}
2.0	9.533^{a}	5.266^{d}	0.766^{a}	6.900^{c}	16.000^{ab}	5086.7^{a}

* The mean values of the same letter or letters are not significantly different at level of 5%

Sensory evaluation of biscuit

Biscuit sample were evaluated for its appearance, color, flavor, taste, texture, and overall acceptability of the results are present in Table (5). Results show no significant increase in the mean values of appearance, color, flavor, taste, and texture of biscuit substituted with 0.5, 1, 1.5 % of karkade flour. In the same time, significant decrease in the mean values of overall acceptability was noticed. Upon used 2 % karkade, a significant decrease in both of appearance, color, texture, and

Table 5. Mean values of sensory characteristics of biscuit fortified with karkade flour

Karkade level %	Sensory characteristics					
	Appearance	Color	Flavor	Taste	Texture	Overall acceptability
0.0	8.3 [a]	8.5 [a]	8.2 [a]	8.2 [a]	7.4 [a]	8.8 [a]
0.5	8.6 [a]	8.8 [a]	8.2 [a]	8.4 [a]	7.8 [a]	8.2 [ab]
1.0	8.4 [a]	8.9 [a]	8.4 [a]	8.8 [a]	8.2 [a]	8.7 [a]
1.5	8.1 [a]	8.5 [a]	8.4 [a]	8.6 [a]	7.5 [a]	8.5 [b]
2.0	6.7 [b]	6.9 [b]	7.8 [a]	8.0 [a]	6.1 [b]	7.5 [C]

* The mean values of the same letter or letters are not significantly different at level of 5%

overall acceptability was noticed. Generally, the scores of all investigated parameters were gradually decreased with increasing of the level of karkade flour. Results represented that the suitable substitution ratio of karkade added to wheat flour for processing high quality biscuit was not exceed 1.50 %. These findings are contradicted with those found by **Zahran *et al* (2002).** They stated that the substitution of wheat flour with karkade significantly improve all organoleptic characteristics.

Cooking quality of noodle

The replacement effect of wheat flour with different levels of karkade flour on noodles cooking quality was given in Table (6). Significant differences were observed in the volume of uncooked noodle between unfortified and most fortified noodle samples. With respect to the cooking time, it was found that all noodles contained karkade flour needed significantly more time for cooking than that of the wheat noodel. The volume of cooked samples and swelling index are significantly differed among all products (Table 6), contained karkade flour. Volume and swelling index of noodles were increased versus to increase the replacing ratio of karkade. Results showed that weight increase of noodle was correlated to its volume increase. Samples containing different levels of karkade flour showed significant differences in cooking loss. Upon adding high amount of karkade flour to wheat flour the cooking loss was significantly decreased.

Sensory characteristics of noodle

Data of noodle's sensory characteristics substituted of karkade flour were statistically analyzed (Table 7). Results showed that noodle contained karkade flour showed significant effect in all properties. The presence of karkade flour decreased the color acceptability of noodle. Noodles substituted with 0.5 and 1 % karkade flour had greater scores for taste

Table 6. Mean values of the Cooking quality of noodle fortified with karkade flour

Karkade level %	Cooking Time (min)	Weight Increase (%)	Swelling (%)	Cooking Loss (%)	Volume/100g		Weight of 100g Cooked (g)
					Uncooked (cm^3)	Cooked (cm^3)	
0.0	8.5[c]	105.403[b]	184.527[d]	11.793[a]	70.000[a]	199.167[b]	202.920[e]
0.5	9.167[b]	105.880[a]	195.673[c]	11.190[b]	69.333[a]	205.000[a]	203.960[d]
1.0	9.333[b]	105.000[c]	199.517[b]	10.823[c]	68.333[b]	203.833[a]	205.000[c]
1.5	9.667[b]	103.960[d]	202.450[a]	10.647[c]	68.000[b]	205.667[a]	205.880[a]
2.0	10.333[a]	102.920[e]	203.940[a]	10.143[d]	67.667[b]	205.667[a]	205.403[b]

* The mean values of the same letter or letters are not significantly different at level of 5%

Table 7. Mean values of the organoleptic characteristics of noodle fortified with karkade flour.

Karkade level %	Sensory characteristics			
	Color	Taste	Flavor	Overall acceptability
0.0	17.7 [a]	16.2 [b]	17.4[a]	16.5 [a]
0.5	14.6 [C]	17.6 [a]	17.3[a]	15.5 [b]
1.0	16.9 [a]	17.6 [a]	17.4[a]	16.4 [a]
1.5	16.4 [b]	16.7 [b]	17.0[ab]	15.9 [ab]
2.0	15.5 [b]	15.2 [C]	16.1[b]	14.3 [C]

* The mean values of the same letter or letters are not significantly different at level of 5%

than control while no significant increase was detected in scores of flavor and aroma. The addition of karkade flour to noodle affected its overall acceptability. Generally, the higher scores of taste, flavor, aroma, and overall acceptability were recorded in noodle made from wheat flour contained 1.0% karkade flour. Meanwhile all properties were significantly decrease when the level of karkade reached to 2 %.

REFERENCES

A.A.C.C. (2000). ***Approved methods of the American Association of Cereal Chemists 10th Ed.*** American Association of Cereal Chemists, Inc. U.S.A.

A.O.A.C. (2000). ***Official Methods of Analysis, 17th Ed. Vol.2, Ch.9:9-17.*** Association of Official Analysis Chemists International. Gaithersburg, Maryland. U.S.A.

Abdou S.N.; S. El-Shibiny; M.B. El-Alfy and N. Mansour (1995), Preparation and Properties of Powdered Beverage Based on Karkadeh Extract in Permeat. Egyptian *J. of Dairy Sci. 23(1): 21-30.*

Adegunloye, B.J.; J.O. Omomiyi; O.A. Owolabi and O.A. Sofola (1996). Mechanisms of the Blood Pressure Lowering Effect of Calyx Extract of *Hibiscus sabdariffa* in Rats *Afr. J. Med. Sci. 25(3): 235-238.*

Al-Kahtani, H.A. and H.H. Bakeri (1990). Spray Drying of Roselle (*Hibiscus sabdariffa* L.) Extract. *J. Food Sci. 55(4): 1073-1076.*

Almana, H. A. (2001). Karkade (*Hibiscus sabdariffa*) Flour as a Mineral and Fiber Supplement in Chocolate Cakes. *Arab. Univ. J. Agric. Sci. Ain Shams Univ., Cairo, 9 (1): 283-295.*

Collins, J.L. and P. Pangloli (1997). Chemical , Physical and Sensory Attributes of Noodles with Added Sweet Potato and Soy Flour. *J. Food Sci. 62(3): 622-625.*

DeMaeyer E. and M. Adiels-Tegman (1985). The Prevalence of Anemia in World. *World Health Statistic Q 38: 302-316.*

Elwasfy, A.S.M. (1986). *Relationship of Mixture Contents to Baking of Biscuits. pp. 29-41.* M.Sc. Thesis, Food Sci. & Tech., Fac. of Agric., Cairo Univ

Esselen, W.B. and G.M. Sammy (1973). Roselle. A Natural Red Colorant for Foods. *Food Prod. Development 7 (1):80-86.*

FAO (1973). *Roselle (Hibiscus sabdariffa linn) or Karkadeh as a Cultivated Edible Plant.* McLean,K.: FAO, Rome, Italy. *70/543:9-10.*

FAO (1988). *Traditional Food Plants. FAO ,Rome, Italy, 42: 328-332.*

Francis, F.J. (1986). *Handbook of Food Colorants. p. 185.* Food & Nutrition Press, Westport, CT.

Gadalla, M.G.E. (2002). *Studies on Some Natural Colorants and their Utilizations in Foodstuff. p. 44.* M.Sc. thesis Food Sci. Dept. Fac. of Agric. Ain Shams Univ. , Cairo.

Haridi, S.M.M. (1980). *Studies on the Biochemical Constituents of Roselle Plant.pp. 69-73.* M.Sc. Thesis Agric. Biochem. Dept. Fac. of Agric. Ain Shams Univ., Cairo.

Hayashi, M. and M. Seguchi (1998). Iron-enriched Bread with Karkade (*Hibiscus sabdariffa*) and Wheat Flour. *Cereal Chem. 75(5): 686-689.*

Ibrahim, M.E.H.; A.K. Karamall and A.H. Khattab (1971). Biochemical Studies on Karkade. *Sudan J. of Food Sci. and Tech., 3: 37-40.*

Lorenz, K.; W. Dilsover and M. Wolt (1979). Faba Bean Flour and Protein Concentrate in Baked Goods and Pasta Products. *Bakers Digest, 25 (3): 39-45.*

Muller, B.M. and G. Franz (1992). Chemical Structure and Biological Activity of Polysaccharides from *Hibiscus sabdariffa*. *Planta Med. 58(1): 60-67.*

Nadler S.B.; J.U. Hidalgo and T. Bloch (1962). The Tulane Table of Blood Volume in Normal Men. *Surgery 51: 224-232.*

Onyenekwe, P.C.; E.O. Ajani and D.A. Ameh (1999). Antihypertensive Effect of Roselle (*Hibiscus sabdariffa*) Calyx Infusion in Spontaneously Hypertensive Rat and Comparison of its Toxicity with that in Wistar Rats. *Cell Biochem. Funct. 17(3):199-206.*

S.A.S. (1996). *Statistical Analysis System.* SAS Institute , Cary NC. U.S.A.

Saeed, A. and M.O. Ahmed (1977). Storage Stability of Carbonated Beverage from Roselle Calyces (*H. Sabdariffa*). ***Sudan J. Food Sci. Tech. 9: 78-83.***

Saleh, S.A.A. (2003). ***Evaluation of Some Additives for Bakery Products as Functional Foods. pp. 39-40.*** Ph.D. thesis Fac. of Agric. Ain shams Univ., Cairo.

Sanderson, G.R.; V.L. Bell; R.C. Clark and D. Ortega (1988). The Texture of Gellan Gum Gels. ***In: Gums and Stabilizers for the Food Industry. pp: 214-229.*** Philips, G.O.; D.J. Wedlock and P.A. Williams (eds.) IRL Press, Washington, DC.

Seyam, A.A.; M.D. Breen and O.J. Banasik (1976). Study of the Use of the Unique Functional Characteristics of Wheat in Product Development. 1 Development of Durm Wheat Fortified Pasta. **Res.** ***Bull. No. 504 North Dakota***, State Univ., U.S.A.

Shrestha, A.K. and A. Noomharm (2002). Comparison of Physico-chemical Properties of Biscuits Supplemented with Soy and Kinema Flours. ***International J. of Food Sci. and Tech. 37: 361-368.***

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods. 7th Ed. Oxford and J. B.H. Publishing Co., N.Y.

Zahran, G.A.H.; A. Hussein; A.S.I. and Omaima, S.R. Shams (2002). Production of Some Healthy Bakery Products for High Blood Pressure 1-A Blend with Karkade Petals and Doum Fruit. ***Proceeding of the 4th International Conference for Food Industries-Quality Control.: 49-68.*** Alexandria, Egypt, June 11-13 2002.

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الكركديه كمصدر لزيادة محتوى البسكويت الجاف و المكرونة الشريطية (النودلز) من العناصرالمعدنية والالياف

[١١]

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استخدم مسحوق الكركديه كمصدر للألياف و العناصر المعدنية في تصنيع البسكويت الجاف و المكرونة (النودلز) بنسب ٠,٥، ١,٠، ١,٥، ٢% من وزن دقيق القمح. و تم تقيم الخواص الطبيعيةللبسكويت (الوزن والسمك والقطر والحجم و معدل الفرد و الصلابة) وكذالك الصفات الحسية مثل (المظهر و اللون والطعم والتركيب والقبول العام) .كما تم تقييم خواص الطهى و الخواص الحسية للمكرونة (اللون والطعم والرائحة و القبول العام). وقد أوضحت النتائج المتحصل عليها من هذه الدراسة زيادة المحتوى المعدنى والألياف بزيادة نسبة الأستبدال فى حين تناقصت قيم بعض الصفات الطبيعية و الحسية بزيادة هذه النسب و خلصت الدراسة الى التوصية بأن أفضل نسب الأستبدال بدقيق الكركديه فى صناعة البسكويت الجاف للوصول الى درجة مقبولة من الصفات والجودة هى نسبة ١,٥ % فى حين كانت هذه النسبة ١% فى حالة المكرونة الشريطية (النودلز).

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