*J. Food and Dairy Sci., Mansoura Univ., Vol. 2 (1): 43 - 58, 2011*

# THE EFFECT OF ADDING CARROT PEEL FIBERS AND VITAMIN A ON IRON BIOAVILABILITY IN BISCUITS

**Khalil, Mona M.*; Amalika D. Eldahshan*; R.A. Eldengawy ** and M. A. Elabsy ****.

*** Food Science Dept., Fac. Agric., Mansoura University, Egypt.**

**** Food Science Dept., Fac. Agric., Domietta, Mansoura Univ., Egypt.**

## ABSTRACT

The present work aimed to study the possibility of preparing biscuit samples made from wheat flour substituted with different levels of carrot peels 5%, 10%, 15% and 20% as a source of fibers and vitamin A. Raw materials and biscuits were analyzed chemically, physically, rheologically and organoleptically. Iron bioavailability also evaluated. The obtained results showed significant differences in moisture, protein, fat, fibers, ash and vitamin A contents in raw materials and all biscuit samples, while there were no significant differences in total carbohydrates of all biscuit samples. Biscuit sample contained 15% carrot peels showed the highest levels of Fe, Ca, and Cr significantly. Evaluation of organoleptic properties indicated that the best two samples were biscuit samples substituted with 10% and 15% carrot peels, respectively. Hematological measurements and biological results showed that biscuit samples of 10% carrot peels produced high levels of blood heamoglobin (13.40g/dl), hematocrit (43.82%), RBCs (4.980millions/ml$^3$) and serum iron (184.00µg/dl). Generally, biscuit samples contained up to 10% carrot peels in the presence of vitamin A showed good results.

## INTRODUCTION

Malnutrition may be due to protein deficiency, mineral deficiency or vitamin deficiency. Iron deficiency is the most prevalent micronutrient deficiency affecting over 2 billions of people, particularly women and children. Providing iron supplementation to school children results in improvement of selective learning and school achievements tests (FAO/WHO, 1988).

Biscuits are a popular foodstuff, consumed by a wide range of populations, due to their varied taste, long shelf life and relatively low cost. Because of competition in the market and increased demand for healthy, natural and functional products, attempts are being made to improve biscuits, nutritive value and functionality by modifying their nutritive composition. Such effects are very often achieved by increasing the ratios of wholegrain raw materials other than wheat or different types of dietary fiber in basic recipes with the attempt to increase biscuit quality, mineral content and availability [Kaur *et al*., 2007].

Carrot peels are considered by product with low cost and low caloric value which has useful roles in protection the body from some diseases. Carrot peels are a better source of dietary fiber and bioactive compounds that have an influence on its total radical trapping antioxidative potential (TRAP) value. The high content of biologically active compounds in carrots makes it preferable for dietary prevention of atherosclerosis and other diseases. [Leontowicz Hanna *et al*., 2007].

The global wheat crisis is a result of high wheat costs and lack of availability. It disproportionately affects poor people and families who spend a high percentage of their limited income on wheat. In the last decade the price of the most basic foodstuffs traded on international markets has increased sharply in every region of the world. For example, the price of wheat has doubled in less than a year. [World Bank and USDA (2008)]. Also, Sara *et al.,* (2010), demonstrated that carrot not only contains provitamin A as carotene, but also contains anthocyanins and non provitamin A carotenoids lycopene, of which both are potent antioxidants.

Therefore this investigation was designed to evaluate iron bioavailability of biscuits made from wheat flour substituted with carrot peels (as a source of fibers) at different levels 5%,10%,15% and 20% in the presence of vitamin A.

## MATERIALS AND METHODS

**Materials:**

The materials used in this study were:

**Wheat Flour:**

Wheat flour (72 % extraction) was obtained from Mills of North Cairo Company, Egypt.

**Carrot peels:**

Carrot was obtained from local market, El-Mansoura City, Egypt. Carrot peels were prepared by washing carefully, hand peeled, and dried at $70^{o}$c for 12hr, then milled using an electric mill (Broun mill type 4249) to pass through 20 mesh sieve, packed in polyethylene bags and stored in refrigerator until use.

**Experimental Animals (Rats):**

The rats were obtained from the Egyptian Organization for Biological and Vaccine production.

**Other ingredients:**

Vegetable shortening, salt (NaCl), sodium bicarbonate, sugar and dextrose were obtained from local market, El-Mansoura, Egypt. The different mixtures of minerals and vitamins used in this study were purchased from sigma Chem. Co., Cairo, Egypt.

**Methods:**

**Chemical analysis:**

Moisture, protein, fat, fiber and ash were determined for raw materials as well as the different prepared biscuit samples, according to the methods described in the AOAC (2000). Total carbohydrates were calculated by difference.

Minerals were determined according to the methods described by (Chapman&Pratt, 1978) using the atomic absorption spectrophotometer (Pye Unicum Model 3300).

Vitamin A (as carotenoids) was determined according to the method reported by Weissenberg *et al*., (1997).

**Rheological properties:**

Farinograph test was carried out on wheat flour as control and wheat flour mixtures using the method described by A.A.C.C (2000).

**Technical methods**

**Preparation of biscuits**

The flour mixtures were prepared as shown in Table (1). Biscuits containing additives were prepared using wheat flour (72% extraction) according to the procedure described by Dovaldk and Williams (1975). The basic biscuits formula was prepared according to the following ratios: wheat flour 225gm, vegetable shortening 64gm, salt (NaCl) 2.1gm, sodium bicarbonate 2.5gm, water 16gm, sugar 130gm and dextrose solution (18.9gm dextrose hydrous in 150ml water) 33gm. Biscuits were baked in continous band oven at 205ºc for 9-10 min. Biscuits samples were packed in polyethylene bags after cooling.

**Table (1): The percentage of ingredients used in biscuits formula preparation**

| No of sample | Wheat flour 72% | Carrot peels powder (g) |
|---|---|---|
| 1 | 100 | --- |
| 2 | 95 | 5 |
| 3 | 90 | 10 |
| 4 | 85 | 15 |
| 5 | 80 | 20 |

**Physical characteristics of biscuits**

The average of diameter (cm), height (cm), spread ratio (diam/ht), weight (g), volume (cc) and specific volume (cc/g) were determined according the method described by A.A.C.C (2000).

**Organoleptic evaluation of biscuits**

Appearance, Texture, Taste, Odour, color and Overall acceptability were evaluated by ten panelists according to the method described by Zabic and Hoojjat (1984).

Color Determination:

Color of different samples was measured by using a Spectro Colorimeter (Tristimulus Color Machine) with CIF lab color scale (Hunter, Lab Scan XE, Germany) According to Hunter, (1971). The color of the ground biscuits was measured in a Hunter Lab. Color difference Meter. The L, a, and b values were reported: L=lightness, a=redness, and b=yellowness. Total color difference (E) was calculated as: $\Delta E = [(\Delta L^2) + (\Delta a^2) + (\Delta b^2)]^{1/2}$.

**Bioavailability of iron:**

Depletion repletion method for biological evaluation of different prepared of biscuits was carried out according to Ranhotra *et al.,* (1983).

**Animal Experiments:**

**Animals:**

Biscuits samples were evaluated biologically using weanling male albino rats of about (23) days old and average weight (45-50gm). Rats were divided into (10) groups (5) rats for each. Rats were housed individually in wire bottomed cages and maintained at room temperature with 12 hr light and

12 hr darkness. Food and dionized water were provided ad libitum. All the procedures were carried out in the Animal Department, Faculty of Science, Mansoura University, and El-Dakahlia, Egypt. The composition of the basal depletion diet was as follows: Casein 11.20%, Cellulose 4.00%, Corn starch 66.50%, Corn oil 13.30%, Salt mixtures (iron free) 4.00%, Vitamin mixtures 1.00%. The composition of free iron mineral mixtures and vitamin mixtures were recommended by the American Institute of Nutrition (AIN, 1977).

**Depletion period:**

All animals were fed on the free iron depletion diet for four weeks until the blood hemoglobin (HB) level dropped to about 8-9 mg / 100 ml. Blood samples were collected from the tested rats throughout the experiment to determine the hemoglobin level until reached the level of iron deficiency.

**Repletion period:**

The depleted rats were fed on different prepared biscuit samples for 28 days. These biscuit samples contained different percentage of fibers. Iron content of all samples was adjusted with appropriate amount of ferrous sulfate (15 mg/100g sample). Rats were weighted weekly. Food intake was recorded daily. Blood samples were collected from the tested rats throughout the experiment. At the end of the experiment after four weeks, rats were sacrificed.

**Blood analysis:**

Five ml intravenous blood was withdrawn from each animal. 1ml was collected in a tube containing EDTA as anticoagulant and shaked well, for the determination of hemoglobin (HB), hematocrit (HCT) and red blood cells count (RBCs) value. The rest of the sample (4ml) were collected in sterilized, dry centrifuge tubes left to colt and the serum were separated after centrifugation for 10 minutes at 5000 r.p.m. Then, the serum was kept frozen at -20ºc in clean dry plastic tubes for the determination of serum iron.

The cyanmethemoglobin procedure was used to determine blood hemoglobin (HB), while hematocrit (HCT) is defined as the volume occupied by erythrocytes in a given volume of blood. It is usually expressed as volume of erythrocytes per 100ml of blood, and serum iron was determined using 2.2 di pyredyl method, also the (RBCs) values were estimated according to the method described by Dacie and Lewis (1984).

**Statical analysis:**

Data were analysis according to SAS program SAS, (1996).

## RESULTS AND DISCUSSION

**Chemical composition of raw materials and biscuits:**

The proximate chemical composition of wheat flour, carrot, peels and biscuits with and without carrot peels at levels of 5%, 10%, 15% and 20% are shown in Table (2), moisture content of raw materials varied between (3.26% to 13.26%). The highest content was in wheat flour 72% (13.26%) which approximately agree with Amer *et al.,* (2009). Mean while, the lowest content of moisture was observed in Control biscuit 100% wheat flour 72%, this result in agreement with Sudha *et al.,* (2007). It could be noticed from the same table the highest protein content was in wheat flour 72% (12.04%) followed

by carrot peels powder (6.09%). These results are agreement with those found by Hussein (2007) and Figuerola *et al.,* (2005). Fat content of raw materials in the same Table was higher in Biscuit of carrot peels 20% (26.86%), while the fat content of wheat flour 72% was (1.24%). These results gave the same attitude with Leaky (1999), Hussein (2001), Amudha *et al.,* (2009), Figuerola *et al.,* (2005) and Bayoumi (2007). The same results in Table (2) showed that carrot peels powder had the highest fiber value (9.87%), while wheat flour 72% had the lowest value (0.87%).

**Table (2): Chemical composition of wheat flour, carrot, peels and biscuits with and without carrot peels at different levels (on dry weight basis)**

| Samples | Moisture (%) | Protein (%) | Fat (%) | Fiber (%) | Ash (%) | T.C (%) | Vit A (µg RE /100g) | Caloric value (K.Cal) |
|---|---|---|---|---|---|---|---|---|
| Wheat flour 72% | 13.26$^{a}$ | 12.04$^{a}$ | 1.24$^{g}$ | 0.87$^{g}$ | 0.74$^{f}$ | 85.11$^{a}$ | --------- | 399.76 |
| Carrot peels powder | 12.47$^{b}$ | 6.09$^{f}$ | 2.05$^{f}$ | 9.87$^{a}$ | 10.48$^{a}$ | 71.51$^{b}$ | 7136.06$^{a}$ | 328.85 |
| Control biscuit 100% wheat flour 72% | 3.26$^{h}$ | 9.67$^{b}$ | 26.59$^{e}$ | 2.35$^{f}$ | 1.86$^{e}$ | 59.53$^{e}$ | 206.13$^{f}$ | 516.11 |
| Biscuit of carrot peels 5% | 4.17$^{g}$ | 8.85$^{c}$ | 26.72$^{bcd}$ | 2.45$^{e}$ | 2.22$^{d}$ | 59.76$^{c}$ | 475.26$^{e}$ | 514.92 |
| Biscuit of carrot peels 10% | 4.82$^{e}$ | 8.44$^{c}$ | 26.80$^{ab}$ | 2.54$^{d}$ | 2.48$^{c}$ | 59.83$^{c}$ | 673.15$^{d}$ | 514.12 |
| Biscuit of carrot peels 15% | 5.63$^{d}$ | 7.72$^{d}$ | 26.85$^{a}$ | 2.80$^{c}$ | 2.84$^{c}$ | 59.79$^{c}$ | 1042.13$^{c}$ | 511.69 |
| Biscuit of carrot peels 20% | 6.22$^{c}$ | 7.30$^{e}$ | 26.86$^{a}$ | 3.05$^{b}$ | 3.20$^{b}$ | 59.59$^{d}$ | 1188.44$^{b}$ | 509.3 |
| LSD 0.05 | 0.18 | 0.26 | 0.09 | 0.09 | 0.09 | 0.10 | 0.012 | --------- |

**LSD = Least Significant Difference.**
**Means with the same letter in each column are not significant different at 0.05.**

These results are agreement with Lehto *et al.,* (2005), Bayoumi (2007), Hussein (2007), and Yaseen *et al.,* (2009). Carrot peels powder had the highest content of ash (10.48%), while the lowest value of ash was in wheat flour 72% (0.74%). These results gave the same attitude with Leaky (1999), Hussein (2001), Ghoneim (2006), Hussein (2007), Chantaro *et al.,* (2008), Rupasinghe *et al.,* (2008), Hussein (2009) and Yaseen *et al.,* (2009). The results in Table (2) showed that wheat flour 72% contained the highest value of carbohydrates (85.11%), while the lowest value was in Control biscuit 100% wheat flour 72% (59.53%).These results supported by Hussein (2001), Bayoumi (2007), Hussein (2007), Rupasinghe *et al., (*2008), and Yaseen *et al.,* (2009). Vitamin A content in carrot peels powder showed the highest value (7136.06µgRE), while in wheat flour 72% was not detected. These results gave the same attitude with Sun and Temelli (2006). Caloric in Table (2) showed that the highest value was in Control biscuit 100% wheat flour 72% (516.11K.cal), while the lowest value found in carrot peels powder (328.85 K.cal). These results are agreement with Hussein (2001), Ghoneim (2006), Bayoumi (2007) and Hussein (2007).

**Minerals in raw materials and biscuits:**

The results in Table (3) showed that Na content of raw materials varied between (12.67-16.87mg). The highest value was in biscuits of apple peels powder 15% (16.87mg), while the lowest content was observed in carrot peels powder (12.67mg). It could be noticed from the same table that the highest Zn content found in carrot peels powder (3.1mg), while the lowest content was observed in wheat flour 72 % (1.7mg). From the same table the highest Ca content was found in biscuits of carrot peels powder 15% (0.64mg), while wheat flour 72 % the lowest value was observed in (12.67mg). In the same Table the highest value of Mg was found in biscuits of carrot peels powder 5% (16.87mg), while biscuits of carrot peels powder 20% had the lowest value (12.40mg). Fe content in Table (3) showed the highest value was in Biscuits of carrot peels powder 15% (6.77mg), while the lowest value showed in wheat flour 72% (1.85mg). In the same Table the highest value of Cu found in carrot peels powder (1.03mg), while the lowest value was found in biscuits of carrot peels powder 20% (0.12mg). It could be concluded that the highest Co value was in wheat flour 72% (0.37mg).While the lowest value showed in biscuits of carrot peels powder 15% (0.05mg). Also, the highest content of Cr was in wheat flour 72% (0.47mg), while the lowest value was found in biscuits of carrot peels powder 5% and 20% (0.16mg). From the same Table the highest value of Mn showed in control biscuit (1.20mg), while the lowest value was in biscuits of carrot peels powder 20% (0. 60mg).The highest Mo content in same Table showed in Control biscuit 0.83mg), while the lowest value showed in wheat flour 72% (0.17mg).

**Table (3): Minerals of wheat flour, carrot, peels and biscuits with and without carrot peels at different levels (on dry weight basis)**

| SAMPLES | Na | Zn | Ca | Mg | Fe | Cu | Co | Cr | Mn | Mo | Se |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wheat flour 72% | 13.43$^{a}$ | 1.70$^{c}$ | 12.67$^{b}$ | 14.8$^{b}$ | 1.85$^{b}$ | 0.16$^{c}$ | 0.37$^{a}$ | 0.47$^{a}$ | 0.76$^{c}$ | 0.17$^{b}$ | 0.004$^{a}$ |
| Carrot peels powder | 12.67$^{b}$ | 3.10$^{a}$ | 14.67$^{a}$ | 17.13$^{a}$ | 4.37$^{a}$ | 1.03$^{a}$ | 0.11$^{a}$ | 0.17$^{b}$ | 0.92$^{b}$ | 0.34$^{a}$ | 0.007$^{a}$ |
| Control biscuit | 16.13$^{c}$ | 1.33$^{a}$ | 42.0$^{e}$ | 16.6$^{b}$ | 2.63$^{ed}$ | 0.4$^{a}$ | 0.06$^{c}$ | 0.3$^{e}$ | 1.2$^{a}$ | 0.83$^{a}$ | 0.007$^{a}$ |
| Biscuits of carrot peels powder 5% | 16.23$^{cb}$ | 1.00$^{cb}$ | 57.0$^{c}$ | 16.87$^{a}$ | 3.67$^{d}$ | 0.16$^{d}$ | 0.06$^{c}$ | 0.16$^{e}$ | 0.97$^{b}$ | 0.33$^{d}$ | 0.011$^{a}$ |
| Biscuits of carrot peels powder 10% | 16.70$^{a}$ | 1.13$^{ab}$ | 61.7$^{b}$ | 16.47$^{b}$ | 5.37$^{b}$ | 0.16$^{d}$ | 0.12$^{b}$ | 0.5$^{d}$ | 0.95$^{b}$ | 0.50$^{c}$ | 0.014$^{a}$ |
| Biscuits of carrot peels powder 15% | 16.4$^{b}$ | 1.13$^{ab}$ | 64.0$^{a}$ | 16.43$^{b}$ | 6.77$^{a}$ | 0.24$^{c}$ | 0.05$^{c}$ | 0.83$^{b}$ | 1.13$^{a}$ | 0.50$^{c}$ | 0.004$^{a}$ |
| Biscuits of carrot peels powder 20% | 16.33$^{cb}$ | 1.2$^{ab}$ | 33.7$^{g}$ | 12.4$^{e}$ | 4.73$^{c}$ | 0.12$^{d}$ | 0.12$^{b}$ | 0.16$^{e}$ | 0.6$^{c}$ | 0.40$^{d}$ | 0.004$^{a}$ |
| LSD 0.05 | 0.24 | 0.21 | 0.23 | 0.24 | 0.26 | 0.06 | 0.03 | 0.15 | 0.16 | 0.07 | 0.02 |

**LSD = Least Significant Difference.**
**Means with the same letter in each column are not significant different at 0.05.**

Se in the same Table showed the highest value in Biscuits of carrot peels powder 10% (0.014mg), while the lowest value was in wheat flour 72% (0.004mg), biscuits of carrot peels powder 15% and biscuits of carrot peels powder 20%. These results gave the same attitude with Khalil *et al*., (2002), Ekholm *et al*., (2007), Vitali *et al*., (2007) and Sharoba et al., (2009).

**Physical properties of biscuits for different samples:**

The results in Table (4) showed that diameter value of biscuit samples fluctuated between (5.5-6.5cm). The highest value was in control biscuits (6.5cm). Mean while the lowest value was observed in biscuits of carrot peels 20% (5.5cm). It could be noticed from the same Table that the highest hight value was in biscuits of carrot peels 15% (1.30cm), while the lowest value was observed in control biscuits (1.10cm). Spread ratio in the same Table was highest in control biscuits (5.91dia/ht), while the lowest value was observed in biscuits of carrot peels 15% (4.46dia/ht). The same results in Table (4) showed that control biscuits had the highest Weight value (26.29gm), while biscuits of the of carrot peels 20% had the lowest value (24.62gm). Also it could be concluded that the highest Volume value was found in biscuits of carrot peels 15% (53.55cc), while the lowest value was observed in control biscuits (50.86cc). From the same Table the highest Specific volume value was found in biscuits of carrot peels 15% (2.15cc/gm), while the lowest value was observed in control biscuits (1.93cc/gm). All of these results gave the same attitude with Hussein *et al.,* (2008).

**Table(4): Physical properties of biscuits from different samples formulas**

| Samples | Diameter (cm) | Height (cm) | Spread ratio (diam./ht.) | Weight (g) | Volume (cc) | Specific Volume (cc/g) |
|---|---|---|---|---|---|---|
| Control biscuit 100% wheat flour (72%) | $6.5^{a}$ | $1.10^{g}$ | $5.91^{a}$ | $26.29^{a}$ | $50.86^{i}$ | $1.93^{g}$ |
| Biscuit of carrot peel 5% | $6.2^{ab}$ | $1.18^{f}$ | $5.25^{b}$ | $25.76^{b}$ | $51.76^{g}$ | $2.01^{f}$ |
| Biscuit of carrot peel 10% | $6^{c}$ | $1.26^{d}$ | $4.76^{d}$ | $25.16^{cd}$ | $52.66^{e}$ | $2.09^{d}$ |
| Biscuit of carrot peel 15% | $5.8^{c}$ | $1.30^{b}$ | $4.46^{f}$ | $24.86^{de}$ | $53.55^{a}$ | $2.15^{b}$ |
| Biscuit of carrot peel 20% | $5.5^{cd}$ | $1.22^{e}$ | $4.50^{e}$ | $24.62^{e}$ | $52.25^{f}$ | $2.12^{c}$ |
| LSD 0.05 | 0.34 | 0.009 | 0.009 | 0.33 | 0.009 | 0.01 |

**LSD = Least Significant Difference.**
**Means with the same letter in each column are not significant different at 0.05.**

**Color characteristics of biscuits**:

Table (5) showed that color characteristics of biscuits from different samples (color characteristics is one of the major parameters that affect the quality of the final product). Table (5) shows Hunter values of whiteness (L), redness (a) and yellowness (b) measured for crust and crumb color. All biscuits samples had slightly lower L values for crust than the control samples and a slightly dark crumb color. The highest value of lightness for crust was shown in control biscuits (85.07), while the lowest value showed in biscuit or carrot peels 20% (57,84). From the same Table, it is seen that, the highest value of redness (a) for crust was shown in biscuit of carrot peels 20% (11.16), while the lowest value was found in biscuits of carrot peels 5% (7.25). It is seen from the same Table that the highest yellowness (b) value was found in biscuits of carrot peels 10% (37.41), while the lowest value

showed in control biscuits (32.37). The ΔE value for crust in table (5) showed that the highest value was found in control biscuit (91.42), while the lowest ΔE value for crust was presented in biscuits of carrot peels 15% (73.18). The same results in Table (5) showed that the highest value of lightness for crumb was in biscuits of control biscuits (58.66), while the lowest value showed in biscuits of carrot peels 20% (45.77). From the same Table, it is seen that, the highest value of redness (a) for crumb was presented in biscuits of carrot peels 15% (17.12). Also, Table (5) shows that, the highest value of yellowness (b), for crumb was in control biscuits (39.85), while the lowest value showed in biscuits of carrot peels 5% (36,47). The ΔE value for crumb in Table (5) showed that the highest value was in control biscuits (72.89), while the lowest ΔE value showed on biscuit of carrot peels 15% (68.90). These results agree very well with Hussein (2007) and Hussein *et al.* (2008).

**Table (5): Color characteristics of biscuits from different samples formulas**

| Samples | Crust | | | | Crumb | | | |
|---|---|---|---|---|---|---|---|---|
| | L | a | b | ΔE | L | a | b | ΔE |
| Control biscuits 100% wheat flour (72%) | $85.07^{a}$ | $8.53^{e}$ | $32.37^{h}$ | $91.42^{a}$ | $58.66^{b}$ | $16.88^{e}$ | $39.83^{a}$ | $72.89^{a}$ |
| Biscuits of carrot peels 5% | $77.39^{b}$ | $7.25^{g}$ | $36.57^{b}$ | $85.90^{b}$ | $57.75^{c}$ | $15.13^{f}$ | $36.47^{h}$ | $70.38^{b}$ |
| Biscuits of carrot peels 10% | $69.66^{g}$ | $10.75^{b}$ | $37.41^{a}$ | $79.80^{e}$ | $57.54^{d}$ | $14.37^{g}$ | $36.55^{g}$ | $69.59^{d}$ |
| Biscuits of carrot peels 15% | $63.42^{h}$ | $9.71^{c}$ | $35.19^{c}$ | $73.18^{h}$ | $55.72^{e}$ | $17.12^{d}$ | $36.75^{f}$ | $68.90^{e}$ |
| Biscuits of carrot peels 20% | $57.84^{i}$ | $11.16^{a}$ | $35.03^{d}$ | $68.54^{i}$ | $45.77^{i}$ | $13.71^{h}$ | $37.75^{d}$ | $69.71^{c}$ |
| L.S.D 0.05 | 0.03 | 0.01 | 0.01 | 0.04 | 0.01 | 0.01 | 0.01 | 0.05 |

**L = lightness (100 = white; 0 = black), a = redness (+100) to green (-80), b = yellowness (70) to blue (-80),** $\Delta E = (\Delta L^2 + \Delta a^2 + \Delta b^2)^{1/2}$

**LSD = Least Significant Difference.**

**Means with the same letter in each column are not significant different at 0.05.**

**Farinograph parameters of dough prepared from different formulas:**

The results in Table (6) showed that Water absorption of wheat flour mixture doughs varied between (64.5-72.5%). The highest value was in wheat flour mixture of carrot peels 20% (72.5%), while the lowest value was observed in wheat flour mixture (64.5%). This result in agreement with El Soukkary (2008). It could be noticed from the same Table that the highest value of arrival time found in wheat flour mixture of carrot peels 20% (9min), while the lowest value was observed in wheat flour mixture of carrot peels 5% (2.25min). But the arrival time value of wheat flour dough was (2.50min). Dough development time of wheat flour mixture was highest in wheat flour mixture of carrot peels 20% (10min), while the lowest value was observed in wheat flour mixture of carrot peels 5% (5.50min). But the dough development time value of wheat flour dough was (6min). From the same table the highest stability time value was found in wheat flour mixture of carrot peels 10%

(11min), while the lowest value was observed in wheat flour mixture of carrot peels 15% and 20% was (9.0min). But the stability time value of wheat flour dough was (10.5min). In the same table the highest weakning value was found in wheat flour mixture (120BU), while the lowest value was observed in wheat flour mixture of carrot peels 20% was (60BU). But the weakning value of control biscuits was (120BU). It could be concluded that the highest value of mixing tolerance index was found in wheat flour mixture of carrot peels 15% was (60BU), while the lowest value was observed in wheat flour mixture of carrot peels 20% was (30BU). But the mixing tolerance of wheat flour dough was (40BU). These results are agreement with Hussein *et al.,* (2008).

**Table (6): Farinograph parameters of dough prepared from different samples formulas**

| Samples | Water absorption (%) | Arrival time (min) | Dough developm-ent time (min) | Stability time (min) | Weakning (BU) | Mixing tolerance index(BU) |
|---|---|---|---|---|---|---|
| Control biscuit 100% wheat flour 72% | 64.5e | 2.50$^{d}$ | 6.0$^{e}$ | 10.5$^{a}$ | 120$^{d}$ | 40.0$^{h}$ |
| Biscuit of carrot peel 5% | 66.0$^{d}$ | 2.25$^{d}$ | 5.5$^{e}$ | 9.5$^{b}$ | 100$^{e}$ | 42.5$^{g}$ |
| Biscuit of carrot peel 10% | 68.0$^{c}$ | 3.00$^{d}$ | 7.0$^{cd}$ | 11.0$^{a}$ | 80.0$^{f}$ | 50.0$^{f}$ |
| Biscuit of carrot peel 15% | 69.5$^{b}$ | 4.50$^{c}$ | 7.0$^{bc}$ | 9.0$^{b}$ | 70.0$^{g}$ | 60.0$^{e}$ |
| Biscuit of carrot peel 20% | 72.5$^{a}$ | 9.00$^{a}$ | 10.0$^{a}$ | 9.0$^{b}$ | 60.0$^{h}$ | 30.0$^{i}$ |
| LSD 0.05 | 0.87 | 0.74 | 0.87 | 0.87 | 0.99 | 0.93 |

**LSD = Least Significant Difference.**
**Means with the same letter in each column are not significant different at 0.05.**

**Sensory evaluation of biscuits from different samples:**

The results in Table (7) showed that the highest score of color was in control biscuits (8.6±0.96), while the lowest score was in biscuits of carrot peels 20% (6.0±1.33). These results are agreement Omobuwajo (2003), Sudha *et al.,* (2007), Ajila *et al.,* (2008) and Ibrahium and Hegazy (2009). In the same Table the highest Flavor score showed in control biscuits (8.5±0.84), this result supported by Ajila *et al.,* (2008), Hussein *et al.,* (2008) and Ibrahium and Hegazy (2009), while the lowest score was found in biscuits of carrot peels 20% (7.3±1.33). It could be noticed from the same Table that the highest Taste score was found in control biscuits (8.5±0.85). These results according to Hussein (2007), Hussein *et al.,* (2008) and Ibrahium and Hegazy (2009), while the lowest score was in biscuits of carrot peels 20% (7.1±1.52). Also, results in the same table showed that the highest Texture score was found in control biscuits (8.3±1.25), this result gave the same attitude with Hussein (2007), Tyagi *et al.,* (2007), Ajila *et al.,* (2008), Hussein *et al.,* (2008) and Ibrahium and Hegazy (2009), while the lowest score was showed in biscuits of carrot peels 20% (7.5±1.08). It could be concluded that the highest Appearance score was found in control biscuits (8.6±0.97), these results are agreement with Hussein (2007), Ajila *et al.,* (2008), Hussein *et al.*, (2008) and Ibrahium and Hegazy (2009) and Nazni *et al.,* (2010), while the lowest score was showed in biscuits the carrot peels 20% (6.4±1.58). Overall acceptability from the same table cleared that

the highest Appearance score was found in control biscuits (8.3±0.82), these results gave the same attitude with Omobuwajo (2003), Hussein *et al.,* (2008) , Hussein (2007), Ajila *et al.,* (2008) and Ibrahium and Hegazy (2009). While the lowest score was showed in biscuits of carrot peel 20% (6.4±1.07).

**Table (7): Sensory evaluation of biscuits from different samples formulas**

| Samples | Color (10) | Flavor (10) | Taste (10) | Texture (10) | Appearance (10) | Overall acceptability (10) | Total Score (60) |
|---|---|---|---|---|---|---|---|
| Control biscuit 100% wheat flour (72%) | 8.6±0.96$^{ab}$ | 8.5±0.84$^{a}$ | 8.5±0.85$^{a}$ | 8.3±1.25$^{a}$ | 8.6±0.97$^{a}$ | 7.7±0.82 | 50.2 |
| Biscuit of carrot peel 5% | 7.6±0.96$^{bc}$ | 8.1±0.73$^{ab}$ | 7.8±1.14$^{abc}$ | 7.8±1.14$^{d}$ | 8.3±1.42$^{a}$ | 7.8±1.03 | 46.1 |
| Biscuit of carrot peel 10% | 6.4±1.26$^{df}$ | 7.6±1.17$^{ab}$ | 7.6±0.70 $^{abc}$ | 7.6±1.17$^{e}$ | 7±1.41$^{bcd}$ | 8.1±1.37 | 50.5 |
| Biscuit of carrot peel 15% | 6.3±1.06 $^{df}$ | 8±1.41$^{ab}$ | 7.2±1.22$^{bc}$ | 7.8±1.03 $^{d}$ | 6.9±1.44$^{cd}$ | 8.1±1.45 | 49.35 |
| Biscuit of carrot peel 20% | 6±1.33$^{f}$ | 7.3±1.33$^{b}$ | 7.1±1.52$^{c}$ | 7.5±1.08$^{f}$ | 6.4±1.58$^{d}$ | 7.5±1.50 | 47.7 |
| LSD 0.05 | 1.03 | 0.99 | 1.04 | --- | 1.21 | 1.13 | 2.53 |

**LSD = Least Significant Difference.**
**Means with the same letter in each column are not significant different at 0.05.**

**The effect of experimental biscuit samples on weight gain, feed intake and feed efficiency after 28 days:**

The results in Table (8) showed that Initial body weight value of experimental biscuit samples varied between (51 to 64g). The highest value was for rats fed on biscuits of carrot peels 5% (64g). Meanwhile the lowest value was found for rats fed on biscuits of carrot peels 20% (51g). But the control biscuits contained (59g). While the basal diet contained (54g). It could be concluded that the highest final body weight was found in biscuits of carrot peels 10% (90g), while the lowest value was found in basal diet contained (67g).

**Table (8): The effect of experimental biscuit samples on body weight gain, feed intake and feed efficiency after 28 days**

| SAMPLES | Initial body weight (g) | Final body weight (g) | Body weight gain (g) | Feed intake (g) | Feed efficiency (FE) |
|---|---|---|---|---|---|
| Basal diet (casein) | 54.0$^{g}$ | 67$^{f}$ | 13$^{e}$ | 103.2$^{i}$ | 0.126$^{b}$ |
| Control biscuit 100% wheat flour 72% | 59.0$^{f}$ | 82$^{d}$ | 23$^{a}$ | 190.9$^{e}$ | 0.120$^{b}$ |
| Biscuit of carrot peel 5% | 64.0$^{b}$ | 82$^{d}$ | 18$^{c}$ | 200.7$^{d}$ | 0.090$^{b}$ |
| Biscuit of carrot peel 10% | 75.0$^{a}$ | 90$^{b}$ | 15$^{d}$ | 204.5$^{c}$ | 0.073$^{b}$ |
| Biscuit of carrot peel 15% | 60.0$^{e}$ | 70$^{e}$ | 10$^{f}$ | 175.8$^{f}$ | 0.057$^{b}$ |
| Biscuit of carrot peel 20% | 51.0$^{h}$ | 60$^{g}$ | 09.0$^{f}$ | 161.3$^{h}$ | 0.056$^{b}$ |
| LSD 0.05 | 0.78 | 2.42 | 1.06 | 0.73 | 0.23 |

**LSD = Least Significant Difference.**
**Means with the same letter in each column are not significant different at 0.05.**
**Feed efficiency (FE) was calculated using the following equation according to A.O.A.C (2000):- FE = Gain in body weight (g) / Feed intake (g).**

But the control biscuits contained (82g). gain body weight in the same table showed that highest value was found in control biscuits (23g), while the lowest value was found in carrot peels 20% (9.0g). While the basal diet contained (13g). From the same Table the highest feed intake value showed in biscuits of carrot peels 10% (204.5g), while the lowest value showed in biscuits of in Basal diet contained (103.2g). But the control biscuits contained (190.9g). Feed efficiency ratio in the same Table showed that the highest value was in basal diet (casein) (0.126), while the lowest value showed in biscuits of carrot peels 20% (0.056). But the control biscuits contained (0.120).

**Hematological measurements of rat's blood after depletion and after repletion of iron:**

The results in Table (9) showed that all rats except basal diet (casein) group were anemic at zero time with no differences between values of HB, HCT, RBCs and serum iron in all groups under investigation, since the HB levels were found to be between (8.23 to8.28g/dl) and HCT values were between (25.32 to 25.83%), while RBCs and serum iron values were between (4.000 to 5.400 millions/ml$^3$) and (95.00 to 99.18µ/dl), respectively. These results are agree with Ahmed (2003) and Saleh *et al.,* (2007).

**Table (9): Measurements of rat's blood after depletion and after repletion of iron**

| Measurements | | Samples No. | | | | | | LSD 0.05 |
|---|---|---|---|---|---|---|---|---|
| | | Basal diet (casein) | (1) | (2) | (3) | (4) | (5) | ------- |
| After depletion | Hb (g/dl) | 14.87$^a$ | 8.28$^b$ | 8.2$^b$ | 8.25$^b$ | 8.27$^b$ | 8.23$^b$ | 1.05 |
| | Hct (%) | 45.00a | 25.83b | 25.8$^b$ | 25.63b | 25.44b | 25.32b | 8.9 |
| | Serum iron (µg/dl) | 188.36a | 99.18b | 99.0$^b$ | 98.10c | 97.70d | 95.00f | 27.5 |
| | RBCs (millions/ml$^3$) | 6.315a | 4.420c | 5.40$^b$ | 4.900c | 4.110c | 4.000c | 106.2 |
| After repletion | Hb (g/dl) | 16.00a | 11.52d | 13.4$^b$ | 13.00b | 12.32c | 12.00c | 4.60 |
| | Hct (%) | 62.00a | 38.90g | 43.8$^b$ | 41.00d | 40.19e | 39.77 | 12.13 |
| | Serum iron (µg/dl) | 198.54a | 166.13 | 184.0$^b$ | 181.98c | 173.00f | 165.85g | 42.13 |
| | RBCs (millions/ml$^3$) | 8.466a | 5.240b | 4.9$^c$ | 4.000c | 3.280d | 2.890e | 174.2 |

**(1): Control biscuit 100% wheat flour 72%. (2): Biscuit of carrot peel 5%.**
**(3): Biscuit of carrot peel 10%. (4): Biscuit of carrot peel 15%.**
**(5): Biscuit of carrot peel 20%. (6): Biscuit of apple peel 5%.**
**(7): Biscuit of apple peel 10%. (8): Biscuit of apple peel 15%.**
**(9): Biscuit of apple peel 20%.**
**Hb: Heamoglobin (normal value = 12-15g/dl).**
**Hct: Hematocrit (normal value = 40-45%).**
**RBCs: Red Blood Cells Count (normal = 6.30- 8.23million/ml$^3$).**
**Normal Serum Iron = (185-200µg/dl).**
**Means with the same letter in each column are not significant different at 0.05.**
**LSD: Least Significant Difference.**

The results in the same Table showed that group fed on sample No. (2) [95% wheat flour 72% + 5% carrot peels powder] scored the highest heamoglobin level (13.40g/dl) compared with the rest samples except the basal diet group. Hematocrit (HCT) is a reflected value of red blood cells count (RBCs) and its content of HB, since the increment of HCT refers to an increasing in RBCs number and their content of heamoglobin (HB). Generally, rats fed on sample No. (2) [95% wheat flour 72% + 5% carrot peels powder] had the highest HCT value (43.82%) as compared with basal diet group (62%). This is may be due to the high level heamoglobin (HB) in the blood of that group. On the other hand, rats fed on sample No. (5) [80% wheat flour 72% + 20% carrot peels powder] showed the lowest value of HCT this may be due to low values of heamoglobin (HB) and red blood cells count (RBCs) for this sample as supported by Khalil *et al.,* (2002). For the red blood cells count (RBCs) in the same table, it was clear that there were differences between the basal diet (casein) and different samples. The highest value was found in sample No. (1) [Control biscuits of wheat flour 72%] (5.240million/ml$^3$) as compared with basal diet group (8.466 million/ml$^3$), while the lowest value was found in sample No. (5) [80% wheat flour 72% + 20% carrot peels powder] (2.890million/ml$^3$). Also, the same data in Table (16) indicated that group of rats fed on sample No. (2) [95% wheat flour 72% + 5% carrot peels powder] (184.00µg/dl) as compared with basal diet group (198.54µg/dl), while the lowest value was showed in sample No. (5) [80% wheat flour 72% + 20% carrot peels powder] (165.85µg /dl).

**Conclusion**

Biscuit samples contained up to 10% followed by 15% carrot peels in the presence of vitamin A showed the best results.

## REFERENCES

AIN (1977). Report of the American Institute of Nutrition Ad Hod Committee on Standards for Nutrition Studies. J. Nut. 107:1370.

A.A.C.C. (2000). Approved Method of the American Association of Cereal Chemists, 10th edn. St. Paul , Minnesota , USA.

A.O.A.C. (2000). (Association Official Analytical Chemists) Official Methods of Analysis of AOAC International, 17th edn. By Horwitz, W. Suite 500, 481 North Fredric avenue Gaithersburg, Maryland 20877-2417, USA.

Ahmed Mohamed Bedear Mohamed (2003). Studies on clinical nutrition. Food Industries Department, Faculty of Agriculture, Mansoura University., Egypt.

Ajila C.M., K. Leelavathi, U.J.S. Prasada Rao. (2008). Improvement of dietary fiber content and antioxidant properties in soft dough biscuits with the incorporation of mango peel powder. Journal of Cereal Science 48; 319-326.

Amer, Thanna A. M.; S. L. L. Louz and Mona M. M. Doweidar., (2009). Biochemical and technological evaluation of biscuits supplemented with nutritional plant sources rich in antioxidants. J. Agri. Sci. Mansoura Univ. ., 34 (4): 2953-2967.

Amudha, O.s.1, Giwa, A.A.1 Bello, LA. , Abdus-Salam, N.2 and Adelowo, F.E.1. (2009). SOME REA VY METALS lK lJRRBA.LA; D RURAL TOPSOILS OF IBADAN, NIGERIA. Int. J. Cltem. Sci. Vol. 2 NO.1; ISSN: 2006-3350.

Bayoumi Doaa El Said Bayoumi. (2007). Fortification of some foods with natural sources of vitamins A and E. Food Science Department Faculty of Agriculture, Ain Shams University.,Egypt.

Chapman HD, Pratt PF (1978). Methods of Analysis for Soils, Plants and Waters. Division of Agriculture Sciences, University of California, Davis, pp. 162-65.

Chantaro Prawta, Devahastin Sakamon and Chiewchan Naphaporn. (2008). Production of antioxidant high dietary fiber powder from carrot peels, Department of Food Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, 126 Pracha u-tid Road, Bangkok 10140, Thailand LWT- Food Science and Technology 41; 1987-1994

Dovaldk, T. Ph. D. and Williams, J. S. (1975). Food products formulary. The Avi Publishing Company, Inc, West Port, Connecticut, USA, 275.

Dacie, J. V. and S. M. C. Lewis (1984). Parctical Heamatology. A collaborative analysis of improved procedure. Churchill livingstone. Edinburch, London, Melbourne and New York.

Ekholm Paivi, Heli Reinivuo, Pirgo Mattila, Heikki Pakkala, Jani Koponen, Anu Happonen, Jarkko Hellstrom, Marja Leena Ovaskainen. (2007). Changes in the mineral and trace element contents of cereals, fruits and vegetables in Finland. Journal of Food Composition and Analysis (20) 487-495.

El Soukkary. F.A.H (2008). Quality characteristics of bread made from composite flours of wheat, corn, barley and fenugreek. J. Agric. Sci. Mansoura Univ.,Egypt. 33(4): 2703-2716.

FAO/WHO (1988). Requirements of vitamin A, iron, folat and vitamin $B_{12.}$ FAO/WHO Series No. 23 .(FAO Food and Nutrition Series, No. 23).

Figuerola Fernando, Maria Luz Hurtado, Ana Maria Esteves, Italo Chiffelle and Fernando Asenjo (2005). Fiber concentrates from apple pomace and citras peel as potential fiber sources for food enrichment. Food chemistry (91): 395-401.

Ghoniem Gehan Ali Awad. (2006). Evaluation of some plant foods as antioxidants and anticarcogenic sources. Food Science Department Faculty of Agriculture, Mansoura University., Egypt.

Hunter G. D. (1971). An experimental examination of the scrapie agent in cell membrane mixtures. III. Studies of the operational size. J. Comp. Pathol. 81:383-391.

Hussein, Nadia. M. A. (2001). Studies on improving the nutritional value of some types of bread. Ph.D. Thesis, Food Science and Tech. Dept., Fac. of Agric., Cairo Univ., Egypt.

Hussein, A.M.S (2007). Chemical rheological and quality properties of biscuits supplemented with fenugreek flours. J. Agric. Sci. Mansoura Univ., Egypt 32 (12): 10245-10255.

Hussein A. M. S., Zeinab A. Saleh., I. H. Badawy and F.A. El Shobaki (2008). Rheological and sensory evaluation of some snacks modified to improve their nutritive and health value. J. Agric. Sci. Mansoura Univ., Egypt 33 (1): 321-330.

Hussein, M.A., M.A. Abou Raya, Manal F. Salama and A.M. Elmahdy (2009). Studies on special bread made from different mixtures. J. Agric. Sci. Mansoura Univ. Egypt, 34 (10): 10015-10031.

Ibrahium. M. I. and Hegazy. A. I (2009). Iron Bioavailability of Wheat Biscuit Supplemented by Fenugreek Seed Flour. World Journal of Agriculture Sciences 5 (6):769-776.

Khalil, Mona M., M. A. Hussein, A. E. Kassem, M. A. Abou Raya, and A. M. Abd El Monem. (2002). Studies on modified baby foods & Bioavilability of iron, calcium and vitamin A. J. Adv, Agric. Res. Vol. (7). No. (4). 731-745.

Kaur, (2007). Effect of mustard flour incorporation on nutritional, textural and organoleptic characteristics of biscuits. Journal of Food Engineering, 80, 1043-1050.

Leakey R.R.B. (1999). Potential for novel food products from agroforestry trees: A review. Food Chemistry, 66, 1-14.

Lehto M., S. Sorvala, R. Kemppainen, T. Salo, and M. Puumala. (2005). Wastes and Wastewaters from Vegetable Peeling Processes. FRUTIC 05, 12 – 16 September 2005, Montpellier France. Information and Technology for Sustainable Fruit and Vegetable Production

Leontowicz Hanna, Maria Leontowicz, Shela Gorinstein, Olga martin Belloso, Simon Trakhtenberg. (2007). Apple peels and pulp as a source of bioactive compounds and their influence on digestibility and lipid profile in normal and atherogenic rats Medycyna Wet. 63 (11) Suplement.

Nermin Bilgicli, Senol Ibanoglu and Emine Nur Herken. (2007) Effect of dietary fiber addition on the selected nutritional properties of cookies. Journal of food Engineering 78; 86 - 89.

Nazni Peerkhan, Subramanian Pradheepa, Abul Hasan. (2010). Effects of weaning biscuits on the nutritional profile and the cognitive development in preschool children. Italian Journal of Pediatrics, 36:18http://www.ijponline.net/content/36/1/18

Omobuwajo Taiwo Olusegun.(2003). VOYAGE OF GLOBAL DISCOVERY VIA THE FOOD ENGINEERING PATHWAY. OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA Inaugural Lecture Series 232.

Ranhotra, G. S.; J. Gelroth, F. Novak, A. Bock and F. Bohannan (1983). Iron enriched bread interaction effect of protein quality and copper on iron bioavailability. J. Food Sci.43:1426-1428.

Rupasinghe H.P. Vasantha, Laixin Wang, Gwendolyn M. Huber, Nancy L. Pitts. (2008). Effect of baking on dietary fiber and phenolics of muffins incorporated with apple skin powder. Food Chemistry 107; 1217–1224.

SAS. (1996): Statical analysis system. In A. A. Ray (Ed.), users guide Cary, NC: SAS Institute, Inc.

Sun Mei and Feral Temelli. (2006). Supercritical carbon dioxide extraction of carotenoids from carrot using canola oil as a continuous co solvent. The Journal of Supercritical Fluids. Vol. 37, issue 3, May 2006 pages 397-408.

Sudha M.L., V. Baskaran, K. Leelavathi. (2007) a. Apple pomace as a source of dietary fiber and polyphenols and its effect on the rheological characteristics and cake making. Food Chemistry 104; 686–692.

Sudha M. L., R. Vetrimani, K. Leelavathi. (2007) b. Influence of fiber from different cereals on the rheological characteristics of wheat flour dough and on biscuit quality. Food Chemistry (100) 1365-1370.

Saleh, Zeinab A.; Khadiga S. Ibrahim ; A. H. Farrag and Eman E. Shaban. (2007). Effect of carrot and wheat germ oil supplementation on rats exposed to benzene. J. Agri. Sci. Mansoura Univ. Egypt., 32 (12): 10153-10165.

Sharoba, A. M. A; A. I. El Desouky; M. H. M. Mahmoud and Kh. M. Youssef. (2009). Quality attributes of some breads made from wheat flour substituted by different levels of whole amaranth meal. J. Agri. Sci. Mansoura Univ. Egypt ., 34 (6): 6413-6429.

Sara A. Arscott and Sherry A and Tanumihardjo. (2010). Carrots of Many Colors Provide Basic Nutrition and Bioavailable Phytochemicals Acting as a Functional Food. Vol. 9, COMPREHENSIVE REVIEWS IN FOOD SCIENCE AND FOOD SAFETY.

Tyagi S.K., M.R. Manikantan, Harinder Singh Oberoi and Gurlen Kaur. (2007). Effect of mustard flour incorporation on nutritional, textural and organoleptic characteristics of biscuits Journal of Food Engineering. Volume 80, Issue 4, June 2007, Pages 1043-1050.

Vitali.D., I. Vedrina Dragojevic, B. Sebecic. (2009). Effects of incorporation of integral raw materials and dietary fiber on the selected nutritional and functional properties of biscuits. Food Chemistry (114). 1462-1469.

World Bank,http://www.worldbank.org. United States Department of Agriculture (USDA)., (2008). http://www.usda.gov.

Weissenberg, M.; Schaeffler, I.; Menagem, E.; Barzilai, M.; Levy, A. (1997). Isocratic non-aqueous reversed-phase high-performance liquid chromatographic separation of capsanthin and capsorubin in red peppers (Capsicum annuum L.), paprika and oleoresin. J. Chromatogr. 757, 89-95.

Yaseen, A.A.; A.A. Shouk and Ferial M. Abousalem (2009). Effect of okara addition on bread quality. J. Agric. Sci. Mansoura Univ., Egypt, 34 (12): 11147-11155.

Zabic, M. E. & Hoojjat, P. (1984). Sugar shap cookies prepard with wheat navybean sesame seed flower blends. Creal Chem., 61:41-4.

**تأثير إضافة ألياف قشور الجزر و فيتامين (أ) على التيسير الحيوى للحديد فى البسكويت**

**منى محمـود خليل*، أماليكا درويش الدهشـان*، رزق أحمد الدنجـاوي** و محمد عبد السلام العبسي ****

*** قسم الصناعات الغذائية – كلية الزراعة – جامعة المنصورة - مصر.**

**** قسم الصناعات الغذائية – كلية الزراعة بدمياط – جامعة المنصورة – مصر.**

أستهدف هذا البحث دراسة عينات مختلفة من بسكويت دقيق القمح المدعم بمستويات مختلفة من قشور الجزر بنسب ٥%، ١٠%، ١٥% و ٢٠% كمصدر للألياف وفيتامين (أ).وقد تم تقييم المواد الخام وعينات البسكويت المختلفة كيميائيا ، فيزيائيا، ريولوجيا، حسيا، وبيولوجيا.، وأوضحت النتائج وجود فروق معنوية بين المواد الخام وعينات البسكويت المختلفة من حيث نسبة الرطوبة، البروتين، الدهن، الألياف، وفيتامين (أ)، بينما لم توجد أي فروق معنوية بين عينات البسكويت المختلفة من حيث نسبة الكربوهيدرات. ولوحظ من النتائج أن عينة البسكويت المحتوية على ١٥% قشور جزر حققت أعلى مستويات في الحديد، الكالسيوم، والكروم.، وأوضح التقييم الحسي أن أفضل عينتين كانتا عينتان البسكويت المدعمتين ب ١٠% و ١٥% قشور جزر على الترتيب. كما أوضحت النتائج البيولوجية أن عينة البسكويت المدعمة ب ١٠% قشور جزر حققت أعلى مستوى في نتائج هيموجلوبين الدم (١٣.٤٠ جم/ديسليتر)، الهيماتوكريت (٤٣.٨٢%)، خلايا الدم الحمراء (٤.٩٨٠ مليون/مل٣)، وحديد السيرم (١٨٤ ميكروجرام/ديسليتر). ومن النتائج السابقة يتضح أن عينة البسكويت المحتوية على ١٠% قشور جزر في وجود فيتامين (أ) حققت أفضل النتائج.

**قام بتحكيم البحث**

| | |
|---|---|
| **أ.د / محمد عبد الحليم محمد حسين** | **كلية الزراعة – جامعة المنصورة** |
| **أ.د / عبد الجواد محمد الشواف** | **معهد الكفاية الإنتاجية بالزقازيق** |