Contents

List of abbreviations

Approx	Approximately
AsA	Ascorbic acid
BHA	Butytated hydrox anisole
BHT	Butalated hydroxyl toluene
C	Degree centigrade
C.A.A	Coated ascorbic acid
cm	Centimeter
CP	Carrot powder
Cp	Centipoises
Concn	Concentration
dl	Dice liter
e.g.	For example
g	Gram (s)
GOT	Aspartate transaminese
Gp	Guava powder
GPT	Alanine aminotransferase
HDL	High density lipoprotein
Hrs	Hour (s)
i.e.	That is
L	Liter
LDL	Low density lipoprotein
min	Minute
mm	Millimeter
ml	Milliliter
O.D	Optical density
ppm	Part per million
r.p.m	Revolution per minute
µ	Micron
U.S.	United States
Vit A	Vitamin C
Vit C	Vitamin E
Vit E	Vitamin A
Wg	Wheat germ

5. SUMMARY

The present study was carried out to investigate the technological process of some innovated bakery products; pretzels and Snap-cookies. Fortification of the innovated bakery products with antioxidant (β-carotene, α-tocopherol and Fat-coated ascorbic acid) and natural sources; foam-mat dried carrots (as source of β-carotene), wheat germ (as source of α-tocopherol) and foam-mat dried guava (as source of ascorbic acid) were studied. The effect of raw materials, processing technology and addition of antioxidants on physio-chemical properties of dough and products was evaluated. Factors affecting antioxidant stability temperature and pH on model systems, as well as biological attributes of antioxidants were also studied.

1. Technological processing of innovated bakery products

a) Pretzels processing

1. Pretzels produced from flour contained (10.56% protein and 31.0% wet gluten) had the best quality characteristics than those produced using flour contain (12% protein and 41.0% wet gluten)

2. Texture and color of pretzels were affected by dipping in different caustic solutions (sodium hydroxide, calcium hydroxide and sodium bicarbonate) at different concen-trations. Pretzels texture and color increased by increasing the concentration of all caustic solution. Pretzels dipped in sodium hydroxide were the best.

3. Hunter colorimeter results for pretzel dipped in sodium hydroxide was the best L*-value than that dipped in calcium hydroxide, sodium bicarbonate and water. The concentrations of sodium hydroxide have a significant effect on color degree of pretzels. Pretzels color (L*-value) increased by increasing sodium hydroxide concentrations. The L*-value were 62, 48, 36, 32 and 30 at 0.25, 0.5, 1.0, 1.5, and 2.0% of sodium hydroxide respectively.

4. The degree of starch gelatinization during baking was influenced by levels and type of caustic solution (sodium hydroxide, calcium hydroxide and sodium bicarbonate) and consequently influenced on pretzels quality.

5. Concerning the sensory evaluation of pretzels, sodium hydroxide was the most acceptable in sensory evaluation then sodium bicarbonate, calcium

hydroxide and the last one was that dipped in water as a control. Sodium hydroxide concentrations have an effect on pretzels quality. The best color was in pretzels dipped in concentration of 1.0% sodium hydroxide. In comparison with 1% NaOH, the concentrations of 0.25 and 0.5% were lighter in color and texture. However, concentrations 1.5 and 2.0% of sodium hydroxide gave darker color and obvious alkaline taste for pretzels.

6. The conclusion of the experimental alkaline-immersion in 1% NaoH as optimums are: Temperature 90ºC, for 10-15 sec.

7. Concerning baking temperature of pretzels. The best was:-Baking at 300ºC for 4 min. moisture content 17%

-Drying at 150ºC for 15 min. moisture content 2%

8. Moisture content in dough was 58% and increased to 64 % after cooking in caustic solutions. During baking, moisture content rapidly reduced to 17%, then pretzel was dried to final moisture content 2%.

b) Cookies processing

1. Cookies produced using high protein content flour have weight and height (30.8 g and 13.5 mm) higher than that produced using low protein content flour

(27.3 g and 12.5 mm), respectively. On the other hand, cookies produced using low protein content flour was have higher diameter value and spread factor (74.5mm and 59.6) than that produced using high protein content flour (69.5 mm and 51.50), respectively. That means flour with low protein content is more suitable in producing cookies of acceptable quality concerning dimensions.

2. Cookies produced using flour with low protein content was higher on sensory evaluation scores than that produced using high protein content.

3. Cookies texture-hardness was increased by increasing flour protein content. It found to be 19.1 kg/cm^2 when flour protein content was 7%, while it was 25.4 kg/cm when protein content increased to 12%.

4. Cookies produced using granulated sugar has lower weight than that produced using powdered sugar; it was 27.3g and 28.6g, respectively. On the other hand. Diameter, height and spread factor of cookies produces by using granulated sugar were higher than that produced by using powder sugar. They were 74.5 mm, 12.5 mm and 59.6 for granulated

sugar and they were 70.5 mm, 12.0 mm and 58.75 for powdered sugar, respectively.

5. Ideal baking condition for cookies was found to be 205ºC for 10 min.

6. Sensory characteristics for produced cookies by using granulated sugar were higher than that produced by using powdered sugar. The surface appearance, internal appearance, eating characteristic and total scour were 20.8, 19.5, 20.0 and 60.3 for cookies with granulated sugar, while they were 18.7, 17.6, 19.5 and 55.8 for cookies with powdered sugar, respectively.

7. Concerning to starch gelatinization there are few amount of degradation starch granule in flour due to the milling process. While, in baked cookies there are many gelatinized starch granules. The gelatinization percentage in baked cookies was lower than in pretzels.

2. Physio-chemical properties and stability of antioxidant

1. Chemical composition of natural antioxidant sources; wheat germ contain 9.35% oil, this oil is very rich in (α-tochopherol). Fresh carrot is very rich in β-carotene (45700 µg/100g), also carrot contain 56

mg/100g ascorbic acid. Guava contain 70.0 mg/100g ascorbic acid

2. Preparation of natural antioxidant sources, foam-mat drying produces good quality carrot and guava powder in compared with conventional drying. Conventional drying for carrots and guava need long time may reach 24 hr. to reach moisture content about 3.4 % and 3.68% for carrot and guava, respectively. While, foam-mat drying using pectinex enzymes reduced dehydration time to be 2 hr. to reach moisture content of 3.25% and 3.43% in carrot and guava, respectively using pectinex ultra-spl enzyme and 3.70% and 3.85%, respectively using ultrazyme enzyme

3. Concerning to factors affecting antioxidants stability, α-tocopherol and β-carotene were higher stable than ascorbic acid at different temperature and pH-value. The mixtures of (ascorbic acid with α-tocopherol), (ascorbic acid with β-carotene) and (β-carotene with α-tocopherol) when exposed to different temperature and pH in model-system antioxidants become more stable. Also the three antioxidants mixture of (ascorbic acid, α-tocopherol and β-

carotene) increased antioxidants stability at different temperature and pH-value.

3. Effect of antioxidant throughout bakery products processing

a) Standard antioxidant

-Stability during processing: The retention of standard antioxidants; Fat-coated ascorbic acid, α-tocopherol and β-carotene during pretzels and cookies processing were 94, 95 and 92 % in pretzels dough, while it were 90, 98 and 98 % in cookies dough, respectively. During baking step, the retained antioxidants (Fat-coated ascorbic acid, α-tocopherol and β-carotene) were 62, 86 and 78 % in pretzels dough, while they were 75, 90 and 82 % in cookies dough, respectively. α-tocopherol gave highest stability of the three antioxidants in cookies after the baking process at 205ºC for 10 min.

- Stability during storage: Stability of standard antioxidants; Fat-coated ascorbic acid, α-tocopherol and β-carotene during storage of pretzels and cookies for 3 months at room temperature showed loss in the three antioxidants. The highest loss were obtained in (AsA) in both bakery products pretzels and cookies.

However, the percentage of degradation was high in cookies than pretzels.

b) Natural source of antioxidants,

1. Effect on physio-chemical properties: Particle size indexes of raw materials were (191.76) in wheat germ, (119.91) in guava powder and (112.17) in carrot powder, respectively. Functional properties of raw materials i. e. pH of dispersions, swollen volume, water hydration capacity (WHC) and oil absorption capacity (OAC) were determined. The obtained results demonstrate that, anti-oxidants sources; wheat germ, carrot powder and guava powder there no very wide differences in pH of dispersions, they were ranged from 4.12 to 6.18. For swollen volume; wheat germ (3.42 ml/g), carrot powder (2.27 ml/g) and guava powder (2.18 ml/g), respectively. Results of water hydration capacity (WHC) showed that wheat germ (0.62 g/g sample), carrot powder (0.87g/g sample) and guava powder (0.93 g/g sample). The results of oil absorption capacity (OAC) indicated that carrot powder has the highest value for (OAC).

2. Effects on rheological properties of dough

- Farinogram properties: The results showed that water absorption values of flour replaced by various levels (5, 10 and 15%) were higher than the control, decrease dough stability in all treatments. The lowest was 15% wheat germ, it was 7.5 min. Dough weakening increased with all blends than control. Carrots powder was the highest values than guava powder and wheat germ at levels 5, 10 and 15%. It was 85, 100 and 125 B.U. for carrots powder, 70, 90 and 110 B.U. for guava powder and 55, 60 and 70 B.U. for wheat germ, respectively.

- Extensogram properties: addition of wheat germ, carrots powder and guava powder at levels 5, 10 and 15% reduced all extensogram properties. Wheat germ showed higher decrease in all extensogram properties. Addition of carrots powder slightly decreased the resistance to extension than control (530, 480 and 340 B.U). On the other hand, the addition of guava powder has no effect on resistance to extension at level 5% (560 B.U), while it sharply decreased at level 15% (110 B.U). Wheat germ at levels 5, 10 and 15% decreased proportional number than control, it were 1.4, 1.3 and 2.2 respectively. For energy (the area under the curve) values, they were

lower in all cases of adding materials than control sample.

- Falling No: The results showed that addition of wheat germ, carrots powder and guava powder to wheat flour (72% extraction) reduced the Falling No. values than wheat flour (control). Also, Falling number values decreased by increasing levels of the addition materials.

3- Effect on quality characteristics of bakery products

a) Effect of additives materials on quality characteris-tics of pretzels

- Physical properties of pretzels: there are no differences in color between control sample and that contain 5% and 10% wheat germ, carrot powder and guava powder. Texture and firmness of pretzel were decreased by adding wheat germ. However, texture increased by adding guava powder. While, there are no differences by adding carrots powder at various levels. The highest increase in texture was obtained in pretzels produced with adding 15% guava powder, while the lowest was by adding 15% wheat germ.

- Chemical composition of pretzels: results shown that protein and fat contents was increased by adding

wheat germ than control sample, while adding dried carrots and guava powders led to decrease protein and fat contents than control samples. Carbohydrate content was decreased by adding wheat germ, dried carrots powder and dried guava powder.

- Sensory characteristics of pretzels: results showed no significant differences between control samples and supplemented by 5% and 10% of each wheat germ, carrots powder and guava powder for texture and flavor, while at 10% there are slightly effect on color and taste by using wheat germ. At 15% all sensory characteristics were affected negatively. It could be concluded that pretzels can fortified with 5 and 10% of wheat germ and carrots powder and 5% guava powder with out effect on sensory characteristics.

b) Effect of antioxidants sources on quality characteris-tics of cookies

- physical properties of cookies: results indicated that weight of cookies fortified with 5% and 10% of wheat germ were lower than control sample, while carrots powder and guava powder were higher than control. A positive relationship could be noticed between replacement level and cookies weight.

Cookies diameter was increased as level of flour replacement increased. Cookies diameter was increased from 74.5 mm. for control sample to 75.0, 75.0 and 76.5 mm. for adding wheat germ at levels 5, 10 and 15%, respectively. Concerning to cookies height, all treatments were lower than control sample except adding at 5% of carrots and guava powders were have the same height of control (12.5). The lowest cookies height was found for adding 15% carrots powder.

- Chemical composition of cookies: cookies fortified with wheat germ, dried carrots and dried guava powders at levels 5, 10 and 15%. indicated an increase in moisture content in comparison with control sample after baking at 205ºC for 10 min. Adding wheat germ at levels 5, 10 and 15% increased cookies protein and fat contents than control samples, while adding dried carrots and guava powders at the same levels decreased protein and fat contents of cookies. The highest increase in protein (7.12%) and fat content (18.68%) were obtained in cookies containing 15% wheat germ. Ash content was not significantly differ for control and other samples. Dietary fiber content was increased from 2.05% for

control sample to 4.45, 5.82 and 6.52% for cookies containing wheat germ at levels 5, 10 and 15%, respectively. Carbohydrate content of cookies fortified with wheat germ, dried carrots and guava powders at levels 5, 10 and 15% were lower than control sample. Vitamins; A, E and C contents in cookies were increased by adding wheat germ, dried carrots and dried guava powders. Vitamin E content increased from 0.240 mg/100g for control sample to 5.014, 6.705 and 7.584 mg/100g for cookies produced by adding wheat germ at levels 5, 10 and 15%, respectively. Vitamin A content increased from 0.612 mg/100g for control to 3.820, 3.952 and 4.320 mg/100g for cookies fortified with dried carrots powder at level 5, 10 and 15%, respectively. In conclusion, cookies fortified with wheat germ and dried carrots and guava powders improved the chemical composition and increase vitamins content of cookies

- Sensory characteristics: there are no significant differences between control samples and supplemented by 5% and 10% of each wheat germ, carrots powder and guava powder for surface appearance, internal appearance, eating

characteristics and total score, while 15% showed significantly differences lower than control cookies.

4. Biological evaluation of antioxidants

-Body weight of rats: Effect of different diets; control basal, diets contain 10% of wheat germ, dried carrots, dried guava and pretzels and diet contains 200ppm of BHT on body weight of rats were studied. At the end of the experiment period, data show that in case of diabetic control group (G2) and (G3) which fed on diet contains 200ppm of BHT showed high decrease in body weight than other groups. However, groups fed on diets contain 10% wheat germ, pretzels and dried carrots showed increase on body weight 17.16, 7.31 and 5.27 %, respectively. All these were significant on ($p< 0.05$).

- Organs weight of rats: Heart and liver weight were affected by type of diet. Highest weight of heart was found in G2 and G3 (diabetic group and group which fed on diet contains 200ppm of BHT) which were 0.72 and 0.75g. respectively. However, the lowest weight of heart was found on (G6) which fed on diet contain 10% guava powder. Relative weight of liver in G1 was the lowest than other groups, while in G2 was the highest. Liver relative weight on groups G4, G5, G6

and G7 were 2.25, 2.72, 2.76 and 2.71% respectively. No significant difference ($p<0.5$) could be noticed between (G1) and those fed on diets contain 10% of wheat germ, dried carrots, dried guava and pretzels. Furthermore, spleen weight in (G2) and (G3) was highest than other groups.

- Serum glucose value: Glucose value before injection ranged from 90.50 mg/dl to 93.26 mg/dl which considered as normal levels. injection with alloxan caused a highly significant increase of serum glucose levels of 6 groups, it was ranged between 253.28 to 273.85 mg/dl. At the end of experimental periods, glucose levels decreased in all groups except control basal (G1). The highest decrease was noticed with (G4) from 273.85 to 1383.78 mg/dl that mean decreased by 49.5%. In addition, glucose levels in G5, G6 and G7 was decreased by 41%, 30% and 33%, respectively.

- Serum total lipids, triglycerides and total cholesterol: levels of serum total lipids, triglycerides and total cholesterol were significantly lower in diabetic groups (G2) than all other groups. They were 377.73, 192.84 and 180.14 mg/dl in diabetic group (G2), respectively. While they were in rats fed on diets

contain natural antioxidants; dried carrots (311.57, 78.64 and 95.17 mg/dl), wheat germ (321.50, 76.04 and 111.74 mg/dl), pretzels as source of Millard compounds (319.23, 83.91 and 115.62 mg/dl) and finally dried guava (333.62, 96.18 and 123.82 mg/dl). From these results, it could be concluded that lipids pattern were decreased with rats fed on diets contain natural antioxidant compare with that fed on diets contain synthetic antioxidant and diabetic rats.

- Serum lipoproteins: The highest values of LDL-cholesterol was in diabetic control (G2) and (G3) which record 122.95 mg/dl and 106.74 mg/dl, while they were the lowest in HDL 18.63 mg/dl and 16.82 mg/dl. The groups fed with natural antioxidants were ranged from 35.78 to 70.14 mg/dl LDL-cholesterol and from 34.44 mg/dl to 47.36mg/dl HDL. The lowest LDL/HDL ration was in rats fed on diet contain carrots (G5) then (G4) which fed with wheat germ 0.82 % and 1.04%., respectively.

- Serum GOT, GPT: The activities of serum aspartate amino transferase (AST/GOT) and serum alanine trancesferase (ALT/GPT) were determined to evaluate the role of antioxidants on liver function. Results shown that the diabetic group (G2) was the

highest in GOT and GPT than other groups 49.16 µ/l and 37.42 µ/l. respectively. Decreasing percentage of GOT and GPT on rats fed on diets contain natural antioxidants G4, G5, G6 and G7 were higher than rats in group (G3) which fed on diets contain synthetic antioxidants BHT. The highest decrease in GOT and GPT was found on rats fed with 10% carrots powder 33.77 and 53.66 µ/l. From these results, it could be concluded that the natural antioxidants (α-tocopherol, β-carotene, ascorbic acid and Millard reaction products) have powerful effect in regulate the liver enzymes AST.

- Renal function: Determination of renal functions which includes serum uric acid, urea and ceratinine is important to evaluate disorders which may be occurred as a result of alloxan injection. Alloxan injection for rats in (G2) caused a highly significant increase in serum uric acid, urea and creatinine values which increased from 3.52, 20.18 and 0.74mg/dl to 6.17, 28.53 and 1.55 mg/dl, respectively. On anther hand wheat germ, carrot and guava powder caused significant decrease in uric acid, urea and creatinine which were 4.42, 4.56 and 4.82 mg/dl

uric acid, 18.50, 17.39 and 21.17 urea and 1.08, 1.05 and 1.14 mg/dl creatinine, respectively.

In conclusion, the above mentioned results indicated that the treatment with natural antioxidants sources; wheat germ, dried carrots, dried guava and pretzels reduced serum glucose level, cholesterol, LDL, (GOT and GPT), uric acid, urea and creatinine values in compared to the diabetic control and BHT groups. In addition, natural antioxidants were affected as a positive action for reducing the activity of liver enzymes AST or ALT. Also, synthetic antioxidants (BHT), in comparison with natural antioxidants showed lower enzyme activity. Meanwhile, diabetic control (injected with alloxan and fed in basal diet) showed negative action.