J. Agric. Sci. Mansoura Univ., 30 (11): 6917 - 6926, 2005

TECHNOLOGICAL, CHEMICAL AND NUTRITIONAL STUDIES TO IMPROVE SOME BAKERY PRODUCTS

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ABSTRACT

In this study the technological process of some bakery products such as cookies was investigated. In cookies processing different types of antioxidants were used (α-tocopherol, β-carotene and fat coated ascorbic acid) in addition to their natural sources. i e, wheat germ as a source of vitamin E, dehydrated carrots powder as a source of vitamin A and dehydrated guava powder as a source of vitamin C compared to the synthetic antioxidant (BHT).Cookies were processed according to the method in AACC (1995). Cookies were fortified with sources of antioxidants at the levels of 5, 10 and 15%. From the sensory evaluation and physical properties, it was found that the best characteristics were observed at the level 10%. Stability of the antioxidant vitamins during cookies processing were investigated. Also biological effect of the natural sources of vitamins were studied. Result indicated that vitamin E was high stable than vitamin A and C during cookies processing. For the biological investigation, the treatment with natural antioxidants reduced glucose, cholesterol, LDL, GOP and GPT values compared to the diabetic control and BHT groups, also natural antioxidants were affected as a positive action for reducing the activity of liver enzymes AST or ALT. Meanwhile, diabetic and synthetic antioxidants (BHT) showed negative action.

INTRODUCTION

Cookies processing:

Surojanamethakul *et al.* (1999) reported that physical properties of cookies containing 5-15% powder cellulose showed no significant differences compared to control. Spread ratio of cookies decreased while hardness increased with addition of cellulose. Sensory evaluation indicated that cookies containing 10% powdered cellulose were of acceptable quality. Abdel-halek (2002) and Gaines (2004).

Biological effect of the three antioxidants vitamins A, E and C:

Antioxidants are compounds that protect cellular systems from the potentially harmful effects of processes that can cause excessive oxidations. By implication, they may inhibit the pathogenesis of the many diseases involving oxidative reactions (Diplock *et al.* , 1998). Antioxidants can be of endogenous and exogeneous origin and which contribute to the complex and integrated biological antioxidant defense system, which normally protects cells from the injurious effects of oxidation. This is achieved by directly scavenging reactive O and n free radical species, by metabolizing peroxides to non-radical products and by chelating metal ions to prevent the generation of oxidizing species.

Ness and Powles, (1997) and Abushita *et al.* (1997). mentioned that in the recent years great interest has been focused on the antioxidant vitamins (Vit C, E and β-carotene), particularly due to their likely role in the prevention of chronary heart diseases and cancer. Antioxidant vitamins can counteract the oxidizing effect of lipids by scavenging oxygen free radicals, which have been found as major promoters of such diseases. Vegetables and fruits are main sources of antioxidant vitamins.

Carotenoids are pigmented constituents adhering in most vegetables and fruits. Nutritional interest was initially, focused on the provitamin-A carotenoids, particularly in vegetables, being considered as major source of dietary vitamin A in most countries. Expanded interest in plant carrotenoids was stimulated in the 1980s by epidemiological and laboratory studies indicating probably to have anticarcinogenic, anticancer or antiaging properties. Wills and rangga, (1996).

Frank *et al.* (2004). studied the effect of vitamin E and β-carotene supplementation on ultraviolet radiation-induced oxidative stress in human skin, and found that vit E or β-carotene supplementation had no effect on skin sensitivity to UVR. Although vit E supplements significantly reduced the skin malondialdehyde concentration, neither supplement affected other measures of UVR-induced oxidative stress in human skin, which suggested no photoprotection of supplementation.

Vitamin E prevents oxidative modification of LDL and oxidation of LDL neither it could be detected or not until all endogenous vitamin E was consumed. Thus, antioxidant intake would be expected to retard the development of atherosclerosis. Zanzinger and Czachurski (2000). Also vitamin E is a powerful antioxidant able to prevent free radical-induced oxidations in biological membranes. El-Hadidy (2004). and Scott et, al. (2004). Virginia *et al.* , (2005), separate spontaneously hypertensive rats (HPR) into two groups (n= 6 per group) control and treated with alpha-tocopherol (α-tocopherol acetate 120IU) for 2 weeks. They concluded that strongly effect of α -tocopherol supplementation to genetically hypert-ensive rats was observed by a reduction of both blood viscosity and BP, and a consequent cardiomyocyte hypertrophy in treated SHRs; an improvement of vessels-to-myocytes ratio in these rats was also observed.

Vitamin C is a powerful water antioxidant which plays a vital role protecting against oxidative damage. It neutralizes potentially harmful reactions in the watery parts of the body, such as the blood and the fluid inside and surrounding cells. It also helps protecting LDL cholesterol against free radical damage. This antioxidant action helps to protect against cancer, the effects of aging heart disease, diabetes, cataracts, blood pressure and immune system. Concepcion *et al.* ,(2003).

MATERIAL AND METHODS

Processing of cookies: Cookies were processed using the method described by AACC (1995)

Chemical analysis: were determined according to the methods described in AOAO (1990).

Biological evaluation:

Experimental animals:

Male albino rats (30 animals) weighing 140-160g were used in the present study. Animals were housed in animal's house of the Food Technology Research Institute (FTRI) and fed on basal diet as suggested by Monsma *et al.* , (1996).

Group (1) fed on the basal diet through the experiment time (4 weeks) as control negative. The other animals (30 rats) were injected by alloxan solution 150mg/kg body weight of recrystallized alloxan (Buko et al, 1996) to induce hyperglycemia and hypercholesterolemia (Arbeeny and Bergquist 1991), then the animals were fed on basal diet for 72hr. where hyperglycemia and hypercholesterolemia were developed. These rats were divided into 6 groups as follows:

Group (2): hyperglycemia and hyperchlestrolemia as control positive
Group (3): fed on diet (2) which contain 200 ppm BHT
Group (4): fed on diet (3) which contain 10% WG (Wheat Germ)
Group (5): fed on diet (4) which contain 10% CP (Carrot Powder)
Group (6): fed on diet (5) which contain 10% GP (Guava Powder)

Biological analysis:

Serum total lipids: were determined according to Frings, *et al.* , (1972).
Total cholesterol: were determined according to Jung and parekh (1971).
GOT/AST and GPT/ALT: were determined according to Reitman and Frankel (1957).
urea, uric acid and creatinine were determined according to Kajeyoma(1971).

RESULTS AND DISCUSSION

Vitamins stabilities during processing and storage of cookies.

Stabilities of the three antioxidant vitamins (Fat-coated ascorbic acid (AsA), α-tocopherol and β-carotene) added to cookies were determined during processing and are shown in Fig (1).The results indicate that the retained vitamins (Fat-coated ascorbic acid, α-tocopherol and β-carotene) were 90, 98 and 98 % in the cookies dough. The high degradation of vitamin C observed in cookies dough may be due to the creaming process for sugar and fat during cookies dough preparing which increased in the oxygen content in dough which caused oxidation of vitamin C. The higher stability of the three antioxidant vitamins after baking were obtained in cookies for α-tocopherol 13 % only. The loss of β-carotene came number two in degradation after α-tocopherol. Results indicate a loss in the three vitamins during storage. The high disappearance was obtained in vitamin C. The high stability during storage at room temperature for three months was obtained for α-tocopherol being 90, 84 and 75 % after 1, 2 and 3 months, respectively.

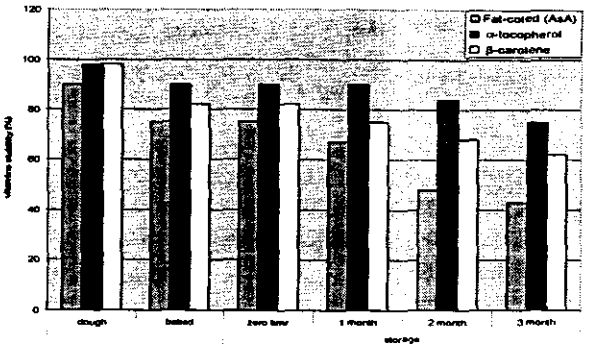

Fig (1): Vitamins stability during cookies processing and storage.

Physical properties of cookies:

Results in table (1) indicate that weight of cookies with 5% and 10% of wheat germ were lower than the control sample, while all the other additives were higher than the control sample. A positive relationship could be noticed between the replacement level and the cookies weight. Cookies weight ranged from 27.3 g for control sample to 29.2 g and 30.6 g for the samples containing 15% of each of carrots and guava powders. Cookies diameter increased as the flour replacement level increased. Cookies diameter increased from 74.5 mm. for the control sample to 75.0, 75.0 and 76.5 mm. for adding wheat germ at levels of 5, 10 and 15% respectively. Cookies diameter of which made by adding carrots powder was the highest than the other samples. It was 76.0, 77.0 and 78.5 mm. at levels 5, 10 and 15%, while it was 75.5,76.0 and 77.5 mm. for the added guava powder at the same levels respectively. Concerning cookies height, all treatments were lower than the control sample except that of added 5% of carrots and guava powders which had the same height of the control (12.5).

Table (1): Physical measurements of cookies.

Treatments		Weight (gm)	Diameter (mm)	Height (mm)	Spread factor
Control		27.3±0.01	74.5	12.5	59.6
Wheat germ	5 %	27.2±0.01	75.0	12.0	62.5
	10%	26.8±0.02	75.0	11.5	65.2
	15%	28.5±0.3	76.5	10.5	72.8
Carrot powder	5%	28.5±0.01	76.0	12.5	63.3
	10%	28.9±0.01	77.0	12.0	64.2
	15%	29.2±0.02	78.5	9.5	82.6
Guava powder	5%	28.7±0.01	75.5	12.5	60.4
	10%	29.2±0.02	76.0	12.0	63.3
	15%	30.6±0.04	77.5	10.5	73.8

Means ± SD

Sensory characteristics: The results shown in table (2) indicate no significant differences between control samples and those supplemented by 5% and 10% of each wheat germ, carrots powder and guava powder for the surface appearance, internal appearance, eating characteristics and total scores, while 15% showed significant differences lower than the control cookies. The best cookies in surface appearance were those containing 5% wheat germ and dried carrots powder, which scored 19.6 and 19.7%, respectively.

Table (2): Sensory evaluation of cookies.

Treatments		Surface appearance	Internal Appearance	Eating characteristics	Total Score
Control*		20.1±0.02	20.1±0.02	20.1±0.02	60.3±0.04
Wheat germ	5%	19.6±0.24 ^{a}	19.5±0.04 ^{a}	19.3±0.04 ^{a}	58.4 ^{a}
	10%	18.2±0.65 ^{ab}	19.0±0.02 ^{a}	19.3±0.04 ^{a}	56.5 ^{a}
	15%	15.1±1.24 ^{cd}	17.7±2.60 ^{bc}	18.6±0.75 ^{b}	51.4 ^{bc}
Carrot powder	5%	19.7±.08 ^{a}	19.30±0.02 ^{a}	19.6±0.01 ^{a}	58.6 ^{a}
	10%	19.5±0.23 ^{a}	19.5±0.28 ^{a}	19.5±0.06 ^{a}	58.5 ^{a}
	15%	18.3±1.35 ^{bc}	17.9±1.36 ^{bc}	18.4±1.02 ^{b}	54.6 ^{b}
Guava powder	5%	19.5±0.08 ^{a}	19.3±0.06 ^{a}	19.8±0.01 ^{a}	58.6 ^{a}
	10%	18.7±0.18 ^{b}	18.8±0.54 ^{b}	19.6±0.21 ^{a}	57.6 ^{a}
	15%	17.6±2.51 ^{bc}	18.2±3.02 ^{b}	19.5±0.03 ^{a}	45.3 ^{ab}
LSD		0.66.8	0.762	0.821	2.521

Means, within the same column ith the same letter are not significantly different ($p<0.01$)

Biological analysis:

Effect of different diets control basal, diet containing 10% of (wheat germ, dried carrots, dried guava and pretzels), diet containing 200ppm of BHT on body weight of rats are recorded in table (3). At the end of the experiment, data show, that the diabetic control group (G2) and (G3) showed high decrease in body weight than the other groups (24.8 g), However groups (G4) and (G5) showed an increase in body weight being 17.16, 7.31 and 5.27 %. respectively.

Table (3): Changes in body weight of rats fed on different diets.

Groups	Initial body weight (g)	Final body weight (g)	Change in body weight	
			(g)	(%)
Control negative C^{-} (G1)	158.26±2.94	174.36±9.7	+16.10	+10.17
Control positive C^{+} (G2)	155.18±1.53	130.43±5.97	-24.82	-15.90
BHT 200 ppm (G3)	153.44±2.15	128.63±4.15	-24.81	-16.17
Wheat germ 10% (G4)	152.08±3.74	178.18±8.05	+26.10	+17.16
Carrot powder 10% (G5)	157.32±1.49	155.61±8.29	+8.29	+5.27
Guava powder 10% (G6)	159.78±2.98	148.32±6.52	-11.46	-7.17
Pretzels 10% (G7)	158.20±3.15	169.78±3.85	+11.58	+7.31

Relative weight of heart, liver, kidney and spleen of rats groups fed on different diets are shown in table (4). From the table. it could be notice that heart and liver weight were affected by type of diet, highest weight of heart was found in group G2 and G3, 0.72 and 75 g respectively, however the

lowest weight of heart was found in G6. Relative weight of liver in G1 was the lowest compared to the other groups, while the G2 was the highest 1.82% and 3.68% respectively. The tested groups G4, G5, G6 and G7, liver relative weight were 2.25, 2.72, 2.76 and 2.71% respectively.

Concerning the kidney weight of tested rats, results in table (4) show that the highest weight was with the diabetic group (G2) injected with alloxan and fed on basal diet. The other groups were significantly different compared to this group. However, no significant difference could be noticed between the group (G1) and those fed on 10% from wheat germ, dried carrots, dried guava and pretzels. Furthermore, spleen weight in both diabetic group (G2) and group (G3) showed the highest relative weight than the other groups being 0.43 and 0.45%, respectively. On the other hand, no significant difference could be seen between (G1) and the treated groups (G4, G5, G6 and G7) in spleen weight.

Table (4): Organs relative weight of rats fed on different diets.

Groups	Heart weight %	Liver weight %	Kidney weight %	Spleen weight %
Control negative C^- (G1)	0.36	1.82	0.45	0.25
Control positive C^+ (G2)	0.55	3.68	0.89	0.43
BHT 200 ppm (G3)	0.58	3.12	0.72	0.45
Wheat germ 10% (G4)	0.32	2.25	0.47	0.20
Carrot powder 10% (G5)	0.34	2.72	0.60	0.24
Guava powder 10% (G6)	0.33	2.76	0.55	0.33
Pretzels 10% (G7)	0.33	2.71	0.55	0.18

All groups significantly with positive control ($p<0.05$)

Data in table (5) indicate that injection with alloxan caused a highly significant increase of serum glucose levels of 6 groups. It was ranged between 253.28-273.85 mg/dl. At the end of the experimental periods, glucose levels decreased in all groups except the control basal (G1). The highest decrease was noticed with the group (G4) from 273.85 to 1383.78 mg/dl that decreased by 49.5%. Also glucose levels in G5, G6 and G7 were decreased by 41%, 30% and 33% respectively.

Table (5): Means of blood glucose level (mg/dl) in rats fed on different diets

Groups	Before injection	After injection	After 4 weeks	change	
				mg/dl	%
Control negative C^- (G1)	92.46	92.46	98.53	+6.07	+6.5
Control positive C^+ (G2)	90.73	260.82	267.28	+6.46	+2.3
BHT 200 ppm (G3)	92.14	256.74	220.65	-36.09	-14
Wheat germ 10% (G4)	93.26	273.85	138.78	-135.07	- 49.5
Carrot powder 10% (G5)	91.93	262.83	154.73	-108.10	- 41
Guava powder 10% (G6)	90.50	258.07	180.15	-77.92	-30
Pretzels 10% (G7)	91.88	253.28	168.70	-85.58	-33

All groups significantly with positive control ($p<0.05$)

The lowest decrease in glucose levels was in G3. The hypoglycemic effect may be due to the occurrence of active components such as dietary fiber, polyphenols, carotenoids, vitamin C, vitamin E and elements, which may stimulate β-cells to secrete insulin and enable cells for better utilization of glucose. (El-hadedy 2004).

The effect of diets containing synthetic and natural antioxidants during the experimental period on lipids pattern are shown in Table (6). These results indicate the levels of serum total lipids, triglycerides and total cholesterol significantly lower in diabetic groups (G2) than all the other groups. It was 377.73, 192.84 and 180.14 mg/dl in the diabetic group respectively. while it was 321.19, 68.61 and 75.41 mg/dl in the normal control basal diet group (G1). Also serum total lipids, triglycerides and total cholesterol were high in G3. On the other hand they were lower in G5, 311.57, 78.64 and 95.17 mg/dl then wheat G4, 321.50, 76.04 and 111.74 mg/dl, then pretzels as a source of millard compounds 319.23, 83.91 and 115.62 mg/dl and finally G6, 333.62, 96.18 and 123.82 mg/dl. From these results, it could be concluded that lipids pattern decreased with rats fed on diets containing natural antioxidants compared to that fed on diets containing synthetic antioxidant and diabetic rats.

Table (6): Mean of serum total lipids, triglycerides and total cholesterol in rats fed on different diets.

Groups	Total lipid mg/dl	Triglycerides mg/dl	Total cholesterol mg/dl
Control negative C^- (G1)	321.19 ± 7.25	68.61 ± 2.12	75.41 ± 1.82
Control positive C^+ (G2)	377.73 ± 5.64	192.84 ± 6.25	180.14 ± 5.24
BHT 200 ppm (G3)	364.29 ± 12.5	88.59 ± 3.17	141.28 ± 2.68
Wheat germ 10% (G4)	321.50 ± 4.95	76.04 ± 2.85	111.74 ± 1.52
Carrot powder 10% (G5)	311.57 ± 6.32	78.64 ± 3.41	95.17 ± 1.18
Guava powder 10% (G6)	333.62 ± 7.51	96.18 ± 2.86	123.82 ± 4.17
Pretzels 10% (G7)	319.23 ± 5.18	83.91 ± 3.24	115.62 ± 3.42

Means ± SD **All groups significantly with positive control ($p<0.05$)**

The change of serum low density lipoprotein (LDL), serum high density lipoprotein (HDL) and LDL/HDL ratio of 7 rats groups fed on different tested diets containing synthetic and natural antioxidants were determined and recorded in table (7).

Table (7) Effect of tested diets on mean value of serum lipoprotein.

Groups	LDL (mg/dl)	HDL (mg/dl)	LDL/HDL Ratio %
Control negative C^- (G1)	33.55 ± 2.50	28.14 ± 1.62	1.20
Control positive C^+ (G2)	122.95 ± 6.48	18.63 ± 0.50	6.60
BHT 200 ppm (G3)	106.74 ± 4.56	16.82 ± 1.08	6.35
Wheat germ 10% (G4)	49.18 ± 3.82	47.36 ± 2.68	1.04
Carrot powder 10% (G5)	35.87 ± 2.80	43.57 ± 3.00	0.82
Guava powder 10% (G6)	70.14 ± 3.30	34.44 ± 2.84	2.04
Pretzels 10% (G7)	58.00 ± 4.10	40.83 ± 3.67	1.42

Means ± SD **All groups significantly with positive control ($p<0.05$)**

The highest values of LDL were in the diabetic control (G2) and (G3) recording 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 on natural antioxidants ranged from 35.78 to 70.14 mg/dl LDL and from 34.44 mg/dl to 47.36mg/dl HDL. The lowest LDL/HDL ratio was in rats fed on diet containing carrots (G5) then (G4) fed with 0.82 % and 1.04%. wheat germ.

The activities of serum aspartate amino transferase (GOT) and serum alanine trancesferase (GPT) were determined in serum to evaluate the role of antioxidants on liver function and the results are shown in table (8). From the table it could be observed that the diabetic group (G2) was the highest in GOT and GPT than the other groups 49.16 µ/l and 37.42 µ/l. Decreasing percentage of GOT and GPT in rats fed on diets containing natural antioxidants G4, G5, G6 and G7 were higher than rats in the group (G3). The highest decrease in GOT and GPT was found in group (G5) 33.77 and 53.66 µ/l.

Table (8): Effect of different antioxidants sources on means of serum GOT, GPT.

Groups	GOT (µ/l)	GPT (µ/l)	Decrease (%)	
			GOT	GPT
Control negative C^- (G1)	32.52 ± 0.3	19.30 ± 0.2	-	-
Control positive C^+ (G2)	49.16 ±0.6	37.42 ± 0.4	-	-
BHT 200 ppm (G3)	38.76 ± 0.5	35.16 ± 0.3	21.15	6.04
Wheat germ 10% (G4)	33.15 ± 0.4	22.55 ± 0.1	32.56	39.73
Carrot powder 10% (G5)	32.65 ± 0.2	21.92 ± 0.5	33.77	53.66
Guava powder 10% (G6)	36.07 ± 0.5	21.13 ± 0.4	26.63	43.53
Pretzels 10% (G7)	34.18 ± 0.4	23.54 ± 0.5	30.47	37.09

Means ± SD **All groups significantly with positive control ($p<0.05$)**

Data in Table (9) indicate the effect of alloxan injection on renal function in rats and the effect of natural antioxidants. The results reveal that alloxan injection caused a highly significant increase in serum uric acid, urea and creatinine values, which were increased, from 3.52, 20.18 and 0.74mg/dl to 6.17, 28.53 and 1.55 mg/dl respectively. On the other 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.

Table (9): Effect of antioxidants on uric acid, urea and creatinine (mg/dl).

Groups	Uric acid (mg/dl)	Urea (mg/dl)	Creatinine (mg/dl)
Control negative C^- (G1)	3.52 ± 0.25	20.18 ± 1.4	0.74 ± 0.02
Control positive C^+ (G2)	6.17 ± 0.38	28.53 ± 1.6	1.55 ± 0.08
BHT 200 ppm (G3)	4.31 ± 0.26	22.75 ± 0.8	1.21 ± 0.40
Wheat germ 10% (G4)	4.42 ± 0.31	18.50 ± 1.1	1.08 ± 0.06
Carrot powder 10% (G5)	4.56 ± 0.18	17.39 ± 0.2	1.05 ± 0.08
Guava powder 10% (G6)	4.82 ± 0.31	21.17 ± 1.5	1.14 ± 0.18
Pretzels 10% (G7)	4.97 ± 0.30	23.11 ± 0.9	1.30 ± 0.07

Means ± SD **All groups significantly with positive control ($p<0.05$)**

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دراسات تكنولوجية وكيمائية وتغذوية لتحسين بعض منتجات المخابز

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في هذا البحث تم دراسة الخطوات التصنيعية لبعض منتجات المخابز مثـل الكـوكيز، تـم تـدعيم الكوكيز بأنواع مختلفة من الفيتامينـات المـضادة للأكـسدة (α-tocopherol, β-carotene and fat-coated ascorbic acid)

وكذلك تم استخدام مصادر طبيعية لهذه الفيتامينات مثل جنين القمح كمصدر لفيتـامين E والجـزر المجفف كمصدر لفيتامين A والجوافة المجففة كمصدر لفيتامين C مقارنة بمضادة الأكـسدة الـصناعي BHT ، تم استخدام مستويات ٥و ١٠و١٥% من المصادر الطبيعية (جنين القمح و الجزر والجوافـة) وتـم دراسة تأثير هذه الإضافات على الخواص الطبيعية والحسية للكوكيز ودراسة تأثيرها البيولوجي على فئـران التجارب وكذلك تم دراسة مدى ثبات الفيتامينات النقية أثنا تصنيع وتخزين الكوكيز لمـدة ثلاثـة اشـهرعلى درجة حرارة الغرفة. وقد أوضحت النتائج أن مستويات الإضافة ٥و١٠% من كل من جنين القمح والجـزر المجفف والجوافة المجففة لم يكن لها تأثير جوهري على الخواص الفيزيقية والتقييم الحسى للكوكيز. كما وجد أن فيتامين E كان أكثر ثباتا من فيتامين Aو فيتامين C أثنا تصنيع وتخزين الكوكيز. كما أوضـحت نتـائج البيولوجي أن إضافة كل من جنين القمح والجزر المجفف والجوافة المجففة والبرتزل الذي يعتبـر مـصدر لمركبات نواتج تفاعل ميلارد أدت إلى خفض قيم الجلوكوز والكوليستيرول فى سيرم الدم مقارنة بمـضادات الأكسدة الصناعية، كما وجد ان لها تأثير معنوي على خفض تركيز LDL في سيرم دم الفئران مما يعكـس دور هذه المواد كمضادات أكسدة. أيضا وجد أن هذه المواد لها تأثير ايجابي على خفـض نـشاط إنزيمـات الكبد.