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UTILIZATION OF COOPERATION BETWEEN AGRICULTURAL TRAILS AND TECHNOLOGICAL EVALUATION OF ARTICHOKE TO PREPARE BISCUITS FOR DIABETICS

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ABSTRACT: *Globe artichoke is one of the important vegetable crops which is considered a great economic and healthy benefits. So, this study was carried out in two parts on artichoke plant (French cultivar). The first part concerned with the cultivation of artichoke and their effects of different levels of potassium mineral fertilizer ;i.e. (0, 30, 60, 90 and 120 kg K_2O/fed.) with and without biofertilizer namely potassiumag at a level of 4 L/fed. on the productivity of artichoke heads, quality and chemical composition including inulin and total phenolics compounds. The second part was related to technological processes for using artichoke powder in preparing special blends of anise biscuits for diabetics and evaluating its sensory characteristics, beside its effect on blood glucose serum level. Results showed that, fertilizing artichoke with 60kg K_2O plus 4L potassiumag/fed. led to increase the productivity of artichoke heads than potassium mineral fertilizer alone and improve most physical characteristics of heads and receptacles. On the other hand, artichoke fertilized with 60 kg K_2O + 4L potassiumag /fed. was the best treatment where it contained the highest contents of total carbohydrates and inulin than other treatments which also, was used for preparing artichoke powder after treating with 0.5% sodium metabisulphite before drying process to minimize the browning of artichoke powder. Biscuit blends fortified by 10 and 15% artichoke powder and prepared for diabetics led to improve sensory properties and chemical composition especially for contents of carbohydrates and fibers as well as, its positive effect on blood glucose level.*

So, it could be recommended that, eating artichoke head are healthy benefits either in a fresh state or in a powder form to prepare functional biscuits for diabetics, and also, encourage the farmers to cultivate more areas in artichoke for export and healthy using.

Key words: *Artichoke, Cynara scolymus L, K-fertilizers, K-biofertilizers, inulin, blood glucose, diabetic.*

INTRODUCTION

Diabetes mellitus is a chronic disorder of glucose metabolism resulting from dysfunction of pancreatic beta calls and insulin resistance (Safder *et al.*, 2004). Diabetes mellitus is one of the most common problem challenging the physicians in 21st century (Ramachandran and Pathak, 2002 and Bennet, 2004). Diabetes mellitus is defined as a chronic disease of carbohydrate metabolism, but lipid and protein metabolism are also affected (Lusi *et al.*, 2000 and Heffiner, 2001).

Globe artichoke (*Cynara scolymus L.*) belongs to the family Compositae and it is probably a native of North Africa or South Western Europe. It is a herbaceous perennial plant, the tops die down each year, but they are renewed from the old crown below the soil. The receptacle and the tender thickened bases of the bracts are eaten. It is normally propagated vegetatively by crown division and offshoots.

Artichoke is considered one of the important vegetable crops grown in Egypt for local consumption and exportation. According to the Central Administration for Agricultural Economics, Ministry of Agriculture, cultivated area of globe artichoke increased gradually from 7451 feddans, in 2002 with total production of 61024 Tons to 19049 feddans, in 2007 with total production of 172774.5 Tons. (Agricultural Statistics, 2002 and 2007). Artichoke has an important nutritional value related to its high contents in inulin, fibers, phenolic compounds especially cynarin, flavonoids and mineral salts. The young heads and stalks of artichoke are rich in inulin, which is used as a natural relief for diabetes. Roberfroid (2005) reported that inulin is a mixture of β (2→1) linked fructans, in most chains the terminal sugar is glucose. Also, inulin has many physiological properties such as improving gut functions, especially by improving regularity, increasing stool frequency and faecal bulking ; having bifidogenic and prebiotic effects ; increasing calcium absorption and reducing blood glucose, cholesterol-levels and serum lipids in hyperlipidaemic individuals.

From horticultural view, potassium has essential functions in the plant nutrition whereas potassium is necessary for photosynthesis, protein synthesis, translocation of sugars and formation of carbohydrates (Imas and Bansal,1999). Meanwhile, potassium plays an important role for improving crop quality by increasing fruit size and stimulating root growth.

Because most of potassium ions in soil is unavailable form for plants; the extended cultivation of vast areas in newly reclaimed soils and the increased prices of potassium fertilizers, recently, researchers started to face these problems by using potassium-releasing bacteria which makes potassium in an available form for plants. This study was carried out to study the effect of potassiumag with different levels of potassium mineral on the productivity of artichoke and the quality of heads and receptacles as well as to prepare biscuits from artichoke powder to study its effects on blood glucose level in diabetic mellitus.

MATERIALS AND METHODS

1. Materials:

Stumps used for cultivating artichoke (*Cynara scolymus L*) were obtained by cutting from full-ripe plants cultivated in previous season 2005-2006 and artichoke heads were harvested during the season of 2006-2007 from a private farm at Kom El-Farag, Abu El-Matamir, Behaira Governorate, Egypt. Potassiumag was obtained from "Unit of Biofertilizers Production" Giza, Egypt. Chemicals were obtained from Sigma Chemical Co., St. Louis, MO, USA. Different ingredients of anise (*Pimpinella Anisum*) biscuits ;i.e. (sugar, wheat flour, salt, anise,...etc.) were purchased from local market at Shibin El-Kom, Minufiya, Egypt.

2. Methods

2.1. Agricultural experiments:

2.1.1. Experimental design:

Agricultural experiments were carried out in a private farm at Kom El-Farag village, Abu El-Matamir, Behaira Governorate, Egypt during the season of 2006-2007 on globe artichoke cv. French. The experimental design was laid out in a complete randomized block design (CRB) with three replicates. Each experimental plot consisted of three rows. Each row was 6 m long and 1 m width. Planting distance was 90 cm. Planting date was 22 August, 2006. Soil preparation was carried out according to the recommendations of the Egyptian Ministry of Agriculture. Sowing was carried out by dividing old crowns from the full-ripe plants, then these pieces soaked in VITA VAX solution at a concentration of 1gm /1L water for 20 min. to protect it from soil rots, then cultivated immediately in hills at a depth of 15-20 cm on the third top of slope north ridge.

2.1.2. Cultural treatments:

The following cultural treatments were applied: 0, 30, 60, 90, 120 kg K_2O in potassium sulphate form (50 % K_2O) alone or with 4 L potassiumage/fed. These treatments were applied as follows: 50% 7weeks after the planting and 50% 7 weeks later. At soil preparation (pre-riding) 30 m^3 farmyard manure was applied. Also, all plants were fertilized with 120 kg N/ fed. in three equal doses at 2, 3 and 4 months after the planting and 46.5 kg P/fed. in two doses 50% at soil preparation and 50% 10 weeks later. Physical and chemical properties of the experimental soil used were analyzed by the method described by Jackson (1967).

Table (1): Physical and chemical properties of the used experimental soil .

Physical properties					
Clay (%)		Silt (%)		Sand (%)	
23		32		45	
Chemical properties					
O M (%)	CaCO3	N* (ppm)	P* (ppm)	K* (ppm)	pH (1:2.5)
0.9	33	16	11	67	8.2

* Available.

2.1.3. Yield characteristics:

Early and total yields:

Early yield (as heads numbers and weights) was calculated from first four pickings. Heads were harvested with 5 cm stem. Total yield was calculated from the rest of pickings. The total harvesting period was about 19 weeks beginning in 1/1/2007 till 15/5/2007 during of 2006-2007 grown season.

Head characteristics:

Randomized samples of 5 heads for both the early and late yields in each plot were taken for determining the following parameters: Head length, diameter, fresh weight as well as edible fresh weight and edible part (receptacle) diameter.

2.2. Technological evaluation:

2.2.1. Chemical Analysis:

Moisture, crude protein, crude fibers, crude fat and ash were determined according to the method of A.O.A.C. (2000). Inulin was determined by the method described by Winton and Winton (1958). Total phenolics were determined by the method of Daniel and George (1972). Ascorbic acid (Vitamin C) was determined by using 2,6 dichlorophenol- endophenol method as described by Askar and Treptow (1993).

2.2.2. Preparation of some solutions used for minimizing of artichoke browning:

The following solutions were used to reduce browning by immersing artichoke hearts for 3 min. in it :

- Distilled water (Control).
- 1 % Citric acid.

- 1 % Ascorbic acid.
- 1 % Citric acid + 1% Ascorbic acid.
- 0.1 , 0.3 , 0.5 % Sodium metabisulphite.

2.2.2.1.Browning index:

Browning index of both treated and untreated (Control) samples with suggested solutions for reducing the browning were carried out according to the method described by (Watts *et al.*,1989).

2.2.3. Preparation of artichoke powder:

Artichoke heads were cleaned with a tap water to remove dust and undesirable materials, then pull off the lowest petals and cut off stems close to base. After that top quarter and tips of petals were cut into reach the heart. The obtained artichoke hearts were immersed in 0.5 % sodium metabisulphite solution for 3 min. to avoid browning of artichoke hearts then, cut into small pieces and dried in an air oven at 60°C for 24 hours. The dried pieces were ground in a cereal mechanical mill to pass through 100 mesh screen sieves. The produced powder was packed in polyethylene bags and stored at 4±1°C in a refrigerator until used.

2.2.2.4. Preparation of biscuits supplemented with anise:

Wheat flour (72% extraction) was substituted by artichoke powder at different levels of 5, 10 and 15 % with 25 and 50 % reduction in sugar level for making anise biscuits by the method of Saba (1991).

2.2.2.5. Sensory evaluation:

The prepared biscuits were evaluated organoleptically according to the method described by Watts *et al.* (1989). The panelists were asked to evaluate the appearance, color, texture, odor, taste and overall acceptability.

Hedonic scales were as follows:
(0 – 1) Very poor (2 - 3) Poor (4 - 5)Fair (6 - 8)Good (8 - 10) Very good.

2.3. Biological evaluation of tested biscuit blends:

2.3.1. Effect of biscuit blends prepared for diabetics on blood glucose:

Diabetics' mellitus were fed with 100 g of tested biscuit blends to determine the effect of these blends on blood glucose level. The fasting and post prandial (p.p.) blood glucose were determined by the method of Trinder (1969).

2.4. Statistical analysis:

Statistical analysis were performed using analysis of variance (one way ANOVA) according to the method described by Senedecor and Cochran (1967). The means of treatments were compared by using Duncan's Multiple Range test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Cultivation of artichoke:

1.1. Effect of potassiumag and potassium mineral on the productivity of artichoke:

Early, late and total yields of treated artichoke plants with potassiumage and potassium mineral at different levels were calculated and expressed as numbers and weights of harvested heads per feddan. Table (2) indicated that, early and total yields were significantly increased with increasing potassium mineral rate from 0 to 120 kg K_2O plus the potassiumag biofertilizer at a rate of 4L/fed. Since the treatment No.10 (120 kg K_2O+4L potassiumag /fed.) gave the highest values of early and total yields, which the early yield was 13477.7 heads with a production of 3.30 Tons/fed. and total yield was 52988.64 heads with a production of 11.89 Tons/fed. comparing with that 11472.22 heads and 2.33 Ton for early yield, 45188.4 heads and 9.22 Ton for late yield respectively in control. Also, there are no significant differences among the treatments No. 8(60 kg K_2O plus 4L potassiumag/fed.), 9 (90 kg K_2O plus 4L potassiumag/fed.) and 10 (120kg K_2O plus 4L potassiumag/fed.) in heads numbers and weights for late and total yields. These results may be due to the positive effect of beneficial bacteria found in potassiumag which turns soil potassium to an available form for plants which affects the energy status of the plant, translocation and storage of assimilates and crop productivity by increasing early and total yields (Kasim *et al.*, 2007). These results are in agreement with that obtained by El- Shall *et al.* (1993) and Mansour *et al.* (2002).

Table (2): Effect of different levels of K- mineral fertilizer with and without potassiumag on early, late and total yields of globe artichoke.

Yield / Treatments.	Early yield / fed.		Late yield / fed.		Total yield / fed.	
	Heads number	Heads weight (Ton)	Heads number	Heads weight (Ton)	Heads number	Heads weight (Ton)
1 (Control)	11472.22g**	2.33 f	33716.18 e	6.89 f	45188.40 f	9.22 f
2 (30 kg K_2O/fed.)	11666.66 fg	2.49 e	34843.94 de	7.38 de	46510.60 ef	9.87 e
3 (60 kg K_2O/fed.)	11938.88 ef	2.6 d	35582.99 d	7.63 d	47521.87 de	10.25d
4 (90 kg K_2O/fed.)	12244.40de	2.75 c	35855.04 d	7.93 c	48099.44 d	10.68c
5 (120 kgK_2O/fed.)	12872.22 bc	2.94 b	37566.31 bc	8.39 b	50438.53 bc	11.33b
6 (4 Lpotassiumag)	11510.99 g	2.42 ef	34866.34 d	7.29 e	46377.33 ef	9.71 e
7 (30 kg K_2O+4LP.*)	12599.88 cd	2.78 c	37255.20 c	8.13 b	49855.08 c	10.91c
8 (60 kg K_2O+4L P.)	13072.09 ab	3.00 ab	38566.11 ab	8.74 a	51638.20 a	11.74a
9 (90 kg K_2O+4L P.)	13066.48 ab	3.00 ab	38888.70 a	8.79 a	51955.18 a	11.79a
10(120 kg K_2O+4L P.)	13477.72 a	3.03 a	39510.92 a	8.86 a	52988.64 a	11.89a
L.S.D. at5%	408.23	0.10	1130.66	0.26	1487.28	0.33

*P. : Potassiumag.

** abcdef based on the least significant difference (LSD).

***Means within each column followed by the same letter at 0.05 significance level are not significantly different.

1.2. Effect of potassiumag and potassium mineral on characteristics artichoke head:

Head weight, length, diameter, receptacle weight and diameter of cultivated artichoke were measured. The obtained results are presented in Table (3) it could be noticed that, the increasing of potassium rate up to 60 kg K_2O with 4 L potassiumag / fed. (Treatment No.8) increased the almost characteristics of heads, where, the highest values of head, receptacle weights and diameters were 230.33 g, 9.04 cm and 65.45 g , 6.72 cm, respectively. Meanwhile, treatment No. 9 (90 kg K_2O+4L potassiumag/fed.) gave the highest head length (12.78 cm) compared with 203.66 g, 12.07 cm, 8.19 cm, 49.96 g and 5.49 cm, respectively in control. The positive effect of potassiumag biofertilizer combined with potassium mineral on head characteristics may be attributed to the presence of potassium in available form for plants by beneficial bacteria found in potassiumag which correlated well with the energy status of the plant and maintenance of tissue-water

(Imas and Bansal, 1999). These results are similar with that obtained by Mansour *et al.* (2002) for head weight, diameter and receptacle weight which were 235.15 g, 8.42 cm and 64.16 g, respectively.

Table (3): Effect of different levels of K -mineral fertilizer with and without potassiumag on characteristics of early yield globe artichoke heads and receptacles.

Characteristics / Treatments.	Head Weight(g)	Head Length(cm)	Head diameter(cm)	Receptacle weight(g)	Receptacle diameter(cm)
1 (Control)	203.66e**	12.07 de	8.19 d	49.96 e	5.49 e
2 (30 kg K_2O/fed.)	213.66 d	12.17 cde	8.56 c	54.89 d	6.03 d
3 (60 kg K_2O/fed.)	220.00 c	12.20 cde	8.64 c	59.84 c	6.58 ab
4 (90 kg K_2O/fed.)	224.66 bc	12.30 bcd	8.66 bc	60.77 bc	6.56 abc
5 (120 kgK_2O/fed.)	228.83 ab	12.05 de	8.68 bc	62.10 abc	6.24 bcd
6 (4 Lpotassiumag)	212.16 d	11.93 e	8.53 c	54.96 d	6.08 d
7 (30 kg K_2O+4LP.*)	220.5 c	12.43 bc	8.97 a	59.21 cd	6.17 cd
8 (60 kg K_2O+4L P.)	230.33 a	12.58 ab	9.04 a	65.45 a	6.72 a
9 (90 kg K_2O+4L P.)	230.16 a	12.78 a	9.00 a	65.07 ab	6.68 a
10 (120 kg K_2O+4L P.)	224.66 bc	12.38 bcd	8.92 ab	63.17 abc	6.62 ab
L.S.D.at5%	5.16	0.34	0.27	4.33	0.40

*P. : Potassiumag.

** abcdef based on the least significant difference (LSD).

** Means within each column followed by the same letter at 0.05significance level are not significantly different.

2.Technological evaluation:

2.1. Effect of potassiumag and mineral potassium on chemical composition of artichoke heads:

Table (4) shows that, artichoke produced with 60 kg K_2O+4L potassiumag/fed. (treatment No. 8) had the highest contents of total carbohydrates, inulin, total phenolics and vitamin C with less content of moisture which were 70.87 , 10.28 , 0.089 % , 28.50 mg/100ml and 85.44 % comparing with that obtained by control which were 68 , 7.17 , 0.042 % , 28.30 mg/100ml and 86.94 % , respe3ctively. These results may be attributed to the positive role of potassiumag and potassium in plant metabolism caused to activates several enzymes especially in the metabolization of carbohydrates (Alam and Naqvi, 2003).

Table (4): Effect of different rates of mineral-K fertilizer with and without potassiumag on chemical composition of globe artichoke*

Constituents(%) / Treatments	Moisture	Crude protein	Crude fat	Crude fibers	Total ash	Total carbohydrates	Inulin	Vitamin C (mg/100ml)	Total phenolics
1 (Control)	86.94a***	11.65 b	1.93 a	13.03 a	5.39 ab	68.00 c	7.17 f	28.30 a	0.042 e
2 (30 kg K_2O/fed.)	86.57 ab	12.00 ab	1.82 a	11.54 b	5.50 ab	69.14 bc	7.94 e	27.65 b	0.046 e
3 (60 kg K_2O/fed.)	86.43 ab	12.00 ab	1.82 a	11.20 bc	5.59 ab	69.39 ab c	8.52 de	26.55 c	0.051 d
4 (90 kg K_2O/fed.)	86.08 bc	12.08 ab	1.78 a	11.45 bc	5.76 ab	68.93 bc	8.88 cd	24.40 de	0.054 cd
5 (120 kgK_2O/fed.)	85.84 bc	12.62 ab	1.37 b	10.45 bc	6.00 a	69.56 b	8.98 cd	24.17 e	0.056 c
6(4 Lpotassiumag)	86.86 ab	11.93 ab	2.03 a	11.45 bc	5.13 b	69.46 b	8.37 de	25.13 d	0.062 b
7(30 kgK_2O+4LP.**)	85.99 bc	12.31 ab	1.36 b	11.09 bc	5.20 ab	70.04 ab	9.55 bc	28.05 ab	0.066 b
8 (60 kg K_2O+4L P.)	85.44 c	12.40 ab	1.05 c	10.42 bc	5.26 ab	70.87 a	10.28 a	28.50 a	0.089 a
9 (90 kg K_2O+4L P.)	86.00 bc	12.44 ab	1.02 c	10.40 bc	5.35 ab	70.79 a	10.20 a	24.89 de	0.090 a
10(120kg K_2O+4L P.)	85.96 bc	13.08 a	1.02 c	10.33 c	5.80 ab	69.77 ab	10.20 a	24.75 de	0.092 a
L.S.D. at 5%	0.75	1.23	0.30	1.16	0.73	1.16	0.71	0.82	0.004

* Values given represent means of duplicate, on dry weight basis.

**P. : Potassiumag.

*** abcdef based on the least significant difference (LSD) .

*** Means within each column followed by the same letter at 0.05 significance level are not significantly different.

2.2. Minimization of Browning in artichoke hearts:

Table (5) shows the effect of 1% citric acid (CA), 1 % ascorbic acid (AA), combinations (1% CA + 1% AA) and concentrations of (0.1, 0.3 and 0.5%) sodium metabisulphite. From the obtained results, it could be noticed that, treating artichoke hearts with sodium metabisulphite at a concentration of 0.5 % before the drying led to minimize browning in artichoke hearts and give a yellow-white artichoke hearts powder. The Minimization is attributed to either the stable colorless products formed by an addition reaction with 0-quinones or binding to the active centre of polyphenol oxidase (PPO) responsible for the enzymatic browning.(Aydemir, 2004).

Table (5): Effect of some inhibitors on artichoke hearts browning.

Inhibitors	formed color	Degree of browning	description of color
Distilled water (Control)	Dark brown	1.00±0.45	unacceptable
1% citric acid (CA)	Brown	2.50±0.67	Unacceptable
1% ascorbic acid (AA)	Brown	3.50±0.63	Unacceptable
1% CA+ 1% AA	Light brown	5.00±0.53	Unacceptable
0.1% Sodium metabisulphite	Light brown	6.00±0.58	Unacceptable
0.3% Sodium metabisulphite	Yellow	7.50±0.48	Acceptable
0.5% Sodium metabisulphite	Light yellow	9.00±0.74	Acceptable

0-2 Dark brown 2-4 Brown 4-6 Light brown 6-8 Yellow 8-9 Light yellow 9-10 White

2.3. Sensory evaluation of anise biscuits blends:

Data presented in Table (6) show the results sensory evaluation for fortified biscuits with different levels of artichoke powder (5, 10, 15 %) prepared for diabetics. Results indicated that, substituting wheat flour with artichoke powder at levels 10 & 15 % and 25 % reduction of used sugar for preparing anise biscuits (blends No.3 & 4) caused to improve the sensory properties of prepared biscuits comparing with control. Among these blends, blend No.4 attained the highest value of overall acceptability (8.54±0.71) followed by blend No.3 (8.43±0.60) comparing with control (8.39±0.54). So, blends No.3 & 4 were chosen for supplementation.

Table (6): Sensory evaluation of fortified wheat biscuits with different levels of artichoke powder.

Characteristics. / Blends**	Color	Taste	Odor	Texture	Appearance	Overall acceptability
Control	8.10±0.84	8.85±0.34	8.60±0.45	8.15±0.78	8.25±0.79	8.39±0.54
1	8.20±0.34	7.80±0.39	8.30±0.34	7.75±0.71	8.10±0.69	8.03±0.48
2	8.20±0.53	8.35±0.33	8.35±0.41	7.95±0.55	8.25±0.75	8.22±0.32
3	8.15±0.41	8.85±0.24	8.65±0.41	8.25±0.42	8.75±0.67	8.43±0.60
4	7.95±0.49	8.80±0.25	8.70±0.34	8.45±0.36	8.80±0.58	8.54±0.71
5	8.35±0.33	5.21±0.45	6.30±1.00	7.45±0.64	7.95±0.68	7.05±0.96
6	8.30±0.42	5.60±0.56	6.70±0.85	7.60±0.51	7.65±0.81	7.17±0.71
7	8.25±.0.26	5.90±0.45	6.95±0.72	8.00±0.52	7.70±0.71	7.36±0.61
8	8.10±0.36	6.10±0.39	7.25±0.63	8.20±0.34	7.90±0.51	7.47±0.49

* Values given represent means of 10 replication with standard deviation.
** Control : 0 % artichoke powder + 25 % sugar.
Blend No.1 : 0% artichoke powder + 18.75 % sugar.
Blend No.2 : 5 % artichoke powder + 18.75 % sugar.
Blend No.3 : 10 % artichoke powder + 18.75 % sugar.
Blend No.4 : 15 % artichoke powder + 18.75 % sugar.
Blend No.5 : 0 % artichoke powder + 12.50 % sugar.
Blend No.6 : 5 % artichoke powder + 12.50 % sugar.
Blend No.7 : 10 % artichoke powder + 12.50 % sugar.
Blend No.8 : 15 % artichoke powder + 12.50 % sugar.

2.4. Chemical composition of anise biscuit blends:

The chemical composition of anise biscuit blends fortified by different levels of artichoke powder are shown in Table (7). It is worthy to notice that, blend No.4 (15 % artichoke powder with 25 % reduction in added sugar level) contained the highest values of crude fibers (3.55 %) and total carbohydrates (76.96 %), whereas the blends contained artichoke powder had the highest percentages of total carbohydrates, crude fibers and inulin than wheat flour which act as a soluble fibers and contribute in a significant way to a well-balanced diet by increasing the fiber content (Cherbut, 2002).

Table (7): Chemical composition of fortified anise biscuits with different levels of artichoke powder.

Constituents / Blends**	Moisture	Crude Protein	Crude fat	Crude fibers	TC****	Total ash
Control	8.79a***	9.17 d	11.65 ab	1.49 c	76.57 a	1.12 a
1	9.18 a	10.08 b	11.60abc	2.07 bc	75.07 bc	1.18 a
2	8.90 a	9.12 de	11.66a	2.13 bc	75.94 ab	1.15 a
3	7.80 b	7.96 g	11.59 bc	2.80 ab	76.47 a	1.18 a
4	7.63 b	6.72 h	11.62abc	3.55 a	76.96 a	1.15 a
5	8.95 a	10.35 a	11.58 c	2.15 bc	73.72 d	1.20 a
6	8.92 a	9.82 c	11.60abc	3.34 a	74.14 cd	1.10 a
7	8.79 a	9.02 e	11.66 a	3.53 a	74.63 cd	1.16 a
8	8.16 b	8.70 f	11.64abc	3.55 a	74.91 bc	1.20 a
L.S.D. at 5%	0.62	0.13	0.36	1.01	1.03	0.15

* Values given represent means of duplicate, on dry weight basis .
** Blends from control to 8 as in table (6).
*** abcdef based on the least significant difference (LSD).
*** Means within each column followed by the same letter at 0.05 significance level are not significantly different.
**** TC: Total carbohydrates.

5.3. Biological evaluation of biscuit blends prepared for diabetics

5.3.1. Effect of anise biscuit blends on fasting and post-prandial blood glucose:

The effects of prepared biscuit blends on blood glucose level in diabetics are shown in Table (8). The post prandial plasma glucose increments recorded after the consumption of anise biscuits substituted by 10 and 15 % of artichoke powder with 25% reduction in sugar level (blends No.3 and 4) were lower than that obtained by the control. This may be attributed to the positive and healthy role of inulin found in artichoke powder that can be reduce the level of cholesterol and serum lipids (Ohr, 2004).

Table (8): Effect of biscuit blends substituted by artichoke powder on fasting and post prandial blood glucose in lean and obese diabetics.

Biscuit blends	Lean			Obese		
	Fasting	P.P.	Increment	Fasting	P.P.	Increment
Control	177.00±6.00	188.00±52	11.00±1.52	188.33±3.51	202.33±4.04	14.00±1.73
3	177.66±4.16	186.66±66	9.00±2.00	182.66±3.78	194.33±3.51	11.66±2.88
4	169.66±5.03	178.66±47	9.00±1.00	176.33±9.01	187 ±10.53	10.66±2.08

Control : 0 % artichoke powder + 25 % sugar.
Blend No.4 : 10 % artichoke powder + 18.75 % sugar.
Blend No.5 : 15 % artichoke powder + 18.75 % sugar.

Conclusions

From the obtained results, it could be mentioned that artichoke fertilizing by 60 kg K_2O with 4 L potassiumag /fed. caused to improve the quality of heads and receptacles as well as it contained the highest contents of total carbohydrates, inulin, vitamin C and total phenolics. Furthermore, the treating of artichoke hearts by 0.5 % sodium metabisulphite led to reduce browning in artichoke hearts. Addition of artichoke powder at levels of 10 , 15 % by replacing with wheat flour in preparing anise biscuits not only reduced the blood glucose, but it also improved chemical and sensory properties of produced biscuits.

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الاستفادة من التعاون بين المحاولات الزراعية والتقييم التكنولوجي للخرشوف لإنتاج بسكويت لمرضى السكر

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الملخص العربي

يعتبر الخرشوف من محاصيل الخضر الهامة لما له من قيمة اقتصادية و صحية , لذا أجريت هذه الدراسة على نبات الخرشوف (الصنف الفرنساوي) على مرحلتين ففي المرحلة الأولى كان الهدف هو دراسة تأثير مستويات مختلفة من السماد البوتاسي المعدني (صفر, ٣٠ , ٦٠ , ٩٠ , ١٢٠ كجم بو٢أ /الفدان) مع وبدون السماد الحيوي (البوتاسيوماج) على إنتاجية وجودة نورات الخرشوف وتركيبها الكيميائي خاصة محتواها من الانيولين والفينولات الكلية بينما استهدفت المرحلة الثانية دراسة إمكانية استخدام مسحوق قلوب نورات الخرشوف في إعداد خلطات بسكويت اليانسون ذو الخصائص الوظيفية لمرضى السكر وتقييم تلك الخلطات حسيا وكيماويا بجانب تأثيرها على مستوي سكر الدم. هذا ولقد أوضحت النتائج أن تسميد الخرشوف بـ ٦٠ كجم بو٢أ مع ٤ لتر بوتاسيوماج / الفدان أدى إلى زيادة إنتاجية الفدان من نورات الخرشوف عن السماد البوتاسي المعدني فقط , كما أدى إلى تحسين معظم الصفات الطبيعية للنورات والجزء الصالح للأكل منها. ومن ناحية أخرى فلقد كانت نورات خرشوف هذه المعاملة أيضا هي الأفضل من حيث محتواها من الكربوهيدرات الكلية و الانيولين , والتي استخدامت في إعداد مسحوق قلوب نورات الخرشوف حيث تم معاملتها بالنقع في ٠,٥ % صوديوم ميتا باى سلفيت قبل إجراء عملية التجفيف لتجنب حدوث التلون البني. أما بالنسبة لخلطات البسكويت المعد لمرضى السكر , فقد وجد أن استبدال دقيق القمح بـ ١٠ , ١٥ %

من مسحوق قلوب نورات الخرشوف قد أدي إلي تحسين الخصائص الحسية و التركيب الكيماوي لها خاصة في محتواها من الألياف و الكربوهيدرات بالإضافة إلى تأثيرها على مستوي سكر الدم.

مما سبق, نستطيع أن نوصى بتناول نورات الخرشوف طازجة أو استخدام مسحوقها في إعداد أغذية وظيفية يمكن تغذية مرضى السكر عليها , وعليه يجب تشجيع المزارعين لزيادة المساحة المنزرعة من الخرشوف لمثل هذه الأغراض.