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STUDIES ON CAROTENOIDS, MINERALS, DIETARY FIBERS AND ANTIFUNGAL EFFECT OF SOME VEGETABLES COMMONLY CONSUMED IN EGYPT

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By

F. A. Ismail, S. M. El-Dash.,E.A M.Abd-El Rihim*and N. M. Hussein *

Department of Food Science and Technology, Faculty of Agriculture, Cairo University

** Food Technology Research Institute, Agriculture Research Center.*

ABSTRACT

Carrots (*Daucus carota* L.), yellow sweet potato (*Ipomoea batatas Lam*), and pumpkin (*Cucurbita pepo*) which are important vegetable crops in Egypt and other countries, and local chicory (*Cichorium intybus*) which is used as vegetable in rural areas were grown on a loam soil. Beta and alpha-carotene were analyzed by High-Performance Liquid Chromatography (HPLC) on both fresh and dehydrated material .Chicory leaf powder and carrot powder gave high contents of beta and alpha-carotene.

Chicory leaf powder and carrot powder contained the highest values of Total Dietary Fiber (TDF), Soluble Dietary Fiber (SDF), and Insoluble Dietary Fiber (ISDF). Chicory leaf powder had high amounts of protein, ash content and minerals especially iron (Fe) compared to carrot, yellow sweet potato and pumpkin powders.

Carrot powder was highly inhibitive to growth of *Aspergillus flavus* at the lowest level used (2%), while pumpkin powder showed a slight effect compared to carrot powder followed by sweet potato powder and chicory leaf powder.

Key words: *a-carotene, anti-fungal effect , carrot, pumpkin chicory leaf, sweat potato.*

1. INTRODUCTION

Carrot is one of the most commonly used vegetables for human nutrition. Being a rich source of carotenoids (Walter *et al.*, 1970) and of dietary fiber (Nyman *et al.*, 1987), it is generally regarded as a healthy food item.

Sweet potato was reported to be a good source of energy, provitamin A, vitamin C, high quality protein and dietary fiber (Picha 1986). Oboh *et al.* (1989) mentioned that sweet potato contained 0.3% fat (dry weight basis).

Abd-El Magied, *et al.*, (1992) found that the percentages of crude fibers in raw sweet potato tubers from five varieties (106, 111, 117, 14 and J_2) on a dry weight basis were 3.90%, 3.50%, 4.10%, 3.60% and 2.20%, respectively.

Bao and Chang (1994) reported that the percentage of protein, lipids and ash for carrot were 5.1%, 1.5%, and 6.2%, respectively.

Biochemical studies on dietary fiber and sugars in some Egyptian food proved that the yellow carrot contained 12.33%, 11.38%, and 23.71% of insoluble, soluble and total dietary fiber, respectively (Ali , 1998).

Chenault (1984) reported that retinol is almost never found in food products of plant origin but carotenoids may be present. The most important carotenoids is called beta-carotene, a bright orange substance found abundantly in yellow and orange vegetables. Pumpkin, carrot and sweet potatoes are extremely rich in beta-carotene.

Morton (1990) reported that approximately 10-40% of beta carotene was lost during cooking depending on the method of cooking. Carotenes are transformed into retinol (actual vitamin A) in the organism. Six molecules of beta carotene remain in the body for every molecule of vitamin A. So, 6mg of beta carotene correspond to 1mg retinol. In terms of International Units (IU), one retinol equivalent equals 3.33 IU retinol or 10 IU beta carotene. He also added that, it is safe to use beta-carotene, hence even very large doses do not lead to the toxicity symptoms or embryo damage which have been observed with excesses of vitamin A. In this respect, it could be mentioned that vitamin A (retinol) is not a strong antioxidant, like its

precursor beta-carotene, but retinol has many other vital functions. Moreover, vitamin A and beta-carotene can protect the cell membranes and other cellular structures from the damage caused by free radicals. The precursor of vitamin A, beta-carotene, is an antioxidant, like selenium, which can inhibit excess oxidation of fats (lipid peroxidation) in the cells. Beta-carotene has a specific affinity to an oxygen-derived free radial called single oxygen. Retinol (vitamin A) lacks this property.

Tee and Lim (1991) studied the carotenoid composition of a pumpkin sample, determined by reversed-phase HPLC. Total carotenoid concentration was less than 2300 μg/100g sample, and the concentrations of lutein and α-and β-carotenes were 940, 756, and 578 μg/100g, respectively. Cryptoxanthin, lycopene, and γ-carotene were not detected. Green leafy vegetables, including several local varieties consumed raw, have been found to be the richest sources of total carotenoids as well as provitamin A carotenes. The chlorophyll present in these leaves masks the carotenoids present.

Velijkovic (1992) studied the nutritional values of pumpkin pulp and seeds. Reference is made to the high K (325 mg %) and low uric acid (approx. 9 mg %) in pulp. The pulp can be used in diuretic and antidiarrheic properties.

Borowitzka, (1993) pointed out the application of microalgae in biotechnology with reference to food use of algae; microalgal species of current importance in biotechnology production of carotenoids (for use as a food or feed colorant, or in the pharmaceutical industry), synthesis of long-chain polyunsaturated fatty acids, polysaccharides and sterols; phycobilins as food colorants and for research applications; bioactive compounds (with anticancer, antibacterial, antiviral or antifungus activity); and research requirements in microalgal biotechnology.

De Jong, *et al.*, (1992) reported that a temperature-sensitive carrot embryo mutant was rescued by a 32-Kda endochitinase and suggested that chitinase may have a role in carrot somatic embryo development. To date, all of the reports on chitinases from carrot have investigated the occurrence of the enzyme in suspension cultured cells. Endochitinases (EC 3.2.1.14) are expressed in many plant species in response to pathogen infection or to other environmental

stresses. Thus, one of the postulated functions of chitinases in plant is in defense against fungal infection (Punja and Zhang 1993).

Kragh *et al.*, (1994) reported that the 32-Kda chitinase was recently characterized as a chitinease.

The present study aimed to cover the main following points: 1) preparation of different sources of carotenoids from some vegetables commonly used in Egypt *i.e.* carrots, yellow sweet potato, pumpkin and chicory leaf using dehydration technology, 2) studies on the chemical composition of different sources of carotenoids and identification of carotenoinds,and 3) Evaluation of the role of addition of dehydrated carrot, yellow sweet potato, pumpkin and chicory leaf to the media (potato dextrose agar) as an antifungal factor.

2. MATERIAL

Carrots (*Daucus carota* L.), yellow sweet potato (*Ipomoea batatas Lam*), and Pumpkin (*Cucurbita pepo*) were obtained from Vegetable Research Institute, Station at Kalubia, Ministry of Agriculture, Kalubia Egypt. Chicory leaf (*Cichorium intybus* L.) was grown on loam soil, Faculty of Agriculture, Cairo University, Egypt. (Sown on January and February 1998-99).

Carotenoid standards: Crystalline β-carotene and α-carotene were purchased from BDH, Dorset, England and Sigma, USA, respectively.

Solvents and Chemicals: For extraction of pigments, the following solvents were used: mixture of 7:3 hexane : acetone (HPLC grade), Methanol (HPLC grade), and Dichloromethane (HPLC grade).

For Mobile phase: Dichloromethane, Acetonitril and methanol (HPLC grade).

Chemicals: Butylated hydroxy toluene (BHT) (Sigma), potassium hydroxide, magnesium carbonate (Idwic) and anhydrous sodium sulfate (Merck).

Culture media

- Potato Dextrose Broth (PDB)

Potato slices	200.0 gm
Dextrose	20.0 gm
Water	1000.0 gm

To the above constituents, 20g agar were added to prepare potato dextrose agar (PDA). Potato dextrose agar was used for isolation, chemical control tests and preservation of fungal cultures in general. Potato dextrose broth was used for toxin production, extraction and fungicide tests.

Aspergillus Flavus

Aspergillus flavus was obtained from Plant Diseases Research Institute.

3. METHODS

3.1. Preparation of dried sample

Carrot roots, sweet yellow potato and pumpkin were washed, peeled and cut into 1-2 mm slices. Chicory leaves were removed from the stem and sliced. The slices were immediately frozen in a freezer at –6°C for 6hr. and perfection freezer at –25°C for 18 hr. After this treatment the slices were dried promptly in an convection oven air circulation at 50±2°C for 24 hrs as described by Park, (1987). The dehydrated slices were milled (ground) using a laboratory disc mill, then sieved on a 630μm sieve and softened in cyclone mill, then sieved on a 160μm (50-60 mesh) sieve. The flours were sealed in polyethylene bags.

$$\textbf{Dehydration ratio} = \frac{\text{Weight of samples after drying}}{\text{Weight of samples before drying}} \times 100$$

3. 2. Chemical analysis

Carrot, yellow sweet potato, pumpkin and chicory leaf powders were chemically analyzed for moisture content, crude protein, ash, crude fiber, total lipids and carotenoids according to the methods described in A.O.A.C. (1990). Total carbohydrates were determined by difference.

3.3. Determination of minerals

Eight minerals (Sodium (Na), Potassium (K), Calcium (Ca), Iron (F), Copper (Cu), Magnesium (Mg), Manganese (Mn) and Zinc (Zn) were determined in the studied samples *i.e.* carrot powder, sweet

potato powder, pumpkin powder and chicory leaf powder using a Pye Unicom SP 19000 atomic absorption spectroscopy technique in Agricultural Research Center. Giza, Egypt as described by A.O.A.C (1990).

3. 4.Chemical analysis of carotene from fresh and dry samples

3. 4.1.Carotene Extraction and saponification

For analysis, the samples were homogenized in a blender (dried samples were not homogenized). 10g of sample were saponified with 20ml of potassium hydroxide (100g KOH + 100ml H_2O) in ethanolic solution (50ml).

The saponification of the carotenoid extracts was conducted to remove the associated chlorophylls and lipids. The majority of Carotenoids are stable toward moderate saponification condition (Piironen *et al.*, 1984). BHT 0.5g was used as an antioxidant. Caroteniods were extracted using a mixture of 7:3 hexane:acetone. Under these conditions the recovery of α and β-carotene was 94% and that of retinol 99%. The entire extraction procedure has been described elsewhere (Ollilainen *et al.*, 1988).

3. 4.2. High-Performance Liquid Chromatography (HPLC).

Two Varian Hewlett Packard Series 1050 liquid chromatographs (Varian, USA) were each equipped with a Varian UV-200 detector and A Varian 1050 integrator. In the nonaqueous reversed-phase (NARP) chromatography of carotenoids.

HPLC column

Column was a Spherissorb ODS 2 guard column (Phase Sep, U.K.) 5μm, 125×4mm i.d. column.

Mobile phase, flow rate, temperature and wavelength

The elution mixture was Dichloromethane, Acetonitril and methanol (HPLC grade) (70:10:20) and the flow rate was pumped at a rate 1.5ml/min. The temperature was 35°C and the wavelength for detection 450nm.

Detection of carotenoids

Peak responses were measured at 450 nm using a variable wavelength visible detector (Hewlett Packard 1050).

For the recovery study a 25µl injection of the standards was considered to have a peak area representing 100% recovery. Two such replicate measures were made at the beginning and at the end of each day's work. The individual areas of the integrated peaks were normalized to the average area of the replicate injection. The linearity of the detector response was verified by injecting varying amount of the mixture of β-carotene and α-carotene.

Determination. A suitable amount of standard carotene solution was injected into the chosen column-solvent system; retention time and peak area.

3. 4.3.Vitamin A value calculation

Calculation was performed based on the vitamin A activity of each carotenoid precursor (β-carotene and α-carotene), according to Bauernfeind (1972), and the conversion factors were provided by the National Academy of Sciences- National Council Research (NAS-NCR, 1980). Vitamin A value was expressed in RE (Retionl Equivalents) per 100g of sample according to the following formula:

RE=0.167× β-carotene + 0.08 [α-carotene + other carotenoid]

It is known that 0.6µg of β-carotene and 1.2µg of α-carotene and other carotenoids are equivalent to 1 IU (International Unit), with 1 RE being equivalent to 10 IU.

3. 5. Determination of soluble, insoluble and total dietary fibers:

Soluble, insoluble and total dietary fibers of carrot , yellow sweet potato, pumpkin and chicory leaf powder were determined according to the following procedures:

3. 5.1 Determination of total dietary fiber (T.D.F).

Total dietary fiber (TDF) was determined in the studied sample according to the method described by (A.O.A.C, 1990).

3. 5.2 Determination of soluble and insoluble dietary fibers

Soluble and insoluble dietary fibers were determined according to the method described by Asp *et al.* (1983).

3.6.Evaluation of the Effect of the sources of carotenoid on mycelial growth of *Aspergillus flavus.*

These sources of carotenoid (carrot powder, pumpkin powder, sweet potato yellow, chicory leaf powder) were tested for their fungal toxicity at Zero, 2.5%, 5%, 7.5%, and 10% concentration against a common storage fungi *Aspergillus flavus*. For the preparation of desired concentration, requisite amount of the source of carotenoid was mixed in 10 ml Dotato Dextrose Agar (P.D.A) in Petri dish plates and plates were shaken gently for thorough mixing. The fungus was allowed to grow first on PDA (Potato Dextrose Agar incubated for 5 days (120 hrs.) at 25°C±2°C after which time (*Aspergillus flavus* disk) mycelial disc 5mm diameter of test fungus (taken from a 5 day-old culture) was put into the center of plate. A control medium was used without any addition.

The treated and control sets were incubated at 25°C±2°C for 5 days and observations were recorded on the 6th day. The fungal toxicity, in terms of percentage inhibition of mycelial growth, was calculated following Dixit *et al.*(1978) as follows:

Percentage inhibition of mycelial growth:

$$= \frac{d_c - d_t}{d_c} \times 100$$

where,

d_c = colony diameter in control. (Average increase in mycelial growth in control set).

d_t = colony diameter in treatment. (Average increase in mycelial growth in treatment set).

3. 7. Evaluation of the Effect of carotenoid sources on growth weight of *Aspergillus flavus.*

These sources of carotenoid (carrot powder, pumpkin powder, sweet potato yellow, and chicory leaf powder) were tested for their fungal toxicity at Zero , 2 , 5 , 10 , 15 % and 20 % concentration against one common storage fungus *Aspergillus flavus*. For the

preparation of desired concentration, requisite amount of the source of carotenoid was mixed in 50 ml PDB (Potato Dextrose Broth) in glass milk-bottles (500ml) then shaken gently for thorough mixing. The glass-bottles were inoculated with an agar culture disc (0.5 cm, approx.) of tested fungus and incubated at room temperature (20-25°C) for 21 days, after which the fungal layer was isolated and weighed.

4. RESULTS AND DISCUSSION

4.1. Chemical composition of dehydrated carrots, yellow sweet potato, pumpkin and chicory leaf.

Dehydrated carrots, yellow sweet potato, pumpkin, and chicory leaves were analyzed for their chemical contents, *i.e.*, protein, fat, ash, fiber and moisture contents, and carbohydrate, were determined by difference. The obtained results are shown in Table (1) on a dry basis.

From the results presented in Table (1) it could be noticed that carrot powder, yellow sweet potato powder, pumpkin powder and chicory leaf powder contained 6.37%, 5.82%, 4.86%, and 7.38% protein, 1.68%, 1.26%, 0.82%, and 3.61%fat, 5.65%, 4.13%, 6.45%, and 12.82% ash, 9.52%, 5.57%, 8.03% and 13.86% crude fiber as well as 76.78%, 83.22%, 79.84% and 62.33% total carbohydrates, respectively.

From the same results in Table (1) it could be noticed that the percentages of the drying ratio were found to be 1:7.34, 1:6.32, 1:14.37 and 1:19.47for carrot root, yellow sweet potato, pumpkin and chicory leaf, respectively and moisture contents of the same dehydrated material were 13.63, 8.98, 14.54 and 7.72%, respectively.

These results are confirmed by the results obtained by Ben-Amotz, and Fishler (1998) who found that the percentages of dry weight of carrot, yellow sweet potato and pumpkin were 11.3%, 15.7%, and 6.2% respectively.

From these results it could be observed that chicory leaf powder was found to have the highest content of fat. Sweet potato powder was found to have the highest content of total carbohydrates, while it showed the lowest contents of crude fiber and ash. However, chicory leaf powder showed the highest contents of protein, ash, and crude

fiber, while pumpkin was found to have the lowest contents of protein and fat. The lowest total carbohydrate content was observed for chicory leaf powder.

These results are in agreement with Hamed, *et al.*, (1973a &b), Park, *et al.*, (1997), Ptitchkina, *et al.*, (1998), and Femenia *et al.* (1998).

The above results also agree with those obtained by Ferndale, (1996) who found the chicory, if managed properly, produces leafy growth which is higher in nutritive and mineral content than alfalfa. Protein levels range between 10 to 32 percent depending on plant maturity.

From the results chicory leaf provide a valuable source of fibre-rich material for use in processed foods which is in agreement Femenia, *et al.*, (1998).

Table (1): Chemical composition of dehyrated materials (on a dry weight basis).

Materials / Composition	Carrot	Yellow sweet potato	Pumpkin	Chicory leaf
Protein % (N X 5.26)	6.37	5.82	4.86	7.38
Ether extract %	1.68	1.26	0.82	3.61
Ash %	5.65	4.13	6.45	12.82
Crude fiber %	9.52	5.57	8.03	13.86
Total carbohydrate %	76.78	83.22	79.84	62.33
Moisture %	13.63	8.98	14.54	7.72
Dehydration ratio%	1:7.34	1:6.32	1:14.37	1:19.47

4.2. β-carotene, α-carotene and Vitamin A activity in selected fresh and dehydrated vegetables.

β-carotene and α-carotene contents and vitamin A activity of the fresh and dehydrated vegetables under study were determined and the obtained results are shown in Table (2). It could be noticed that the fresh raw materials, *i.e.*, carrot root, sweet potato, pumpkin and chicory leaf contained 8437, 3643, 7463 and 9271µg β-carotene/100g sample, respectively. The results also indicate that carrot root, pumpkin and chicory leaf contained 3365, 5896 and 6104 µg α-

carotene/100g sample, respectively. However, sweet potato was found to be free from α-carotene. Vitamin A activities were calculated as a Retinol Equivalent (RE) in fresh raw materials, *i.e.* carrot root, yellow sweet potato, pumpkin and chicory leaf. The values were found to be 1686.58, 607.17, 1735.17, and 2053.83 RE, respectively.

The results in the same table show also that β-carotene contents in carrot, sweet potato, pumpkin and chicory leaf powders, were 49542, 9712, 22045, and 55209 (μg/100g), while α-carotene contents were 13996, 0.00, 8712, 9545 (μg/100g) respectively. Vitamin A, activities were found to be 9423.33, 1618.67, 4400.17 and 9996.91 RE, respectively.

These data are in agreement with those of Tee and Lim (1991), Veljkovic, (1992), Park, *et al.*, (1997) Ben-Amota, and Fishler (1998), and Ptitchkina, *et al.*, (1998).

Table (2): β -carotene and α - carotene concentrations (μg /100g) and vitamin A activity in selected fresh and dry materials.

Raw material	α-carotene	β-carotene	RE*
Fresh Carrots	3365	8437	1686.58
Dehydrated Carrots	13996	49542	9423.33
Fresh sweet potato	ND.	3643	607.17
Dehydrated sweet potato	ND.	9712	1618.67
Fresh pumpkin	5896	7463	1735.16
Dehydrated pumpkin	8712	22045	4400.17
Fresh chicory leaf	6104	9271	2053.83
Dehydrated chicory leaf	9545	55209	9996.92

RE = Retinol Equivalent ND. = not detected

4.3. Mineral contents of dehydrated vegetables; carrots, yellow sweet potato, pumpkin, chicory leaf.

Mineral contents, *i.e.*, Magnesium (Mg), Sodium (Na), Zinc (Zn), Manganese (Mn), Iron (Fe), Calcium (Ca), Potassium (K) and

Copper (Cu) of dehydrated materials were determined and the obtained results are shown in Table (3). It could be observed that carrot powder contains the highest amount of Na and pumpkin powder contains the highest amount of K. Chicory leaf powder showed the highest Mg, Zn, Mn. Fe, Ca and Cu contents. However yellow sweet potato powder showed low contents of most minerals.

The data are in agreement with those of Abd-El Magied, (1990), Abd-El Magied, *et al.*, (1991) and Abd-El Magied, *et al.*,(1992).

4.4.Dietary fibers of dehydrated carrot, yellow sweet potato, pumpkin, chicory leaf.

Total dietary fiber (TDR), soluble dietary fiber (SDF) and insoluble dietary fiber (ISDF) contents of dehydrated carrot, yellow sweet potato, pumpkin and chicory leaf powders were determined and the obtained results are shown in Table (4). It could be noticed that dehydrated chicory leaf contained the highest values of TDF (27.31%), and ISDF (17.86%) followed by carrot powder which contained 25.60, 15.34 and 10.26 of these values respectively followed by pumpkin powder which contained 20.65, 7.20 and 13.45 of these values respectively followed by yellow sweet potato powder which also contained 13.62, 6.71 and 6.91 of these values, respectively.

The same results also indicate that ISDF contents of carrot powder, yellow sweet potato powder and chicory leaf powder were greatly higher than SDF contents, while SDF content of pumpkin powder was greatly higher than ISDF content.

Recently, dietary fiber beneficial effects on human health have received much attention. Lack of adequate dietary fibers in the diet is associated with constipation, diverticlosis, cardio vascular disease and cancer while increased consumption of dietary fibers has been advocated as indicated by Trowell *et al.*, (1985).

The high content of ISDF of carrot powder, yellow sweet potato powder, pumpkin powder and chicory leaf powder also were found to be of great importance. These insoluble fibers include

Table (3): Mineral contents of raw materials (mg/100gm) on a dry weight basis.

Raw material	Mineral content (mg/100g)							
	Mg	Na	Zn	Mn	Fe	Ca	K	Cu
Carrot powder	138.70	456.97	7.73	0.29	8.55	184.10	2135.50	1.581
Pumpkin powder	302.63	226.29	4.57	0.54	7.56	166.40	3623.60	1.823
Chicory leaf powder	485.05	225.96	14.01	8.58	116.28	497.90	2385.38	4.804
Yellow sweet potato powder	23.14	130.87	0.34	2.97	2.25	124.90	1607.49	0.784

Table (4): Total dietary fibers, soluble dietary fibers and insoluble dietary fibers of dehyrated carrot, yellow sweet potato, pumpkin and chicory leaf.

Material	*TDF	**ISDF	***SDF	SDF/TDF %	ISDF/TDF %
Carrot powder	25.60	15.34	10.26	40.08	59.92
Yellow sweet potato powder	13.62	6.71	6.91	50.73	49.27
Pumpkin powder	20.65	7.20	13.45	65.13	34.87
Chicory leaf powder	27.31	17.86	9.45	34.60	65.39

***TDF:** Total dietary fiber

****SDF:** Soluble dietary fiber

*****ISDF:** Insoluble dietary fiber

cellulose, hemicellulose and lignin. These provide bulk to the diet and are associated with prevention of diverticulitis as well as being as to prevent constipation, since they tend to draw water into the bowel. They are through to bind bile acids, leading to the extraction of cholesterol. Soluble fiber, although not fibrous in nature, include pectins, gum and, mucilages and are found mostly in vegetables (Augustin *et al.*, 1989).

4.5. Effect of different sources of age carotenoid on the mycelial growth and inhibition percentage of fungi.

The effect of the same dehydrated carrot , yellow sweet potato, bumpkin and chicory leaf powders additions on mycelial weight and the percentage of inhibition was also studied and the obtained results are shown in Tables (5) and Table (6).

From the results presented in Table (5) it could be noticed that addition of carrot powder to the medium (potato dextrose agar) at concentrations of 2.5%, 5%, 7.5% and 10% (g/v) decreased the diameter of growth and the percentages of mycelial inhibition were 55.42%, 73.49%, 81.92% and 86.75%, respectively compared to control (10ml medium only).

These results may be due to the contents of carrot powder from beta-carotene which were found to have antibacterial, antiviral or antifungus activity as reported by Borowitzka, (1993). Mercier, *et al.*, (1993) also reported that carrot contained antifungal and antimicrobial compounds such as polyacetylenes falcarindiol and falcarinol, the production potential of the phytoalexin 6-methoxymellein (6-MM,an ntimicrobial compound).

Moreover, Punja and Zhang (1993) found that carrot contained endochitinase enzyme, which analyses the chitine of the fungi cells.

The results presented in Table (6) show that the addition of carrot powder to the potato dextrose broth at levels of 2, 5, 10, 15 and 20% (g/v) led to decreased dry weight of mycelium by 25.0%, 58.9%, 73.2%, 90.5% and 96.8%, respectively compared to the control sample.

Results presented in Table (5) show that the addition of yellow sweet potato powder to the medium (potato dextrose agar) at concentration of 2.5%, 5%, 7.5% and 10% (g/v) decreased the diameter of growth and the percentages of mycelial inhibition were

8.40%, 37.34%, 53.01% and 63.85%, respectively compared to control (10ml media only).

Moreover, the results presented in Table (6) show that the addition of yellow sweet potato powder to the potato dextrose broth at levels of 2, 5, 10, 15 and 20% (g/v) decreased the dry weight of mycelium by 6.4%, 14.1%, 26.8%, 33.6% and 53.6%, respectively.

However, from the results presented in Table (5) it could be noticed that the addition of pumpkin powder to the media (potato dextrose agar) at concentrations of 2.5%, 5%, 7.5% and 10% (g/v) decreased the diameter of growth and the percentages of myselial inhibition were 22.89%, 44.58%, 66.27% and 77.11%, respectively compared to the control (10ml medium only).

Moreover, the results presented in Table (6) show that the addition of pumpkin powder to the potato dextrose broth at the levels of 2, 5, 10, 15 and 20% (g/v) decreased the dry weight of mycelium by 11.6%, 32.1%, 56.3%, 76.3% and 88.0%, respectively.

From the results presented in Table (5) it could be noticed that the addition of chicory leaf powder to the medium (potato dextrose agar) at concentration of 2.5%, 5%, 7.5% and 10% (g/v) decreased the diameter of growth and the percentages of myselial inhibition were 6.02%, 26.51%, 44.58% and 61.45%, respectively compared to the control (10ml media only).

Results presented in Table (6) show that the addition of chicory leaf powder to the potato dextrose broth at levels of 2, 5, 10, 15 and 20% (g/v) decreased the dry weight of mycelium by 9.8%, 13.4%, 35.0%, 48.4% and 66.6%, respectively.

Table (5): Effect of carrot, yellow sweet potato, pumpkin and chicory leaf powder on the inhibition of mycelial growth of *Aspergillus flavus* (incubation period 120hrs).

Concentration (g/10ml potato dextrose agar)	Diameter (cm)	Inhibition of mycelial growth (%)
Control (10ml media)	8.3	0%
Carrot powder		
0.25g/10ml media (2.5%)	3.7	55.42%
0.50g/10ml media (5%)	2.2	73.49%
0.75g/10ml media (7.5%)	1.5	81.92%
1g/10ml media (10%)	1.1	86.75%
Yellow sweet potato powder		
0.25g/10ml media (2.5%)	7.6	8.40%
0.50g/10ml media (5%)	5.2	37.34%
0.75g/10ml media (7.5%)	3.9	53.01%
1g/10ml media (10%)	3.0	63.85%
Pumpkin powder		
0.25g/10ml media (2.5%)	6.4	22.89%
0.50g/10ml media (5%)	4.6	44.58%
0.75g/10ml media (7.5%)	2.8	66.27%
1g/10ml media (1%)	1.9	77.11%
Chicory leaf powder		
0.25g/10ml media (2.5%)	7.8	6.02%
0.50g/10ml media (5%)	6.1	26.51%
0.75g/10ml media (7.5)	4.6	44.58%
1g/10ml media (10%)	3.2	61.45%

Table (6): Effect of different concentrations of carrot, yellow sweet potato, pumpkin and chicory leaf powders on mycelial growth of *Aspergillus flavus* (dry weight of mycelium).

Concentrations (g/50ml potato dextrose broth)	Dry weight (mg)	Decreasing %
Control (50 ml media)	560	0%
Carrot powder		
1g/50ml media (2%)	420	25.0%
2.5g/50ml media (5%)	230	58.9%
5g/50ml media (10%)	150	73.2%
7.5g/50ml media (15%)	53	90.5%
10g/50ml media (20%)	18	96.8%
Yellow sweet potato powder	524	6.4%
1g/50ml media (2%)	481	14.1%
2.5g/50ml media (5%)	410	26.8%
5g/50ml media (10%)	372	33.6%
7.5g/50ml media (15%)	260	53.6%
10g/50ml media (20%)		
Pumpkin powder		
1g/50ml media (2%)	495	11.6%
2.5g/50ml media (5%)	380	32.1%
5g/50ml media (10%)	245	56.3%
7.5g/50ml media (15%)	133	76.3%
10g/50ml media (20%)	67	88.0%
Chicory leaf powder		
1g/50ml media (2%)	508	9.8%
2.5g/50ml media (5%)	485	13.4%
5g/50ml media (10%)	364	35.0%
7.5g/50ml media (15%)	289	48.4%
10g/50ml media (20%)	187	66.6%

Finally the results indicate that carrot powder was highly inhibitive to growth at the lowest level used 2%. While pumpkin powder showeda slight effect compared to carrot powder followed by sweet potato powder and chicory leaf powder.

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دراسات علي الكاروتينات والعناصر المعدنية والألياف الغذائية وتأثير التضاد الفطري لبعض الخضراوات المستخدمة عادة في مصر

فريال عبد العزيز إسماعيل، سيد محمود الدش،
عيد أحمد محمد عبد الرحيم*، نبيل محمد حسين*

قسم الصناعات الغذائية – كلية الزراعة – جامعة القاهرة
* قسم الخبز والعجائن – معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية

ملخص

أجريت دراسة على أربعة محاصيل خضر ، زرعت فى أرض صفراء هى: الجزر والبطاطا الصفراء و القرع العسلي و هى من أهم محاصيل الخضر في مصر ، و كذلك الشكوريا البرية التى تستخدم فى الريف أو تزرع أحيانا كمحصول خضر. وأوراق الشكوريا المحلية الذي تنمو في الأراضي الصفراء. تم قياس كل من البيتا-كاروتين والألفا-كاروتين بواسطة التحليل الكروماتجرافي (HPLC) في كل من المواد الطازجة والمجففة. أعطت كل من الشكوريا والجزر أعلي محتوي من البيتاكاروتين والألفاكاروتين.

إحتوي كل من الجزر والشكوريا المجفف علي قيم عالية من الألياف الغذائية غير المهضومة بواسطة الإنزيمات (TDF) والألياف الغذائية الذائبة وغير الذائبة.

كانت الشكوريا المجففة أعلي في محتواها من البروتين والعناصر المعدنية وبالأخص عنصر الحديد بالمقارنة بالجزر والبطاطا الصفراء والقرع العسلي المجففين.

أعطى الجزر المجفف أعلي تأثير مثبط لنمو فطر الأسبراجلس عند أقل مستوي مستخدم ٢% من الجزر في البيئة بينما القرع المجفف كان له تأثير أقل بالمقارنة بالجزر يليه البطاطا والشكوريا المجففين .

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (٥٣) العدد الثالث (يوليو ٢٠٠٢):٤٤٣-٤٦٤.