Journal of Food and Dairy Sciences

Journal homepage: www.jfds.mans.edu.eg
Available online at: www.jfds.journals.ekb.eg

Antimicrobial and Anticancer Effect of Bioactive Compounds in Red Beet Roots

Samah M. Abd Elraziek [1*]; Mona M. Khalil[2]; Azza K. Abd El-Hameed [1] and Rania E. El-Gamal [2]

[1]Agriculture Research Center- Giza- Egypt.
[2] Food Industries Dept. Fac.of Agriculture Mansoura Univ.

ABSTRACT

This research was carried out to study the bioactive compounds which found in red beet roots as antimicrobial activity and as anticancers in the lung and breast . Red beet roots were used and a set of technological treatments (drying, blanching than drying and freeze-drying) were carried out to choose the most appropriate treatments to reduce the loss of bioactive substances. Chemical properties, minerals and active substances were estimated for each of the previous treatments. Results showed that the drying treatment of red beet roots exhibited the lowest rates of loss in chemical composition and active substances. Methanolic extract of fresh red beet roots and other treatments of red beet roots as antimicrobial activity of some types of bacteria, fungi and yeasts, and the results showed positive effects on bacteria and yeast. Also, the effect of the methanolic extract of fresh beet roots and other treatment of red beet roots were examined as anticancers on the carcinogenic cells of the lung and breast.The results showed that the IC_{50} obtained from fresh and dried red beet roots extract were 352, 227, 242 and 321 µg/ml on both of breast and lung cancer cells, respectively. Therefore, the study recommends that red beet roots could be added in many foodstuffs to reduce the incidence of cancer.

Keywords: Red Beet root, antimicrobial, anticancer.

INTRODUCTION

Nowacki *et al*.,(2015) said that their studies aims to compare the cytotoxic effect of the beet root NP, silica-beet NP with 5fu (flourarcil) NP, a chemotherapeutic agent against tongue carcinoma cell line scc-090. Beet root appears to be a powerful dietary source of antioxidant agent with anti-cancer effect due to ability to scavenge free radicals. Application of silica-nanoparticles (SiNP) in cancer treatment are promising, with increased data suggesting anti-proliferative effects in cancer cells. The MTT cytotoxicity assay revealed that beat root (nano) and Si-beat roots (nano) have obbvious cytotoxicity on SSC-090 cancer cell lines at low significant IC50 value as 0.73µg/ ml and 2.94 µg/ml respectively. While 5FU drug revealed obvious cytotoxicity on SSC-090 cancer cell lines at higher value IC50 8.83 ug/ml. these results denote that low doses of beat root (nano) may exert remarkable cell death on tongue cancer cells line scc-090. The finely results demonstrate that beet root NP could be capable of inducing cancer cell death with prominent apoptosis at very low ic50 value 0.73µg/ml against oral tongue carcinoma SCC-090 cell lines.

Saani and Awrence, (2016) evaluation of pigments as antioxidant and antibacterial agents from Beta Vulgaris Linn . In the antibacterial test was examined against gram positive (*B. subtilis, S. aureus*) and gram negative (*E. coli, S. dysenteriae*) bacterial strains.

They found that methanolic extract exhibits strong activity against both gram positive and gram negative strains and showed highest activity against B subtilis with 18.2 mm ZI. On the other hand ethanolic extract showed weak antibacterial activity that was comparable with the standard. Methanolic and ethanolic extracts exhibited antibacterial activity in descending order *B. subtilis>S. aureus>E. coli>S. dysenteriae*. This result have similar observation with that of TPC as the methanolic extract possessed higher phenolic content than ethanolic extract. Thus Beet root extracts could be used as an effective antibacterial agent.

So this research was carried out to study the bioactive compounds which found in red beet roots as antimicrobial activity and as anticancer in the lung and breast .

MATERIALS AND METHODS

Materials

Red beet roots (*Beta vulgaris L.*) were obtained from Field Crops Research Institute, Agricultural Research Center, Giza, Egypt.

Chemicals

All chemicals analytical and reagents used in this study were purched from El- Gomhouria Company for medical materials,Giza,Egypt.

Nutrient agar media

Beef extract 3.0 g , Peptone 5.0 g and Agar 15.0 g in water which were purchased from Food Technology Research Inst., Agric. Res. Center .Egypt (Salem *et al*.,2014).

Methods

Technological Methods

Preparation of samples:

Fresh red beet roots were immediately washed thoroughly with tap water ,cleaned, drained , then cut in to small pieces and divided into two groups:

* **Corresponding author.**
E-mail address: samah.mohamed395@yahoo.com
DOI: 10.21608/jfds.2021.188353

Frist group were divided into 3 parts subjected to different pre-treatment process as follow:

A) Drying in air oven at at 60 ºC ±5 for 72 hours.

B) Blanched in steam boiling for 10 minutes, then drying in the air oven at 60°C for 72 hours.

C) Dehydration with freeze drying process for 5-7 hours.

While second group examined as control (raw fresh red beet root). All the previous treatments packed in Polyethylene pouches then stored at ambient temperature for analysis.

Analytical Methods

Gross chemical composition of red beet roots

Fresh red beet roots and their treatments were chemicaly analyzed for moisture, ash, total acidity, crude protein, total fat and crude fiber using A.O.A.C. methods(2016) in Food Technology Research Inst., Agric. Res.

The pH value was calculated using a Beckman pH metre with a glass electrode at 25°C according to the methods used (A.O.A.C, 2010). Minerals were determined according to the methods of A.O.A.C, 2016).

Total and reducing sugars determined as the methods of Somogi, (1952) and Nelson (1974) in Food Technology Research Inst., Agric. Res**.**

Bioactive compounds:

Total phenol content was determined according to the method described by Danial and George, (1979). Total flavonoids were determinned at 440 nm (Zhisen,1999). Betalains pigment from red beet roots was extracted by Francis (2000). Total betalains was expressed as mg betalains/ 100g using the following equation as determined by Castellar *et al*., (2003). The free radical capacity was carried out as reported by Mansouri *et al*.,(2005), at Food Technology Research Institute, Agric. Res. Center .Giza ,Egypt.

Phenolic compounds were determined by HPLC according to the method of Goupy *et al*., (1999) in Food Technology Research Inst., Agric. Res. Center, also flavonoid compounds determined by HPLC according to method of (Mattila *et al*., 2000).

Preparation of fresh and selected dried samples of red beet roots extracts for Antimicrobial activity and Cytotoxic activity:

Fifty gram dry matter of red beet roots were extracted by 500 ml of methanol. The extracts were filtered and evaporated by rotary evaporator at 45°C. Then the dried extracts were stored at -18°C until measuring the cytotoxicity for anticancer by SRB assay ″Sulforhodamine B Colorimetric assay″. AS mentioned by Skehan *et al* .(1990) for determining potential cytotoxicity at the National Cancer Institute, Cairo, Egypt.

Determination of Antimicrobial activity :

Antimicrobial activity was determined using the system defined by Fadda and Hala (2013) at the Food Technology Research Institute, Agric.Res.Center, Giza, Egypt.

Cytotoxic activity as anticancer:

Cytotoxicity for anticancer by SRB assay ″Sulforhodamine B Colorimetric assay″, It was used method of Skehan *et al* .(1990) for determining potential cytotoxicity, the half maximal inhibitory concentration (IC_{50}) was calculated from the equation of the dose response curve. The experiment was conducted at the National Cancer Institute, Cairo, Egypt.

RESULTS AND DISCUSSIONS

Physicochemical properties of Fresh red beet roots and their dried treatments

The results in Table (1) showed that moisture content, pH value, total acidity, ash, crude fiber, crude protein and fat were 87.354%, 7.44, 0.029%, 9.591%, 26.885%, 10.71% and 2.13% for fresh red beet roots respectively, while total sugars and reducing sugars were 50.505 and 18.345% respectively, these results nearest to the results obtained by Kale *et al*., (2018) found that the chemical composition of red beet roots at fresh weight were moisture content was found to be 87.4 percent, carbohydrate 7.59 percent, Protein 1.35 percent, fat 0.3 percent and betalain content of beetroot was recorded to be 14.20 mg/100g. The other parameters such as viscosity, acidity and pH of beetroot juice were indicated 0.72 Pa s, 0.014 percent and 6.3 respectively. The mineral showed highest in sodium 72.58, potassium 30.12 followed by zinc and iron 0.21 and 0.75 mg/100g respectively. Dried red beet roots treatments showed decrement in the chemical composition compared with fresh red beet roots, which heat air oven dried recorded 7.969%, 7.573, 15.99, 10.09, 2.00, 50.928 and 12.865% for moisture, ash, crude fiber, protein, fat, total sugars and reducing sugars respectively, a high increase was observed in pH value (7.680) and total acidity (0.061%). A clear decrease was observed in the chemical composition of steam blanched heat air oven dried and freeze dried treatments when compared with fresh red beet roots except protein content , fats and reducing sugars of freeze dried treatment increased to 11.75, 2.27 and 14.501% respectively compared to fresh red beet roots USDA, (2011) revealed that fresh red beet roots contain 87.57% moisture content, 9.56% carbohydrates, 29.3% crude fiber ,70.7% sugar, 1.9% protein and 0.1% lipids, also red beet roots considered a source of potassium, choline, vitamin C, niacin and betalaine, nitrogen, containing pigments.

Table 1. Physicochemical properties of Fresh and dried red beet roots treatments (g/100gm dry weight basis).

Treatment properties	Samples of red beet roots			
	Fresh	Oven dried	Steam blanched - dried	Freeze dried
Moisture%	87.354	7.969	9.157	5.577
pH	7.440	7.680	7.200	7.520
Acidity (as citric acid)%	0.029	0.061	0.051	0.057
Ash%	9.591	7.573	8.502	3.081
Crude Fiber%	26.885	15.990	16.080	19.556
Protein%	10.710	10.090	9.100	11.750
Total Fat %	2.130	2.000	1.860	2.270
Total sugar%	50.505	50.928	43.700	41.771
Reducing sugar%	18.345	12.865	8.971	14.501

Minerals contents

Minerals contents of Fresh red beet roots and their dried treatments (mg/100gm D.W).

Data in Table (2) observed that fresh red beet roots had high concentration of sodium(Na), potassium(K), phosphorus(P), calcium(Ca) and magnesium(Mg) which recorded 3321.208, 2288.792, 1739.680, 957.613 and 744.657 mg/100gm respectively. Concerning dried red

beet roots by heat air oven the results showed that potassium increased to 2749.073 mg/100gm, while the other minerals (sodium, calcium, magnesium and phosphorus) decreased gradually. The data in the same Table illustrated the high minerals content in the treatment of steam blanched heat air oven dried of red beet roots, it was found that potassium increased to 2818.048 mg/100gm while sodium, calcium, phosphorus and magnesium decreased to 1497.088, 922.749, 275.20 and 219.828 mg/100gm respectively compared with the fresh sample, on the other hand a clear decrease was observed in all the macro elements after treated red beet roots by freeze dried. The macro elements of fresh red beet roots such as manganese, iron and zinc were 1.531, 1.595 and 0.584 mg/100gm. Air oven dried and steam blanched heat air oven dried led to decrease in manganese and iron and increase in zinc, while freeze dried treatment led to a high increase in manganese (3.197 mg/100gm) and decrease in zinc (0.370 mg/100gm) .

These results are in little agreement with the results of the USDA (2011), and this may be due to the difference in cultivar, soil and fertilization (Marko *et al*., 2019).

Table 2. Minerals content of Fresh red beet roots and their dried treatments, (mg/100gm dry weight basis).

Treatment Minerals	Samples of red beet roots			
	Fresh	Oven dried	Steam blanched - dried	Freeze dried
P	1739.680	282.513	275.20	317.651
K	2288.792	2749.073	2818.048	1281.196
Na	3321.208	1423.433	1497.088	1334.138
Ca	957.913	857.375	922.749	116.472
Mg	744.657	662.752	219.828	105.883
Mn	1.531	0.8 24	0.7 64	3.197
Fe	1.595	0.7 05	0. 630	0.0232
Zn	0.584	0. 653	0. 684	0.370

Bioactive compounds:

Bioactive compounds , radical scavenging activity (DPPH) and pigments of Fresh red beet roots and their dried treatments (mg/100gm dry weight basis).

Data in Table (3) revealed that total phenolic compounds of fresh red beet roots were 4.554 mg/100gm, raised to 9.710 and 10.843 mg/100gm for heat air oven dried and steam blanched heat air oven dried treatments respectively, a slight decrease was observed after freeze dried treatment (4.129 mg/100gm), The increase in total phenolic compounds may be related to the conversion of low molecular weight tannin to condensed tannin(HMWT) which showed an increase in treatment as mentioned Lutz *et al*., (2015)who reported that phrnolic compounds may either increase or decrease after drying, depending not only on the cultivar, but also on the production system used (conventional or organic).,.also said that TPC increased in GS apple and dehydrated tomato, by 4.9 and 56.9 fold, respectively. This may be attributed to the release of bound phenolics, hydrolysis of complex phenolics (tannins, lignins), leading to the production of low MW compounds among others.

Concerning total flavonoids compounds of fresh red beet roots, it contain 2.332 mg/100gm increased to 6.526 and 7.860 mg/100gm for heat air oven dried and steam blanched heat air oven dried treatments respectively, while decreased to 0.116 mg/100gm in the treatment of freeze dried, Dalmadi *et al*., (2005) reported that the increase and decrease were depending on the ability and sensitivity of every phenolic and flavonoids compound to heat and oxidation during processing and storage.

Radical scavenging activity (DPPH) was 73.37% in fresh red beet roots, decreased to 72.41%, 51.39% and 57% for heat air oven dried, steam blanched heat air oven dried and freeze dried treatments respectively, Awad *et al*.,(2011) reported that radical scavenging activity of fresh red beet roots and their dried treatments may be related to non-enzymatic antioxidant (phenolic , flavonoids , pigments) and enzymatic antioxidants (peroxidase, catalase and super oxide dismutase), also the antioxidant of fruits, vegetables may react with ROS(Reactive Oxidation Species) to damage them directly by donating electrons to ellminate the unpaired condition of ROS and they reduce the cellular free radical by enhancing the activities indirectly and expression of antioxidant enzymes that due to protection of lipid peroxidation and DNA damage as reported by EL-Far *et al*.,(2016).

While Sheila *et al*.,(2017) revealed that beet root with peel contains maximum amount of water soluble nitrogenous pigments called betalains (54%) which utilized as natural food colorants in food industry and it also scavenge free radicals. Betalains and other phenolic compounds present in red beet roots peel decreases oxidative damage of lipid improves antioxidant status in humans, scavenges free radicals, exhibits inflammatory effect, anticancer property and reduces risk of chronic illnesses such as cancer and cardiovascular diseases.

Concerning betalains content in fresh red beet roots and their dried treatments, the data in Table (3) showed that the average amount betalains in fresh red beet roots was estimated to be 495.91 mg/100gm.

Ravichandran *et al*.,(2013) found that there was a decrease in betaxanthin content of 18%, 23% and 33% and a decrease in betacyanin of 6%, 22% and 51% after heating beets at 80°C for 60s, 120s and 180s respectively, also when thermally processed, of betalains are converted to decarboxylated derivatives (Nemzer *et al*.,2011). Varner,(2014) studied the effect of drying the crushed red beet roots with vacuum belt dryer at three temperature (75, 85, 95°C) and with addition of three level of maltodextrin (0, 0.3, 0.6 g maltodextrin /g red beet root solids), the results showed that mg betalnin /g powder dry basis was 0.55 also neither temperature nor maltodextrin content led to degradation of betalains.

Renata *et al*.,(2016) found that all beet root juices were abundant in betalains, Betanin 3-o-glucoside concentration ranged between 156.45 and 532.42 mg/ 100g . Betalains are more resistant to temperature changes than other natural pigments.

Table 3. Bioactive compound and (DPPH%) of Fresh red beet roots and their dried treatments.

Treatment properties	Samples of red beet roots			
	Fresh	Oven dried	Steam blanched - dried	Freeze dried
**Total phenolic compounds	4.554	9.710	10.843	4.129
***Total flavonoid compounds	2.332	6.526	7.860	0.116
Betalain Pigment mg/100gm	495.91	345.5	389.59	210.375
Antioxidant by DPPH%	73.37	72.41	51.39	57

****mg/100gm as Galic acid. ***mg/100gm as Quercetin.**

Fractionation of phenolic compounds of fresh red beet roots and their dried treatments (mg/100gm dry weight basis) .

From Table (4) it was nearly about 19 compounds were fractionated in all red beet roots samples, fresh red beet roots had the highest concentration of Pyrogallol being (422.74 µg /100gm), followed by protocatechuic acid (150.40 µg /100g), catachein (101.37 µg /g) , clorogenic acid (77.570 µg /100 g). catechol (38.030 µg /100 g) and vanillic acid (35.031 µg /100 g), while the other identified phenolic compounds had a moderate and little values concentration as shown in Table (4). After dried all treatments have a clear decrease was observed, while a little increase was noticed in gallic acid for heat air oven dried treatment to 33.100 µg /100 g ,benzoic acid increased to 26.800 µg /100 g and 49.701 µg /100 g for heat air oven dried and steam blanched heat air oven dried respectively, caffic acid increased to 5.5 µg /100 g for steam blanched heat air oven dried treatment, while vanillic acid increased to 60.80 and 38.60 µg /100 g for heat air oven dried and freeze dried treatments while 3.4.5 methoxy cinnamic increased from 4.190 µg /100 g for fresh red beet roots to 6.43, 4.32 and 7.95 µg /100 g for heat air oven dried, blanched heat air oven dried and freeze dried treatments respectively as shown in the same Table .

Finally , decreases in the phenolic compounds may be related to the oxidation of phenolic compounds to quinone (Dalmadi *et al*.,2005), also the increase in some phenolic compounds may be related to non-enzymatic browning reaction as mentioned by (Vranova and Ciesarva,2007).

Renata *et al*.,(2014) revealed that Poly phenols and phenolic acids content (mg /100gm) of fresh red beet root juice were 129.31±19.26 and 127.30±19.27 respectively, while the major phenolic compounds were Gallic acid (120.37±19.28), Chlorogenic acid (5.11±0.38), Caffic acid (0.49±0.07) and Ferulic acid 1.34±0.10 mg $100g^{-1}$ respectively .

Sheila *et al*.,(2017), found that phenol and flavonoid content of methanolic extract of beet roots was 99.1 µg/mg GAE and 4.76 µg/mg QE while for acetone extract the phenol content and flavonoids content was found to be 46.53 µg/mg GAE and 4.51 µg/mg QE respectively.

Fractionation of flavonoids compounds of fresh red beet roots and their dried treatments (mg/100gm dry weight basis).

Results showed about 17 flavonoids compounds were Fractionated in all red beet roots treatments. Data presented in Table (5) showed that the high concentration of Apignin 6-arabinose was 1470.58 µg /100gm in fresh red beet roots compared to the other treatments. Results also showed little concentration of Luteolin. 7-glucose, Rosmarinic, Apignin 7- glucose, Hespertin, Kampferol , Apigenin,Apignin 7-O-neohespiroside and Acacetin 7 neo-rutinoside were observed in fresh red beet roots. Heat air oven dried treatment led an observed decrease in Luteolin. 7-glucose (15.1 µg /100gm) and Apignin 7-O-neohespiroside (14.2 µg /100gm) also, decreased to 9.0 for the treatment of steam blanched heat air oven dried. All the other flavoglycosides decreased in dried treatments. The major flavonoids of fresh red beet roots and their treatments were (Narengin, Rosmarinic, Hesperdine, Rutin, Quercetrin, Narengenin, Quercetin, Hespertin, Kampferol and Apigenin) were the major which recorded 71.48, 11.70, 75. 04, 31.63, 38.35,32.57,16 .84,6.72,3.63 and 10. 91 µg /100gm D.W respectively,all treatments were decreased except heat air oven dried treatment increased in Hesperdine (195µg /100gm).

A relative variation was observed in the other flavonoids which decrease or increase after dried treatments Lutz *et al.,* (2015).

Table 4. Phenolic compounds of of Fresh red beet roots and their dried treatments by HPLC (µg /100gm dry weight basis).

Treatment Phenolic compounds	Samples of red beet roots			
	Fresh	Oven dried	Steam blanched - dried	Freeze dried
Pyrogallol	422.74	49.7	203	362
Gallic acid	32.81	33.1	10.5	6.08
Protocatechuic acid	150.40	84.1	42.4	15.4
Catechol	38.03	18.5	15.3	7.99
4-Aminobenzoic	9.09	3.52	3.02	0.698
Catachein	101.37	82.3	16.3	30.6
Chlorogenic	77.57	3.19	16.4	8.92
P-OH-benzoic	18.66	6.58	11.6	14.2
Benzoic acid	24.35	26.8	49.7	ND
Caffic acid	4.42	1.06	5.5	4.04
Vanillic acid	35.03	60.8	ND	38.6
P-Coumaric	12.57	0.793	1.81	2.36
Caffeine	ND	ND	13.1	ND
Ferulic acid	19.29	1.47	3.17	6.9
Iso- Ferulic	ND	4.15	3.32	4.99
Alpha-Coumaric	6.08	1.4	2.04	0.571
Coumarin	9.33	4.009	1.88	1.58
3,4,5-methoxy-cinnamic	4.19	6.43	4.32	7.95
3-OH tyrosol	ND	ND	ND	7.08
Total phenolic compounds	965.93	307	403	519

ND =Not Detected

Table 5. Flavonoids compound of Fresh red beet roots and their dried treatments, (µg /100gm dry weight basis).

Treatment Flavonoids compounds	Samples of red beet roots			
	Fresh	Oven dried	Steam blanched - dried	Freeze dried
Apignin 6-arabinose	1470.58	841	960	237
Narengin	71.48	35.2	11.8	11.4
Rosmarinic	11.70	3.57	4.38	1.83
Apignin 6-rhaminose	ND	ND	ND	ND
Luteolin. 7-glucose	16.84	15.1	8.07	9.97
Hesperdine	75.04	195	66.3	55.2
Rutin	31.63	6.40	1.78	4.36
Apignin 7- glucose	3.55	1.69	0.374	0.455
Apignin 7-O-neohespiroside	13.20	14.2	9.0	4.96
Quercetrin	38.35	33.5	9.74	16.2
Narengenin	32.57	6.10	3.89	3.31
Quercetin	16.84	5.20	3.45	2.12
Hespertin	6.72	2.47	4.66	0.794
Kampfeerol 3-2-p-comaroyl	ND	ND	ND	8.79
Acacetin 7 neo-rutinoside	17.47	8.17	5.0	3.87
Kampferol	3.63	0.825	0.627	0.603
Apigenin	10.91	7.74	6.88	0.825
Total Flavonoids compounds	1820.21	1176	1095	365

ND =Not Detected

Effect of fresh red beet roots and their dried treatments extracts as antimicrobial agents.

In the present study the antimicrobial activities of fresh red beet roots and their dried treatments extracts with different concentration (100, 200 and 400 µg/1mL) against some pathogenic microorganisms bacteria namely (*Escherichia coli, Salmonella typhi, Staphylococcus aureus and Bacillus cereus*), mold (*Asperigillus flavus*) and yeast, were shown in Table (6). The results indicated that the highest inhibition effect was found in heat air oven dried red beet root treatment extract with the concentration of 400, 200 and 100 µL which led to 2.5, 2.2 and 0.8 cm inhibition zone for *Escherichia coli* followed by freeze dried, fresh red beet roots extracts and steam blanched heat air oven dried extract respectively. Heat air oven dried treatment extract had the highest inhibition zone against *Salmonella* being (3.2 cm inhibition zone), followed by steam blanched oven dried extract was (3.1 cm), freeze dried treatment and fresh red beet roots extracts (2.9 and 2.9 cm inhibition zone) respectively. Also in all different concentration(100, 200 and 400 µg/1mL) of fresh red beet roots and their dried treatments extracts led to an inhibition zone against *Staphylococcus aureus* as shown in Table (6) recorded 2.4, 2.1 and 2 cm inhibition zone for fresh red beet roots, 1.7 and 1.5 cm for freeze dried treatment extract, 1.5, 1.4 and 1.2 for, heat air oven dried treatment extract and 1.3, 1.1 and 1.1 cm inhibition zone for steam blanched heat air oven dried treatment extract against *Staphylococcus aureus* respectively. On the other hand an inhibition zone was recorded against pathogenic bacteria (*Bacillus cereus*) and yeast at concentration of 400 µL for heat air oven dried, steam blanched heat air oven dried and freeze dried treatments which accounted (2.5, 2.5 cm), (2.1, 2.0 cm) and (2.3, 2.2 cm) respectively. Also no effect on the inhibition zone for all fresh red beet roots and their dried treatments extracts was observed against mold (*Asperigillus flavus*) .

Koochak *et al*.,2010 found that The extracts of ethanolic of *Beta Vulgaris L* against antibacterial, and they reported that the extract did not possess inhibitory activity, while Rauha *et al*.,(2000) tasted the antimicrobial activity of methanolic extract of beet roots (500 µL of extract, 1ml/ml) and observed only slight antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*.

Sheila *et al*.,(2017) found that maximum inhibitory effect was seen in methanolic extract of red beet roots against four bacterial strains such as *Escherichia coli, Staphylococcus aureus, Shigella flexneri* and *Klebsiella pneumoniae.*

Table 6. Effect of fresh red beet roots and their treatments against some of microbial pathogenic (cm inhibition zone) .

Samples	Conc µg/L	E.coli	*Salmonella typhi*	*Asperigillus flavus*	*Staphylococcus aureus*	*Bacillus cereus*	*yeast*
Fresh red beet roots	400 µg/L	2.2	2.9	ND	2.4cm	ND	ND
	200 µg/L	2.0	2.2	ND	2.1cm	ND	ND
	100 µg/L	0.2	0.4	ND	2cm	ND	ND
Oven dried red beet roots	400 µg/L	2.5cm	3.2cm	ND	1.5cm	2.5cm	2.5cm
	200 µg/L	2,2	ND	ND	1.4cm	ND	ND
	100 µg/L	0.8	ND	ND	1.2cm	ND	ND
Steam blanched - dried red beet roots	400 µg/L	2.0	3.1	ND	1.3cm	2.1	2.0
	200 µg/L	1.1	ND	ND	1.1cm	ND	ND
	100 µg/L	ND	ND	ND	1.1cm	ND	ND
Freeze dried red beet roots	400 µg/L	2.4	2.9	ND	1.7cm	2.3	2.2
	200 µg/L	2,0	ND	ND	1.5cm	ND	ND
	100 µg/L	0.3	ND	ND	ND	ND	ND

ND =Not Detected

Biological evaluation

Cytotoxic effect of red beet extract as anticarcinogenic of red beet roots extracts and their treatments on some cancer cell.

Studying the role of fresh red beet roots and dried red beet roots extracts as anticancer on human breast cancer cell line (MCF7) its influence has been traced in vitro as cytotoxicity in (Table 7) , it was observed that the best concentration (lowest concentration) which lead to decrease cell viability to 50% (IC50) were 352 and 227 µg /ml of fresh and dried red beet roots respectively. The best concentration leading to the lowest percentage of surviving fraction on breast cancer cell line (MCF7) was (33.8 and 26.1 %) in the concentration of 250 and 500 µg /ml for fresh red beet roots and dried red beet roots extracts respectively as shown in Table (7).

The effect of fresh red beet roots and dried red beet roots extracts on lung cancer cells line (HI299) its influence has been traced in vitro as cytotoxicity in (Table 8) and it was noticed that the IC50 of fresh and dried red beet roots extracts were 242 and 321 ug/ml respectively .By using the concentration of 250 µg /ml , it was showed the lowest percentage of cells viability and surviving fraction of human lung cell line (HI299) in fresh red beet roots was 48.2 %, and 48 % at the concentration 500 µg /ml for dried red beet roots extracts respectively .

Red beet root (*B. vulgaris L.*) contain phytochemicals that have beneficial effects on human health. C-Glycosyl Flavonoids from *B. vulgaris* cicla and betalains from *B. vulgaris* rubra showed strong antioxidant, anticancer, and anti-inflammatory activities,Betalains through dietary use block the proliferation of tumor cells and inhibit their pro-survival pathways. Betanin-enriched red beetroot (Beta vulgaris L.) extract induces apoptosis and autophagic cell death in MCF-7 Cells (Ninfali *et al*.,2017).

Nowacki *et al*.,2015 found that Beetroot extracts showed cytotoxic effect on cancer cells. Betanin/isobetanin significantly decreased cancer cell proliferation and viability in MCF-7-treated cells.

Govind *et al*., (2011) studied and compared the cytotoxic effect of the red beetroot extract with anticancer drug, doxorubicin (adriamycin) in the androgen-independent human prostate cancer cells (PC-3) and in the

wellestablished estrogen receptor-positive human breast cancer cells (MCF-7). This red colored anticancer antibiotic was selected for comparative cytotoxic study because its chemical structure with a planar configuration of an aromatic chromophore attached to a sugar molecule is remarkably similar to that of betanin, the beetroot extract constituent primarily responsible for its red color. Both doxorubicin and the beetroot extract exhibited a dose-dependent cytotoxic effect in the two cancer cell lines tested. Although the cytotoxicity of the beetroot extract was significantly lower when compared to doxorubicin, it continued to decrease the growth rate of the PC-3 cells (3.7% in 3 days vs. 12.5% in 7 days) when tested at the concentration of 29 g/ml.

Table 7. Cytotoxic effect of fresh and dried red beet roots extracts against Breast cancer cells (MCF7).

Samples of red beet roots	Surviving fraction of human carcinoma cell line %	Concentration (µg/mL) 0	62.5	125	250	500	IC_{50} (µg/mL)
Fresh	Surviving fraction of MCF7%	100	100	91.7	33.8	37.5	352
Dried	Surviving fraction of MCF7%	100	97.3	81.7	42.8	26.1	227

IC_{50}:Concentration able to decrease cell viability by 50% versus control cultures
***MCF7: Breast carcinoma cell line**

Table 8. Cytotoxic effect of fresh and dried red beet roots extracts against lung cancer cells (H1299).

Samples of red beet roots	Surviving fraction of human carcinoma cell line %	Concentration (µg/mL) 0	62.5	125	250	500	IC_{50} (µg/mL)
Fresh	Surviving fraction of H1299%	100	95.1	97	48.2	56	242
Dried	Surviving fraction of H1299%	100	85.6	72	51.2	48	321

IC_{50}:Concentration able to decrease cell viability by 50% versus control cultures
***H1299: lung carcinoma cell line**

RECOMMENDATIONS

The obtained data of this research pointed that red beet roots rich by protein, fibers ,minerals and a good source of antioxidant compounds such as phenolic, flavonoids compounds and pigments which play an important role as anticancer and antimicrobial activities especially fresh and dried of these vegetables, so we must not neglect the importance of bioactive products.

REFERENCES

A.O.A.C (2010) .Association of Official Analytical Chemists international Official Methods of Analysis 20th ed.Washington,DC,USA.

A.O.A.C (2016).Association of Official Analytical Chemists international Official Methods of Analysis 20th ed.Washinton,DC,USA.

Awad, M. A.; Al-Qurashia, A.D.; Mohamed, S.A.(2011). Antioxidant capacity, antioxidant compounds and antioxidant enzyme activities in five date cultivars during development and ripening. *J. of Sci. Hort.*; 129: 688-693.

Babarykin, D. ; Smirnova, G. ; Pundinsh, I. ; Vasiljeva, S. ; Krumina, G. and Agejchenko, V. (2019). Red Beet (*Beta vulgaris*) Impact on Human Health. *Journal of Biosciences and Medicines*, 2019, 7, 61-79.

Castellar,MR.; Obo´n, JM.; Alacid,M.; and Ferna´ndez-Lo´pez, JA.(2003). Color properties and stability of betacyanins from Opuntia fruits. J. Agr. Food Chem.51, 2772-2776.

Dalmadi, I.; Rapeanu, G.A. and Hendrickx, M. (2005). Characterization and Inactivation by Thermal and Pressure Processing of Strawberry (*Fragaria Ananassa*) Polyphenol Oxidase: A Kinetic Study, Journal of Food Biochemistry, 30: pp. 56–76.

Danial, J.A. and George, S.M. (1979). Peach seed dormancy in relation to indigenous inhibitors and applied growth substances, J. American Society. Hort. Sci., 27: pp. 651-654.

El-Far, A.H.; Shaheen, H.M. and Mousa, S.A.(2016).Date palm (phoenix dactylifera. L) protection and remedy food. I Med Pub J. Current Trends in Nutraceuticals; 1:2-9.

Fadda,A.A. and Hala, M.R. (2013). Synthesis and antimicrobial activity of some novel hydrazide, benzochromenone, dihydropyridine, pyrrole, thiazole and thiophene derivatives-Euro.J.of Med. Chem; 70: 419-426.

Francis, F. G. (2000). Anthocyanin and betalains composition and application.Cereal Food World, 45: 208-213.

Goupy, P.; Hugues, M.P. and Amiot, M.J. (1999). Antioxidant composition and activity of barley (Hordeum vulgare)and malt extracts and of isolated phenolic compounds. J. Sci. Food Agric., 79: pp. 1625-1634.

Govind ,J.; Kapadia , Magnus, A.; Azuine, G.; Subba, R.; Takanari, A.; Akira, I.; and Harukuni, T.(2011).Cytotoxic Effect of the Red Beetroot (*Beta vulgaris L.*) Extract Compared to Doxorubicin (Adriamycin) in the Human Prostate (PC-3) and Breast (MCF-7) Cancer Cell Lines . Affiliations expand Anti-Cancer Agents in Medicinal Chemistry, 2011, 11(3): 280-284.

Kale ,RG.; Sawate, AR.; Kshirsagar, RB.; Patil, BM and Mane, RP .(2018). Studies on evaluation of physical and chemical composition of beetroot (*Beta vulgaris* L.) International Journal of Chemical Studies 2018; 6(2): 2977-2979.

Koochak, H.; Seyyednejad, SM.; Motamedi, H.; Preliminary .(2010). Study on the anti-microbial activity of some medicinal plants of Khuzestan (Iran). Asian Pac. J. Trop. Med. 2010; 3:180-184.

Lutz, M ,José, H, &Carolina, H. (2015).Phenolic content and antioxidant capacity in fresh and dry fruits and vegetables grown in Chile Journal of Food. Volume 13, 2015 - Pages 541-547.

Mansouri,A.;Embarek, G.; Kokkalou, E.; and Kefalas, P.(2005). Phenolic profile and antioxidant activity of Algerian ripe data palm fruit *(phoenix dactylifera.L). J. of Food Chem.*; 89: 411-420.

Marko PetekID 1, Nina Toth 2 , Marija ecina 3 , Tomislav Karaz˘ija1 4 , Boris Lazarević 5, Igor PalčićID 6, Szilvia Veres 7 , Mirjana, P. (2019). Beetroot mineral composition affected by mineral and organic fertilization . RESEARCH ARTICLE September 2019 PLoS ONE 14(9):e0221767.

Mattila,P.;Astola,J.andKumpulainen,J.(2000).Determinatio n of flavonoid in plant material by HPLC with diode – array and electro-array detections .J.Agric.Food Chem.,48:520-528.

Nelson, N. (1974). A photometric adaptation of the somogi methods for determination of glucose J. Biological chemistry.153:375- 380.

Nemzer, B.;Pietrzkowski, Z.; Sporna, A.; Stalica, P.; Thresher, W.; Michalowski, T. and Wybraniec, S. (2011). Betalainic and nutritional profiles of pigment-enriched red beet root (*Beta vulgaris* L.) dried extracts. *Food Chemistry*, 127(1), 42-53.

Ninfali, P.;Antonini, E.; Frati, A. and Scarpa, ES.(2017). C-glycosyl flavonoids from *Beta vulgaris* cicla and betalains from *Beta vulgaris* rubra: Antioxidant, anticancer and antiinflammatory activities-A review. Phytother Res 2017;31:871-84.

Nowacki, L.; Vigneron, P.;Rotellini, L.;Cazzola, H.; Merlier, F.; Prost, E.;Ralanairina, R.;Gadonna, JP.; Rossi, C.; Vayssade,M. and Phytother, R. (2015).Betanin-Enriched Red Beetroot (*Beta vulgaris L.*) Extract Induces Apoptosis and Autophagic Cell Death in MCF-7 Cells. Dec;29(12):1964-73. 2015.

Ravichandran, K.; Saw, N.M.M.T.; Mohdaly, A. A. A.; Gabr, A.M.M.; Kastell, A.; Riedel, H. and Smetanska, I. (2013). Impact of processing of red beet on betalain content and antioxidant activity. *Food Research International*, 50(2013), 670-675.

Rauha, JP.;Remes, S.; Heinonen, M.;Hopia, A.; Kahkonen, M. and Kujala, T.(2000) .Antimicrobial effects of Finnish plant extract containing flavonoids and other phenolic compounds. Int. J.Food Microbiol. 2000; 56: 3-12.

Renata ,K.;, Ewelina, H.;, Janusz, L.;Nadzieja, D.; Anna, K.; Tõnu, P.; Darja, M.;Anne, L.;, Dariusz, G.; and Ewa,R.(2014). Beetroot (*Beta vulgarisL.*) and naturallyfermented beetroot juices from organic and conventional production: metabolomics,antioxidant levels and anticancer activity. Research Article. J Sci Food Agric2014;94: 2618–2629.

Renata, K.; Agata, S.; Ewelina, H.; Dominika, Ś.;and Ewa, R.(2016). Chemical Composition of Selected Beetroot Juices in Relation to Beetroot Production System and Processing Technology. Not Bot Horti Agrobo, 2016, 44(2):491-498.

Roomi MW, Niedzwiecki A, Rath M (2018). Scientific Evaluation of Dietary Factors in Cancer. J Nutri Med Diet Care 4:029. doi.org/10.23937/2572-3278.1510029.

Saani, M. and, Awrence, R. (2016) .Evaluation of pigments as antioxidant and antibacterial agents from beta vulgaris linn . Int J Curr Pharm Res, Vol 8, Issue 3, 77-81.

Salem, W.M.; Sayed, W.F.; Haridy, M. and Hassan, N.H.(2014). Antibacterial activity of *Calotropis procera* and *Ficus sycomorus* extracts on some pathogenic micro-organisms. African J. of Biotechnology. 13(32):3271-3280.

Sheila, J.; Sarah Jane, M.; Priyadarshini, S.; Sivaraj, C. and Arumugam, P.(2017). Antioxidant and Antibacterial Activities *of Beta vulgaris L.* Peel Extracts. Int J Pharma Res Health Sci. 2017; 5 (6): 1974-79.

Skehan, P.; Stroneng, R.;Scudiero, D. and Vistica, D.(1990). New Colorimetric cytotoxicity assay for anticancer drug screening J. of Natl. cancer Inst .; 82(13): 1107-1112.

Somogi,M .(1952).Notes on sugar determination. J. Biol.,195,19.

USDA. U.S. Department of Agriculture (2011). National Nutrient Database for Standard Reference, Release 26.

Varner, A.S.(2014). Modeling and optimization of the dehydration of beets for use as a value-added food ingredient. A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree. MASTER OF SCIENCEATHENS, GEORGIA2014.

Vranova, J. and Ciesarva, Z. (2007). In-house validation of a simple headspace gas chromatography-mass spectrometry method for determination of furan levels in food. Journal of Food and Nutrition Research, 46:pp. 123–127.

Zhisen, J. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food Chemistry.64:pp. 555-559.

التأثير المضاد للنشاط الميكروبى و المضاد للسرطان للمواد الفعاله فى جذور البنجر الأحمر.

سماح عبد الرازق محمد[1]، منى محمود خليل[2] ، عزة كمال الدين عبد الحميد[1] و رانيا ابراهيم الجمال[2]

[1]مركز البحوث الزراعية – الجيزة – القاهرة

[2]قسم الصناعات الغذائية – كلية الزراعة – جامعة المنصورة

أجرى هذا البحث بغرض دراسه تأثير المواد الفعاله الموجوده فى جذور البنجر الأحمر كمضادات للنشاط الميكروبى و كمضادات للسرطان فى الثدى و الرئه. تم استخدام جذور البنجر الأحمر و أجريت عليها مجموعة من المعاملات التكنولوجية و هى (التجفيف ، السلق ثم التجفيف ، التجفيد) لإختيار أنسب المعاملات في تقليل الفقد في محتوى المواد الفعاله و تم تقدير كلاً من االتركيب الكيماوى ومحتوى المعادن و المواد الفعاله لكل من المعاملات السابقه . أظهرت النتائج أن معامله جذور البنجر الأحمر بالتجفيف أعطت اقل معدلات للفقد في التركيب الكيماوى و المواد الفعاله. وكذلك تم دراسه تأثير المستخلص الميثانولى لجذور البنجر الأحمر الطازج و المعاملات المختلفه لجذور البنجر كمضادات للنشاط الميكروبى لبعض الأجناس المختلفه من البكتريا و الفطريات و الخمائرو أظهرت النتائج تأثيرات إيجابيه على البكتريا و الخميرة . وكذلك تم دراسه تأثير المستخلص الميثانولى لجذور البنجر الأحمر الطازج و المعامله بالتجفيف كمضادات سرطانية علي الخلايا المسرطنة للرئه و الثدى. أعطت النتائج أن IC_{50} الناتج من مستخلص جذور البنجر الطازج و مستخلص جذور البنجرالمعامله بالتجفيف كانت ٣٥٢ و ٢٢٧ ، ٢٤٢ و ٣٢١ ميكروجرام / مل و ذلك علي الخلايا المسرطنة الثدى و للرئه على التوالى. لذلك توصى الدراسه بإضافة جذور البنجر الأحمر في العديد من المواد الغذائيه لتقليل الإصابه بالسرطان.

الكلمات الإفتتاحية: جذور البنجر الأحمر, مضادات الميكروبات ومضادات السرطان.