

## **Therapeutic effect of lycopene-rich tomato juice on cardiac disorder in rats fed on fried food in oxidized frying oil**

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### **Abstract**

Therapeutic effect of lycopene-rich tomato juice against evoked cardiac disorders in rats fed on fried potato in oxidized frying cotton seed oil (20% w/w ) for 4-weeks was studied using lycopene at a daily dose of 1 mg/Kg body weight.

Total lipids, total cholesterol, triglycerides, phospholipids, low-density lipoprotein cholesterol (LDL-c) and high-density lipoprotein cholesterol (HDL-c) were estimated in different animal groups. Lactic dehydrogenase (LDH), creatine kinase (CK), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) as well as serum calcium, potassium and magnesium were determined

The obtained results revealed that, feeding on fried potato in deep oxidized frying oil induced a notable increase in lipid profiles and LDL-c associated with a marked elevation in specific heart enzymes, LDL, CK, ALT and AST activities. These biochemical alterations ameliorated when lycopene was administered to rats fed fried potato in oxidized frying oil.

**Key words: Lycopene - tomato juice - fried food - frying oxidized oil.**

### **Introduction**

Vegetables and fruit are rich sources of a variety of nutrients, including vitamins, trace minerals, and dietary fiber, and many other classes of biologically active phytochemical compounds (Lampe, 1999).

Epidemiologic data support the association between high intake of vegetables and fruits and low risk of different chronic diseases as several common cancers (Steinmetz and Potter, 1996) and cardiovascular disease (Banerjee and Maulik 2002 and Seifried *et al.*, 2003).

Lycopene is considered as one of the phytochemical, synthesized by plants and microorganisms but not by animals. Human can not produce lycopene, so, they must take it in their food (Bramley, 2000).

Lycopene is a hydrocarbon carotenoid found in tomatoes, tomato products and in other fruits (Clinton, 1998). Lycopene is associated with the red color in tomatoes. Concentrated cooked sources of tomatoes, such as tomato sauce, are associated with

greater health benefits. Lycopene can be absorbed more efficiently by the body after it has been processed into juice, sauce, paste or ketchup (Giovannucci, 1999). Heating and adding a small amount of fat makes the lycopene more easily absorbed by the body (Arab and Steck, 2000).

Diets high in fat, saturated fat and cholesterol, in addition to physical inactivity, still plays a key role in heart disease risk by increasing blood lipids (Ernst and Schaefer, 2002).

During deep-fat frying, when the fat is used repeatedly, oxidative and thermal effects result in the formation of many volatile and nonvolatile products, some of which are potentially toxic and accumulate in our dietary frying food (Battino *et al.*, 2002).

Fat frying is a popular food preparation method, but several components like antioxidant vitamins could be lost due to oxidation and some others with toxic effects could appear. Many reactive

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electrophilic chemicals (e.g. acrylamide and hydrazine) are most probably formed during heating of starch-rich foods to high temperatures and these could individually or cumulatively contribute to human cancer or other diseases (He *et al.*, 2004).

The process of hydrogenation increases the saturated fat content. Unfortunately, this process produces trans-fatty acids, which plays a major role in disease. This of course, increases the risk of atherosclerosis, diabetes, obesity, heart disease and a weakened immune system (Otero, 1997).

Therefore, a good opportunity has been taken to investigate the possible curative or ameliorative effects of lycopene-rich tomato juice against induced cardiac disturbances in rats fed on fried potato in oxidized frying oil.

### Materials And Methods

#### Experimental animals:

Adult male rats (*Rattus norvegicus*) weighing 120-150 gm were used in this study. They were placed in separate cages and allowed food and water *ad libitum*. They were kept under suitable airflow and temperature during the whole period of experimentation.

#### Preparation of fried potato, oxidized frying oil and tomato juice:

Cotton seed oil and potato purchased from a local supermarket were subjected to the following frying process:- Oil was poured into a cast iron wok and heated on a gas stove which was adjusted to maintain the oil temperature at  $205 \pm 5$  °C. Potatoes were peeled and cut into sticks then fried in the oil. Every 30 min, a batch of potato sticks was fried for 5 min. The potato frying process was performed for 4 hrs /day and was repeated for 7 successive days (Liu and Lee, 1998 ). The first fried potato (after 3 min from frying process) and the last fried potato (after 28 hrs from frying oil process) were used only in the experimental study to evaluate the effect of fried food in deep oxidized oil.

Concerning tomato juice preparation, fresh tomatoes washed and good homogenized by mechanical process then slightly heated with little amount of olive oil to facilitate lycopene absorption by the body (Arab and Steck, 2000).

#### Experimental design:

Rats were divided into five main groups, each consists of 6 rats. Groups were treated as follows:

**Group I:** Control untreated group: normal control rats were maintained on normal diet and provided with tap water.

**Group II:** Lycopene-rich tomato juice treated group: Rats received orally tomato juice at a daily dose of 8.25ml/Kg body weight which equal daily lycopene dose of 1mg/Kg body weight (Micozzi *et al.*, 1992 and Liu *et al.*, 2003) for 4- weeks. (paetau *et al.*, 1999)

**Group III:** First fried potato - fed rats treated group: Animals received first fried potato in deep oxidized frying oil (after 3 min only from frying process of oil) (20% w/w in diet) for 8- weeks.

**Group IV:** Last fried potato- fed rats treated group: Rats received 20% last fried potato in deep oxidized frying oil (after 28 hour from frying process of oil) for 8- weeks.

**Group V :** Last fried potato-fed rats and lycopene treated group: Rats received last fried potato in deep oxidized frying oil (after 28 hour from frying process of oil) (20% w/w in diet) for 4-weeks and simultaneously administered orally with lycopene as tomato juice at the same mentioned dose (1 mg/Kg B wt) besides the same diet of deep fried potato for another 4- weeks.

Rats of different groups were weighed weekly to calculate the body weight change.

#### Blood and Tissue sampling:

At the end of the period of treatment fasted overnight animals were sacrificed by cervical dislocation and blood was collected in clean centrifuge tubes. Serum was separated from coagulated blood by

centerifugation at 3000 g for 20 min. Serum were quickly frozen at -20 till time analysis. Liver and heart were dissected as rapidly as possible, weighed, homogenized in ice cold saline solution and were also frozen at -20 °C for subsequent analysis..

#### **Biochemical analysis:**

Total lipids, total cholesterol, triglycerides, LDL-c and HDL-c were determined by using a commercially available reagent Kits obtained from Randox Lab Ltd, U.K.. Phospholipid was assayed according to the method of Baginiski *et al.* (1972). The activity of the following enzymes LDH, CK, AST and ALT were determined using reagent Kits supplied by Bio-Merieux Laboratory Reagents and Products, France. Serum Calcium, Potassium and Magnesium were estimated by an atomic absorption spectrophotometer following the method of Zettner and Seligson (1964).

#### **Statistical analysis:**

Statistical analysis of the present data and student's t-test were carried out as described by Sokal and Rahif (1981).

#### **Results**

The obtained results of the present work are represented in Tables 1, 2, 3, 4 and 5 respectively.

Table (1) showed that, the percentage of body weight gain in group (IV) increased after the experimental period when comparing with group (III), meanwhile, rats supplemented with lycopene, group (V) tend to reach control level.

Table (2) demonestrated the serum and liver concentrations of lipids profils as well as serum lipoprotein fractions, as LDL-cholesterol and HDL-cholesterol levels for the control and treated rats. The results showed that all classes of serum and liver lipids as well as serum LDL-cholesterol were significantly increased in deep fried potato in oxidized frying oil fed rats, while serum HDL-cholesterol was significanttly decreased. On the other hand the lycopene rich tomato juice ameleorate lipid fractions and lipoproteins. This effect is manifested by the significant decrease in lipid fractions, LDL-cholesterol and a marked elevation in a HDL-cholesterol.

The levels of LDH, CK, AST and ALT in seum, liver and heart for control and treated rats were cited in Table (3). Rats fed on deep fried potato in oxidized frying oil had more activity of the LDH, CK,AST and ALT in serum, liver and heart as compared with rats fed on fried potato in normal oil (Group III). However, administration of lycopene rich tomato juice to rats that received fried potato in oxidized frying oil, showed a significant decrease in the activity of all the above mentioned enzymes when compared to group (IV).

The data for serum Ca, K and Mg concentrations in of the control and treated rats were summarized in Table (4). Dietary deep fried potato in oxidized frying oil decreased the serum K and Mg concentrations. However, serum Ca level was increased. Moreover, an undesirable rise in serum calcium / magnesium ratio was recorded in deep fried potato fed rats. When concomitant administration of lycopene to rat fed deep fried potato in frying oil, the ratio was decreased compared to rats fed on fried potato in normal oil (group III).

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**Table (1): Mean percentage of body weight gain during 8 weeks in control and treated animal groups.**

Groups→ Parameters↓	Group I	Group II	Group III	Group IV	Group V
Before examination	100%	100%	100%	100%	100%
1 <sup>st</sup> Week	106	108	105	105	105
2 <sup>nd</sup> Week	110	115	110	110	110
3 <sup>rd</sup> Week	115	123	115	117	117
4 <sup>th</sup> Week	122	130	124	125	125
5 <sup>th</sup> Week	127	134.5	131	130.3	129
6 <sup>th</sup> Week	135	140	147	137	135
7 <sup>th</sup> Week	140	146	145	144	141
8 <sup>th</sup> Week	147	153	148	153	146
% of change		+0.041 <sup>•</sup>	+0.007 <sup>*</sup>	+0.034 <sup>*</sup>	-0.046 <sup>°</sup>

•% of change compared to control (Group I).

\* % of change compared to group III.

° % of change compared to group IV.

**Table (2): Changes in total lipids, total cholesterol, triglycerides, phospholipids in serum and liver as well as LDL-cholesterol and HDL-cholesterol levels in control and treated groups.**

	Groups→ Parameters↓	Group I	Group II	Group III	Group IV	Group V
Serum	Total lipids (mg/dl)	738.11 ± 3.52	699.11 ± 2.31*	812.10 ± 3.24*	998.25 ± 1.25*	803.41 ± 3.25°
	Total cholesterol (mg/dl)	129.91 ± 3.25	102.56 ± 2.35*	134.11 ± 1.24	187.22 ± 3.21*	167.52 ± 2.35°
	Triglycerides (mg/dl)	101.11 ± 0.21	100.21 ± 0.45	112.31 ± 0.32*	134.21 ± 0.36*	122.32 ± 0.52°
	Phospholipid (µmol/min/ 100ml)	8.41 ± 1.20	7.94 ± 2.01	9.11 ± 2.05	14.52 ± 1.21*	10.12 ± 2.45
	HDL-cholesterol (mg/dl)	44.37 ± 2.21	49.21 ± 3.25	41.11 ± 2.35	30.21 ± 3.50*	49.21 ± 2.58°
	LDL-cholesterol (mg/dl)	65.32 ± 2.01	32.51 ± 2.41*	70.54 ± 1.03*	130.17 ± 2.35*	93.85 ± 2.89°
liver	Total lipids (mg/ g wet tissue)	32.3 ± 4.52	34.11 ± 6.24	36.31 ± 4.15	48.25 ± 3.65*	38.12 ± 3.84°
	Total cholesterol (mg/ g wet tissue)	3.11 ± 2.54	3.22 ± 4.15	4.01 ± 2.35	9.22 ± 1.15*	4.32 ± 2.56°
	Triglycerides (mg/ g wet tissue)	22.16 ± 5.45	20.31 ± 3.21	24.31 ± 3.25	34.10 ± 2.45*	27.22 ± 1.98°
	Phospholipid (µmol/min/g dry tissue)	40.32 ± 2.01	38.51 ± 2.35	42.25 ± 1.26	48.31 ± 2.78*	38.21 ± 2.35°

Results are presented as means ± SE. (n=5).

- P<0.05 compared to control (Group I).
- P<0.05 compared to group III.
- ° P<0.05 compared to group IV.

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**Table(3): Changes in lactic dehydrogenase (LDH), creatine kinase (CK), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) enzymes activities in serum, liver and heart of control and treated groups.**

	Groups→ Parameters↓	Group I	Group II	Group III	Group IV	Group V
Serum	LDH (U/l)	385.31 ± 3.25	380.11 ± 1.28	390.21 ± 3.63	450.10 ± 2.95 *	401.21 ± 3.41°
	CK (U/l)	60.22 ± 3.32	59.31 ± 1.25	62.11 ± 4.25	108.62 ± 3.25 *	80.32 ± 2.32°
	AST (U/l)	24.13 ± 1.12	23.15 ± 2.25	26.11 ± 0.36	31.31 ± 1.05 *	25.22 ± 1.32°
	ALT (U/l)	18.12 ± 2.25	20.22 ± 1.45	24.32 ± 2.05*	31.21 ± 1.98 *	22.20 ± 2.14°
Liver	LDH (U/g)	309.12 ± 3.25	311.15 ± 5.25	322.22 ± 4.25*	381.11 ±3.25 *	340.21 ± 2.35°
	CK (U/g)	80.31 ± 2.15	84.11 ± 3.25	98.12 ± 2.36*	137.32 ±3.63 *	102.32 ± 4.11°
	AST (U/g)	12.22 ± 2.21	13.41 ± 3.25	14.25 ± 2.35	21.71 ±2.25 *	15.41 ± 1.54°
	ALT (U/g)	8.31 ± 3.20	8.01 ± 2.30	9.21 ± 2.45	16.31 ±1.85 *	9.22 ± 1.03°
Heart	LDH (U/g)	411.22 ± 3.61	409.31 ± 3.25	422.14 ± 3.65*	480.32 ± 4.15 *	412.25 ± 4.18°
	CK (U/g)	111.41 ± 2.52	109.25 ± 2.35	122.14 ± 2.58*	298.23 ± 3.25 *	196.23 ± 3.25°
	AST (U/g)	17.81 ±2.47	17.91 ± 8.32	18.31 ± 6.35	27.25 ± 3.25	18.31 ± 5.65
	ALT (U/g)	9.11 ± 3.21	8.89 ± 2.36	10.12 ± 3.54	17.80 ± 3.17	13.22 ± 2.51

Results are presented as means ± SE. (n=5).

•P<0.05 compared to control (Group I).

\*P<0.05 compared to group III.

° P<0.05 compared to group IV.

**Table (4): Changes in serum calcium, potassium and magnesium concentrations, as well as calcium/magnesium ratio of control and treated groups.**

	Groups→ Parameters↓	Group I	Group II	Group III	Group IV	Group V
Serum	Ca (mg/dl)	7.66 ±1.02	7.08 ± 0.64	6.22 ± 0.23	11.74 ±1.03*	6.54 ±0.87°
	K (mmol/l)	3.58 ± 2.25	3.64 ± 1.02	4.25 ± 1.25	3.31 ± 1.32	5.98 ±1.36
	Mg (mg/dl)	2.99 ± 1.20	3.85 ± 1.23	3.78 ± 2.10	2.68 ± 1.02	3.78 ±1.32
	Ca / Mg Ratio	2.56 ± 1.02	1.84 ± 0.32	1.64 ± 0.36	4.38 ± 1.12	1.74 ±1.09

Results are presented as means ± SE. (n=5).

•P<0.05 compared to control (Group I).

\*P<0.05 compared to group III.

°P<0.05 compared to group IV.

## Discussion

Today, intervention studies of disease prevention using vegetables, fruit, or both are rare. Consumption of a low-fat diet enriched with fruit and vegetables compared with a standard low-fat diet was associated with an apparent 40% reduction in cardiac events and a 45% reduction in mortality in 406 men with myocardial infarction. (Singh *et al.*, 1993).

A diet rich in vegetables and fruit may provide protection against cardiovascular disease (Ness and Powles, 1997). Serdula *et al.* (1996) showed that increased intake of fresh fruit and vegetables increased the level of physical activity. Higher Lycopene concentration in the adipose tissue tended to be most protective against myocardial infarction in human (Kohlmeier *et al.*, 1997).

As presented in Table (1), body weight gain in rats fed a diet enriched with 20% fried potato in deep frying oil for 8 weeks higher than those fed the control diet enriched with 20% fried potato in fresh

frying oil. The result agrees with Huang *et al.* (1988) as well as Liu and Huang (1995). The obtained data may be due to hyperlipidemia and hypercholesterolemia. However, the treatment with tomato juice restored the body weight gain to the level of that of the corresponding control group.

Dietary manipulation, particularly of fats, result in marked changes in lipid profiles and lipoprotein composition (Adamopoulos *et al.*, 1996) In the present study, it has been found that, total lipids, total cholesterol, triglycerides and phospholipids in addition lipoprotein pattern; especially LDL-cholesterol were significantly increased in rats fed deep fried potato in oxidized frying oil (Group IV) compared to those of the fried potato in fresh frying oil (Group III). However, HDL-cholesterol showed a significant decrease in the same animals (Table 2). These results are in agreement with those reported by Broekmans *et al.* (2003) who recorded higher plasma cholesterol, triglycerides and

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LDL-cholesterol levels in human fed deep fried potato. In addition Liu and Lee (1998) observed that plasma cholesterol concentration was highest in guinea pigs fed oxidized frying oil. Furthermore, Abdel Hamid *et al.* (1993) revealed hyperlipidemia and hypercholesterolemia in the liver of sheep fed on boiled Sun oil. These findings may be attributed to increase of synthesis of fatty acids in the liver or possibility of incidence of liver cholestosis (Zilva and Pannall, 1975). The elevation in the lipid fraction may be also due to appearance of different fractions of low molecular weight compounds from such oxidized oils due to heat oils for prolonged time. Some of these compounds are much toxic and accumulate in the deep fried food and can change the metabolism of lipids (Eder, 1999). Changes in lipoproteins composition, transport and/ or turnover taken into consideration by Steinberg (1979).

In the present work, our results showed therapeutic effect of oral intake of lycopene as tomato juice for treating the occurred hyperlipidemia due to dietary deep frying potato. This effect is manifested by the significant decrease in total lipids, total cholesterol, triglycerides and phospholipids as well as LDL-cholesterol and a marked elevation in HDL-cholesterol. This coincides with data previously observed in human by Maruyama *et al.* (2001) and Sesso *et al.* (2003). It could be contributed to the role of lycopene in protecting LDL or phospholipid in LDL from oxidation in addition to its role in inhibition of cholesterologenesis by inhibit hydroxymethylglutaryl coenzyme A (HMG-CoA) reductase activity and to upregulate LDL receptor activity in macrophages (Arab and Steck, 2000 and Heber and Qy, 2002) or may be due to its powerful antioxidant that has been shown to neutralize free radicals, especially those derived from oxygen, resulting in protection against chronic disease especially coronary heart disease (Agarwal and Rao, 2000).

As shown in table (3), there was a marked increase in heart energetic enzyme activity in group IV. An expected results which may reveal cellular damage in heart,

liver and kidney by fried food thermally oxidized fat were detected by Alexander (1981). This damage may be due to undesirability of primary lipoxy radical under high temperature and formation of polymer compounds and carbonyls. Feeding rats on deep fried potato induced notable elevation in the serum, liver and cardiac activities of LDH, CK, AST and ALT. These results may be attributed to hyperlipidemia that leads to liver tissue injury. So when cell membrane get damage, these enzymes which are normally located in the cytosol leak in the blood streams thus manifesting damage affected liver and other tissues. These results were in accordance with Shyamala *et al.* (2003), who reported that both ALT and AST enzymes activities were increased in rats fed with high fat diet. Also, the observed increasing in LDH and CK activities may be attributed to a generalized increase in membrane permeability (Doran and Wilkinson 1975). Heart disease due to hyperlipidemia may play a role in these results, it has been reported that a significant elevation in LDH activity was detected in heart diseases (Lanter, 1975). Also, Elevated serum total cholesterol, LDL-cholesterol, and triacylglycerol concentrations, as well as reduction in HDL-cholesterol concentrations, are identified risk factors for coronary artery disease (Austin, 1991). Elevation of the above mentioned enzymes may be attributed to circulatory failure with shock and hypoxia or myocardial infarction (Julian *et al.*, 2000).

Furthermore, the most interesting effect of lycopene was achieved by reduced the hyper activity of LDH, CK, AST and ALT in rat fed deep fried potato in oxidized frying oil accompanied by neutralization the electrolytes pattern by elevation of K and Mg and inhibition of Ca influx. This effect may be attributed to alterations of the plasma membranes of the hepatocytes.

Regarding to the estimated electrolytes, the data showed disturbance in serum Ca, K and Mg as hypercalcemia, hypokalemia and hypomagnesemia, these indicating heart disorders in the rat fed deep fried potato. Consequently, the lowering in potassium and magnesium could be



attributed to the muscular weakness, hypotonia and cardiac arrhythmias (Mayne, 1994). Another possible interpretation for the decrease in K and Mg ions in rats fed on deep fried potato could be related to elevation in free fatty acids (FFAs) which may be caused disturbance of muscular function as Flink *et al.* (1979) reported that increases in the circulating FFAs levels can reduce the divalent cation.

Moreover, an undesirable rise in the ratio of serum calcium/magnesium was recorded in deep fried potato fed rats where the ratio between calcium to magnesium is very important in dealing with the causes and prevention of a number of disorders including myocardial infraction or arrhythmia, atherosclerosis, hypertension, urolithiasis, and infant-death syndrome. The observed elevation of the Ca/ Mg ratio may be due to the elevation of calcium and inhibition of magnesium in rats fed deep fried potato. In all cases, a lower calcium/magnesium ratio or a higher magnesium/calcium ratio is desirable (Karppanen *et al.*, 1978 and Esashi, 1992). While, the neutralization of the ions levels were achieved by clear improvement in the observed imbalances in these electrolytes when administration of lycopene to rats fed deep fried potato in frying oil. The obtained results may be attributed to alterations of the physiological activity of the heart muscle and cell membrane permeability, an explanation, which need further investigation.

The therapeutic effect of lycopene recorded in the present investigation may be due to lycopene's antioxidant activity (Copper *et al.*, 1999)

In conclusion: The oral intake of lycopene rich tomato juice might be beneficial for ameliorating the cardiac disorders arising sometimes from dietary oxidizing fat in deep fried food. So eating a balanced diet, which plenty of fruits and vegetables is important against the noteworthy effect of the update take away highly fat foods.

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## التأثير العلاجي لعصير الطماطم الغنى بالليكوبين على الاختلال القلبي في جردان مغذاة على طعام مقلي في زيت قلي مؤكسد هناء علي حسن و جمال محمد ادريس

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تهدف هذه الدراسة الى توضيح الدور العلاجي المحتمل الذي يلعبه عصير الطماطم الغنى بالليكوبين في منع أو تحسين الاضطرابات المختلفة الناجمة عن التغذية بالبطاطس المقلية في زيت بذرة القطن المستخدم في التحمير لمدة 28 ساعة.

وقد اجريت الدراسة على ثلاثين جردا تم تقسيمهم إلى خمس مجموعات، تركت المجموعة الأولى دون معالجة كمجموعة ضابطة، أما المجموعة الثانية فقد أعطيت ليكوبين في صورة عصير طماطم عن طريق الفم (1 مجم/كيلو جرام من وزن الجسم) يوما بعد يوم لمدة شهر، والمجموعة الثالثة تم تغذيتها على بطاطس مقلية في زيت التحمير الطازج المستخدم لأول مرة (20٪ في الوجبة الغذائية لمدة شهرين) ، بينما المجموعة الرابعة غذيت على بطاطس مقلية في زيت التحمير المستخدم لمدة 28 ساعة بنفس الجرعة المذكورة سابقا في المجموعة الثالثة أما المجموعة الخامسة فقد تم تغذيتها بنفس الوجبة المستخدمة في المجموعة الرابعة لمدة شهرين مع إعطائها ليكوبين في صورة عصير طماطم خلال الشهر الأخير من مدة التغذية.

هذا وقد تم تعيين بعض المعايير الفسيولوجية لأيض الدهون و الدهون البروتينية مثل الدهون الكلية، الكولسترول الكلي، الجليسيريدات الثلاثية، الدهون الفسفورية، الليبوبروتين ذو الكثافة المنخفضة (LDL) والليبوبروتين ذو الكثافة العالية (HDL). كما امتدت الدراسة لتقدير نشاط إنزيمات الطاقة القلبية مثل أنزيم اللاكتات ديهيدروجينيز والكرياتين كينيز وأنزيم الأسبرتات أمينو ترانسفيريز (AST) والألانين أمينو ترانسفيريز (ALT). أيضا تم قياس أيونات الكالسيوم والبوتاسيوم والماغنسيوم في مصل الجردان المعالجة.

وقد أسفرت النتائج عن أن التغذية على البطاطس المقلية في زيت التحمير الطازج المستخدم لأول مرة لم تنجم عن أي تأثيرات معنوية في جميع المعايير الفسيولوجية السابق ذكرها ، بينما التغذية على البطاطس المقلية في زيت التحمير المستخدم لمدة 28 ساعة قد أحدثت خلل واضح في مستوى الدهون والليبوبروتينات تمثل في الزيادة الملحوظة في كل من الدهون الكلية، الكولسترول الكلي، الجليسيريدات الثلاثية، الدهون الفسفورية و الليبوبروتين ذو الكثافة المنخفضة (LDL) مع هبوط حاد في الليبوبروتين ذو الكثافة العالية (HDL). هذا وقد سجلت النتائج زيادة ايجابية في نشاط انزيمات الطاقة القلبية . كما بينت الدراسة زيادة في مستوى الكالسيوم مصحوب بنقص ذو دلالة غير احصائية في مستوى عنصرى البوتاسيوم و الماغنسيوم مما نتج عنه ارتفاع في نسبة الكالسيوم الى الماغنسيوم.

وعلى الجانب الاخر لوحظ بوضوح التأثير العلاجي لليكوبين الممثل في عصير الطماطم والذي تم اثباته بالتأثير الإيجابي في تحسن مستوى الدهون والليبوبروتينات . بالإضافة الى تعديل مستويات انزيمات القلب والتركيز الايوني للكالسيوم والبوتاسيوم والماغنسيوم بصورة ايجابية بعد المعالجة بالليكوبين. وكان تأثير عصير الطماطم على الجردان الطبيعية تأثير غير ذي دلالة احصائية.

وبذلك فان نتائج هذا البحث تعطى صورة واضحة للدور الفعال لليكوبين ضد الاختلال القلبي الناجم عن التغذية الغير سوية المحدثة لكثير من الامراض. وتؤكد هذه الدراسة مدى أهمية احتواء الوجبة الغذائية على الفواكه والخضروات للحصول على حالة صحية جيدة ويوصى البحث بمزيد من الدراسة للتعرف على الاليات المختلفة للفواكه والخضروات للوقاية من الامراض. وقد نوقشت النتائج وتم القاء الضوء على أسبابها المحتملة.