Effect of black plum and black cherry juice on blood lipids and hepato-renal functions in rats with cuprizone-induced multiple sclerosis.

By

Elsayed Elbadrawy
Faculty of Specific Education.
Mansoura University

Afaf- Hanem. M. Ramadan
Faculty of Specific Education.
Mansoura University

Hala Elkewawy
Faculty of Specific Education.
Mansoura University

Mona Rehan
Faculty of Specific Education.
Mansoura University

Research Journal Specific Education
Faculty of Specific Education
Mansoura University

ISSUE NO. 67, MAY , 2022

مجلة بحوث التربية النوعية - جامعة المنصورة
العدد السابع والستون - مايو ٢٠٢٢

Effect of black plum and black cherry juice on blood lipids and hepato-renal functions in rats with cuprizone-induced multiple sclerosis.

*Elsayed Elbadrawy** *Afaf- Hanem. M. Ramadan**

*Hala Elkewawy** *Mona Rehan**

ABSTRACT

The purpose of this study was to investigate the impact of using black plum (Prunus salicina) and black cherry (Prunus cerasus) juices in the alleviation of the side effects resulting from multiple sclerosis (MS) in rats. Chemical composition and phytochemical screening of the two fruits were carried out in addition to the estimation of the antioxidant activity of the fruit juices in vitro. In the biological experiment, thirty adult male albino rats (weighing 135 to 145 g) were used, six of them were served as normal control which remained on the basal diet during the period of the experiment. The remaining groups were injured with cuprizone in a dose of a 3 g / kg diet, one of them was left as a positive control (MS control) while the other three groups were treated daily with the juices of black plum, black cherry, and their mixture (1:1 v/v) in a dose of 15 ml/kg b.wt. using a stomach tube. The weight gain of the rats and food efficiency ratio was calculated. At the end of the experiment, the rats were sacrificed, and their blood was drawn for analysis. The results showed that the weight gain and food efficiency ratio of the positive control decreased significantly as compared to the normal control while significant increases in their values were seen in the three treated groups as compared to the positive group. The findings showed that the levels of serum ALT and AST increased while the level of serum albumin decreased significantly in the positive control. The treated groups with the juices revealed significant improvements in these liver parameters where significant decreases in both ALT and AST and a

* Home Economics Department, Faculty of specific Education, Mansoura University, Egypt.

significant increase in serum albumin were observed. As for serum creatinine, which is a kidney function test, the results indicated that the treated groups with the examined juices exhibited a remarkable decrease in their serum creatinine in comparison with positive control at $p < 0.05$. On the other hand, significant decreases in serum levels of total cholesterol, triglycerides, and LDL-c and a significant increase in HDL-c were noticed in the treated groups. In conclusion, significant improvements in the liver and kidney functions of MS rats have been achieved by using black plum and black cherry juices or their mixture which was probably attributed to their content of phenolics, flavonoids, and anthocyanins.

Key words: Black plum – black cherry – DPPH – lipid profile – liver function tests – MS.

1. Introduction:

Multiple sclerosis (MS) is a chronic inflammatory disease that is characterized by leukocyte infiltration and subsequent axonal damage, demyelinating inflammation, and the formation of sclerosing plaques in brain tissue (**Cui et al., 2020)**. It is a common neurological disability that can lead to severe physical and cognitive incapacitation where it affects the central nervous system **(Compston and Coleo, 2011)**. It is one of the most common neurological diseases among young people and at the same time a major cause of physical disability among young people **(Rahmanzadeh et al., 2019)**. Many factors contribute to an increased risk of developing MS. However, the main causes of this disease are still unknown, but a combination of environmental and genetic factors may have a noticeable role in the pathogenesis of the disease. Similar to this, other inflammatory diseases, oxidative stress, and lipid peroxidation are also associated with multiple sclerosis **(Ferreira et al., 2020)**. Cuprizone is one of the neurotoxicant that cause neurodegeneration through enzyme inhibition and oxidative stress. The cuprizone toxin-induced demyelination model is widely used to investigate pathophysiological mechanisms of demyelination and remyelination phases of multiple sclerosis **(O'Loughlin et al., 2020**). Cuprizone-induced toxicity has been reported to cause memory impairment,

weight loss, impairment in exploratory drive and increased oxidative stress (**Omotoso et al., 2019**). The polyphenols of medicinal plants have antioxidant properties which can treat or prevent several human pathologies in which oxidative stress seems to be one of the causes **(Rad et al., 2020)**

Medicinal plants, vegetables, and fruits are recommended daily because they possess different kinds of flavonoids. Furthermore, they are considered metabolic modulators due to their ability to influence different cellular molecules and pathways. They have been categorized into anthocyanidin, flavanols, flavone, isoflavonoids, chalcones, and flavanone **(Arora & Itankar, 2018; Rengasamy et al., 2019).** Flavonoids are a class of plant-derived dietary polyphenols that have been known for their precognitive and anti-inflammatory effects, they are characterized as antioxidants. It is believed that flavonoids act directly on neurons and glia through the interaction with major signal transduction cascades, in addition to their indirect interaction with the blood-brain barrier and cerebral vasculature **(Jaeger et al., 2018).**

The flavonoids from fruits and vegetables can help make food choices for optimal cardiovascular health and neurodegenerative diseases.

This work focused on two fruits which are black plum and black cherry. The antioxidant properties of plums were determined by their bioactive compounds including polyphenolic compounds such as anthocyanins, mainly retinoid derivatives, and phenolic compounds such as chlorogenic and neochlorogenic acid. **(Sahamishirazi et al., 2017; Navarro et al., 2018; Cabrera- Banegil et al., 2020)**

In recent times, **Igwe and Charlton (2016)** reported that plums have been described as foods with health-promoting properties. They advised increasing research to show the health effects of plum via its anti-inflammatory, antioxidant, and memory-improving characteristics. The importance of plum research lies in its high content of phenolics, especially the anthocyanins, which are well known as a natural antioxidant. Phenolic extracts of plum have can scavenge free radicals and inhibit xanthine

oxidase activity, thus developing the potential of foods or pharmaceuticals as antioxidants and xanthine oxidase inhibitors. **(Li et al., 2016)**

Sweet cherries (*Prunus avium* L.) are consumed in large quantities due to their attractive color, sweetness, and wealth of antioxidants and nutrients. They contain carotenoids, serotonin, melatonin, and high amounts of phenolic compounds**. (Goncalves et al., 2019)**

Many studies have proved that sweet cherries are great sources of non-colored phenolic compounds and anthocyanins, including chlorogenic acids and cyanidin derivatives, whose biological potential is well described. **(Goncalves et al., 2017; Martini et al., 2017)**

Therefore, this work aims to study the effect of black plum and black cherry intake in alleviating the side effects of multiple sclerosis through their roles in preventing oxidation, inflammations, neurodegeneration.

2. MATERIALS AND METHODS

2.1. Materials

***Fruits*:** Black plum (*Prunus salicina)* and Black Cherry (*prunus cerasus*) were purchased from the local market in Mansoura City.

Chemicals: All the used kits and chemicals of analytical grade were purchased from Al-Gomhorya Company for Trading Medicines and Medical equipment, Mansoura, Egypt and Cuprizone was obtained from the Lab chemical for trading, Egypt

Diet: A standard diet of fine ingredients was prepared according to NRC (1995).

Animals: Thirty adult male albino rats (weighing 135 to 145 g), were obtained from Helwan farm of experimental animals, Cairo, Egypt. (Guidelines for ethical conduct in the care and use of animals in research were obtained from the concerned department in Mansoura University).

Black plum and Black cherry juice preparation: The fruits were washed three times with tap water, dried with blotting paper, and then stored under freezing until use. After that, the fruits were squeezed in the blender to reach the

appropriate consistency to be given daily to the rats via the stomach tube with a dose of 15 ml/kg body weight.

***2.2. Experimental design*:**

The thirty male rats used in this experiment were housed in metallic cages under healthy environmental conditions for acclimatization. Water and diet were provided *ad-libitum*. They were divided into 5 groups (6 rats each), one of them remained on the basal diet only which served as normal control. The remaining groups were treated with cuprizone in a dose of a 3 g / kg diet **(Buonvicino et al., 2021)**. One of these four groups was left as a positive control (MS control). The other three groups were treated separately with the juices of black plum, black cherry, and their mixture (1:1 v/v) in a dose of 15 ml/kg b.wt. using a stomach tube from the first day to the end of the experiment (6 weeks). At the end of the experiment, all the rats were sacrificed, their blood was drawn from the portal vein and their plasma was separated. Brains, sciatic and optic nerves from each rat were collected then immersed in 10 % formalin as a fixative, and then sent to the pathology department of veterinary medicine college, Mansoura university for histopathological examination.

2.3. Estimation of Gross chemicals composition:

Moisture, crude protein, crude fat and ash in the two fruit samples were determined according to **A.O.A.C. (2015)**.

2.4. Phytochemicals Screening of the fruits powder:

To determine the presence of bioactive chemicals, phytochemical screening was performed in crude methanolic extracts **(Arefin et al., 2015)**

2.5. Antioxidant activity:

Determination of free radical scavenging activity of black plum and black cherry:

It was determined by using 1,1-Diphenyl-2-picrylhydrazyl (DPPH) radical according to the method of **Dasgupta et al. (2016)**.

2.6. Biological assays:

Biochemical analysis: Examination of Total cholesterol, Triglycerides and High-density lipoprotein cholesterol (HDL-c), were estimated by enzymatic

colorimetric methods as described by **Abell et al. (1952)**; **Bucolo and David (1973)**, and **Kostner (1976)**, respectively. On the other hand, very low-density lipoprotein cholesterol (VLDL-c), and low-density lipoprotein cholesterol (LDL-c) were calculated mathematically as follows; VLDL-c = TG/5 While LDL-c=Total cholesterol – (HDL-c +VLDL-c) (Fruchart,1982).

Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined as mentioned by **Whitaker (1969)**.

Serum total albumin was assessed according to **Bartholomewet and Delaney (1966).**

Creatinine was estimated by the method of **Houot (1985).**

2.7. Statistical analysis:

The results were statically analyzed by using a computer program (SPSS); a one-way analysis of variance (ANOVA) was carried out, and the difference was considered significant at P-value < 0.05.

3. RESULTS & DISCUSSION

3.1. Elementary chemical composition of fruit samples under investigation

Moisture, ash, protein, fat, and carbohydrates of black plum and black cherry were determined and recorded in Table (1).

It was observed that the moisture content of black plum was 10.5% which is higher than that of black cherry (9 %), while the ash content of black plum is almost equal to its content in black cherry (3%). It was also observed that the protein content in black plum is 3.8% while in the black cherry is 3.2%

Regarding fat content, the results showed that the fat content of black plum is 3.5% which is higher than that of black cherry (3%). The fiber content of black plum is 3.6 % while its value in black cherry is 2.9%. Carbohydrates represented the main component in both black cherry and black plum with values of 78.88% and 75.

Table (1) : Elementary chemical composition of black plum and black cherry (g/100g) on dry weight basis

component / Samples	Moisture	Ash	Protein	Fat	Fiber	Carbohy-rate
Black plum	10.5	3.0	3.8	3.5	3.6	75.6
Black cherry	9.0	3.0	3.2	3.0	2.9	78.88

These results agree to a less extent with those of **Ajenifujah-Solebo and Aina (2011)** who reported the following values; 20.02 + 0.67 for moisture , 3.08 + 0.02 for crude protein, 1.25 + 0.07 for crude fiber, 5.46 + 0.02 for ash, 3.81 + 0.03 for crude fat, and 66.40 + 0.71 for carbohydrate in black plum. **Luna-Vázquez et al. (2013)** reported that the values of the proximate composition of black cherry were moisture (81.18 ± 0.87), (ash 0.86 ± 0.11), fat (0.05 ± 0.01), fibre (3.58 ± 0.03), protein (2.10 ± 0.01), and carbohydrate (12.23 ± 0.79) g/100 g on wet weight basis.

3.2. Phytochemical Screening of black plum and black cherry:

Data in Table (2) represents the phytochemical screening of black plum and black cherry. The results indicated that the black plum contains large amounts of glycosides/carbohydrates and flavonoids, while it contains medium amounts of tannins, alkaloids, saponins, and phenols.

These results agree with those of ***Kunle and Egharevba(2009)***; ***Borges et al. (2012) and Imoisi et al. (2021)*** who found that black cherry contains large amounts of glycosides/carbohydrates and a moderate amount of alkaloids, saponins Phenols, and tannins. **Amarowicz and Pegg (2019)** found that black cherry has a lot of total phenolic components like flavonoids and tannins

Table (2) : Preliminary phytochemical screening of black plum and black cherry juices

Component / Sample	Glycosides/ Carbohydrates	Tannins	Alkaloids	Flavonoids	Saponins	Phenols
Black plum	+++	++	++	+++	++	++
Black cherry	+++	+	++	++	++	++

3.3. Antioxidant activity of black plum and black cherry:

3.3.1. DPPH assay

Free radical scavenging activity was performed by using DPPH radical. Free radicals are considered one of the causes of many diseases where they initiate many degenerative processes which may cause damage to deoxyribonucleic acid (DNA), cell membrane, and proteins. The assay of the DPPH radical depends on its maximum absorption at a wavelength of 517 nm. In the presence of antioxidant substances, the color is converted to pale yellow. The reduction that occurred in the DPPH radical by the two fruit juices with different concentrations was recorded in Table (3). It was obvious from the results that the highest increase in the antioxidant activity of the two fruit juices was noticed with the concentration of 150 µg/mL with values of 56.19 and 52.01% for black plum and black cherry, respectively. The concentration of 100 µg/ml showed values of 50.23 and 49.8 % inhibition whereas the lowest concentration (50 µg/ml) showed little activity. A slight difference in the scavenging activity was observed with the concentration of 150 and 100 ug /ml, so it is preferable to use the concentration of 100 µg/ml to save fruit juice. Consumption of foods especially vegetables and fruits which are rich in antioxidants can prevent oxidative stress and hence protect the body from many diseases **(Joshi et al., 2012). Gonçalves et al. (2017)** stated that phenolic compounds of sweet cherry have a high antioxidant activity, DPPH scavenging activity, and glucose oxidase inhibition activity.

3.3.2. Reducing power

Regarding the reducing power, it was noticed that the concentration of 400 *µg /ml* revealed the highest reducing power. This means that with increasing the juice concentration, the reducing power increases although the two fruit juices have nearly good results with the low concentration. The half maximal effective concentration (EC 50) was 549.41 and 568.65 µ*g /ml*, for black plum and black cherry, respectively

Table (3): Antioxidant activity using DPPH assay and Reducing power

Samples / Concentration($\mu g/ml$)	Black plum	Black cherry
DPPH scavenging activity %		
50	45.12	42.24
100	50.23	49.80
150	56.19	52.01
Reducing power (OD)		
50	0. 169	0.210
100	0.218	0.230
200	0.280	0.274
400	0.361	0.366
EC50 $\mu g/mL$	549.41	568.65

3.4. Biological assay:

3.4.1. Effect of black plum and black cherry juices and their mixture on body weight gain, feed intake, and feed efficiency ratio (FER) in cuprizone-induced MS rats.

The data in Table (4) revealed that the weight gain of the positive control group decreased significantly (159.25±10.24g) as compared to the normal control group (198.00±8.04) at the end of the experiment. In contrast, the treated groups showed significant increases in body weight in comparison with both normal and positive control, this may be due to the high sugar content of the two fruits. On the other hand, there were no significant differences between the three treated groups. The highest percentage of weight gain was 52.47 ± 5.6 in the MS group treated with black plum while the lowest percentage (11.15 ± 6.13) was observed in the positive control that was treated with cuprizone only. This means that the fruit juices used improved the weight loss caused by the cuprizone drug.

Regarding feed intake, a significant decrease in its value was observed in the positive control group that received the cuprizone drug, whereas the other MS groups that were treated with the fruits showed

significant increases in the feed intake compared to normal and positive controls. This may be due to the delicious taste of the fruits which increased the appetite of rats.

Table (4): Effect of black plum and black cherry juices and their mixture on body weight gain, feed intake and feed efficiency ratio (FER) in MS rats.

Variables / Groups	Initial Weight (g)	Final Weight (g)	Weight Gain (g)	Weight Gain (%)	Food Intake (g)	FER
Normal Control	141.25±3.50 a	198.00±8.04 b	56.75±9.54b	40.27±7.29b	19.13±0.26b	0.071±0.012b
Positive Control	143.25±3.95a	159.25±10.24 c	16.00±8.76c	11.15±6.13c	14.80±0.82c	0.026±0.013c
Black Plum	138.25±1.26a	210.75±6.40a	52.50±7.33a	52.47±5.63a	19.20±0.61b	0.090±0.006a
Black Cherry	138.75±3.86a	208.50±7.33ab	69.75±3.69a	50.25±1.56a	20.60±1.24a	0.081±0.007ab
Mixture of the two fruits	140.75±1.71ab	212.25±2.50a	71.50±1.29a	50.80±0.89a	19.68±0.65ab	0.087±0.002a

Each value is the mean ±SD

Mean values in each column with different superscripts (a,b,c,d,..) are significantly different at P < 0.05.

As for feed efficiency ratio (FER), the best result was observed in the mixture-treated group (0.087±0.002) followed by the group of black plum (0.090±0.006) and the group of the black cherry (0.081±0.007) which were significantly higher than the FER of positive control (0.026±0.013). Our findings are consistent with those of **Ittiyavirah and Hema (2019) and Omotoso et al. (2019)** who reported that cuprizone consumption resulted in a significant decrease in body weight of rats as compared to the normal control and the plant-treated groups.

Previous research has demonstrated that the polyphenols catechins and anthocyanins present in plums control physiological problems in obesity and help to reduce liver and body weights (**Noratto et al., 2015)**

3.4.2. Effect of black plum and black cherry juices and their mixture on Lipid profile in multiple sclerosis rats.

The results recorded in Table (5) showed the serum lipid profile in the normal control and cuprizone-induced MS groups. It was clear that the positive control group which received cuprizone only has significant increases in serum total cholesterol (TC) (108.67±1.03 mg/dl), triglycerides (TG) (125.50±0.85 mg/dl), and low-density lipoprotein (LDL-c) (47.23±0.61 mg/dl), while it revealed a significant decrease in high-density lipoprotein (HDL-c) ((36.33±0.72 mg/dl) in comparing with the normal control group as their values were 68.67±1.13, 97.83±1.29, 4.25±0.37 and 44.33±1.08 mg/dl for TC, TG, LDL-c and HDL-c, respectively.

All the treated groups with the juices of black plum, black cherry, and their mixture showed significant decreases in total cholesterol (TC) in comparison with the positive control group. The fruit mixture group was the best in reducing serum TC where its level reached 68.33±0.79 mg /dl, which is like that of the normal control, followed by black cherry (80.00±1.46 mg/dl) and black plum (86.67±0.87bmg/dl).

Regarding Serum triglyceride (TG) levels, the three treated groups revealed significant decreases in their TG levels as compared to the positive control. The fruit mixture group showed the best decrease (87.33±0.79 mg/dl) which is significantly lower than not only the positive control but also the normal control (97.83±1.29 mg /dl), followed by black cherry (95.67±1.02 mg/dl) and black plum (112.83±1.38 mg/dl).

Concerning serum HDL-c levels, the results revealed that its level decreased significantly in the positive group (36.33±0.72 mg/dl) as compared to the normal control (44.33±1.08 mg/dl). All the treated groups revealed significant increases in their serum HDL-c as compared to the positive control where black plum was the best in this respect followed by black cherry and their mixture. This means that consuming the fruits of black plum and black cherry are good sources for modulating lipid profile and hence protect the body from the side effects of MS disease and cardiovascular diseases.

On the other hand, the serum LDL-c of the positive control group showed a significant increase in serum LDL-c level (47.23±0.61 mg/dl) as compared to the normal control (4.25±0.37mg/dl) while the three treated groups showed significant decreases in their serum levels of LDL-c in comparing with the positive control. The best among the treated groups was the mixture group followed by the black cherry and finally the black plum group.

Table (5): Effect of black plum and black cherry juices and their mixture on Lipid profile in multiple sclerosis rats.

Parameter / Groups	TC (mg/dl)	TG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
Normal Control	68.67±1.13d	97.83±1.29 c	44.33±1.08b	4.25±0.37e	19.57±0.55 c
Positive Control	108.67±1.03a	125.50±0.85a	36.33±0.72d	47.23±0.61 a	25.10±0.64 a
Black Plum	86.67±0.87b	112.83±1.38b	44.67±1.46b	19.93±0.39 b	22.57±0.44 b
Black Cherry	80.00±1.46 c	95.67±1.02d	47.50±0.84a	13.37±0.38 c	19.13±0.30c
Mixture of the two fruits	68.33±0.79d	87.33±0.79e	38.83±1.71c	12.03±0.53 d	17.47±0.48 d

Each value is the mean ±SD

Mean values in each column with different superscripts (a,b,c,d,..) are significantly different at P < 0.05.

The serum level of VLDL-c in positive control was parallel to that of TG as its value in the positive control was 25.10±0.64 mg/dl which is significantly higher than the values of the other groups. As can be seen, all the treated groups resulted in significant improvement in the lipid profile parameters. The best results have been noticed in the group which received the mixture of the two fruits, then the black cherry followed by the black plum group.

Tinker et al. (1991) found that individuals, with mild hypercholesterolemia, who consumed 100 g of dried plums revealed a significant reduction in both total and LDL-cholesterol levels. They attributed this decrease to the plums' high content of pectin, which is a soluble fiber important for lowering serum cholesterol in both rats and

human beings. **Donovan et al. (1998)** reported that dried plum extracts and prune juice extracts contain high amounts of antioxidant phenolic compounds that have been found to inhibit LDL oxidation in vitro.

Darshan et al. (2018) found that consumption of sweet cherries decreased TG/HDL-c ratio in diabetic women. They suggested that sweet cherry is important for decreasing inflammation and oxidative stress.

3.4.3. Effect of black plum and black cherry juices and their mixture on liver functions of rats with multiple sclerosis (MS)

The results in Table (6) showed that alanine transaminase enzyme (ALT) elevated significantly in the positive control group (50 ± 6.9 U/L) as compared to the normal control (36 ± 4.55 U/L). On the other hand, all the groups treated with the fruit juices showed significant decreases in ALT enzyme in comparison with the positive control where their values were 39± 3.5, 42.25 ± 4.99, and 35.5 ± 3.7 u/l for black plum, black cherry, and the mixture of them, respectively.

As for aspartate transaminase (AST), the results showed that the values of serum AST in the positive group raised significantly to a value of 210.50±11.85 U/L in comparison with normal control (139.50 ±13.03 U/L) while all the treated groups illustrated significant decreases in serum AST as compared to positive control. On the other side, there was a significant difference among the treated groups where the black cherry group showed the best result in this respect followed by the mixture of the two fruits. The reduction percentages reached 44% for black cherry, 36.7 % for mixture, and 21% for black plum. The findings in the same table showed that the serum albumin level of the positive control group (3.26±0.14 g/dl) decreased significantly as compared to the normal control (4.31±0.29 g/dl).

In terms of the MS groups which have been treated with the examined fruits, significant improvement in the serum albumin level was observed in comparison with the positive control. The mixture of the two fruits revealed the best result among the treated groups where its albumin value was 4.41 ± 0.14g/dl which is similar to that of the normal control.

Creatinine is one of the common parameters of kidney function tests. The serum creatinine level of the positive control rats elevated to 1.17 mg/dl which is significantly higher than that of the normal control (0.67 mg /dl). The MS rats treated with the fruits showed significant decreases in their serum creatinine level in comparing with the positive control.

The best result among the fruits was the mixture which reduces the creatinine level with a percentage of 38.5 % as compared to positive control followed by black plum and black cherry

Table (6): Effect of black plum and black cherry juices and their mixture on liver and kidney functions in multiple sclerosis rats.

Parameters / Groups	ALT (U/L)	AST (U/L)	Albumin (g/dl)	Creatinine (mg/dl)
Normal Control	36.00±4.55 b	139.50±13.03 c	4.31±0.29 ab	0.67±0.08 c
Positive Control	50.00±6.98 a	210.50±11.85 a	3.26±0.14 d	1.17±0.15 a
Black Plum	39.00±3.56 b	166.50±7.19 b	3.95±0.18 c	0.97±0.08 b
Black Cherry	42.25±4.99 b	117.75±9.54 d	4.04±0.27 bc	0.98±0.05 b
Mixture of two fruits	35.50±3.70 b	133.50±5.97 c	4.41±0.14 a	0.72±0.05 c

Each value is the mean ±SD

Mean values in each column with different superscripts (a,b,c,d,..) are significantly different at $P < 0.05$.

Ahmed et al. (2010) observed a significant reduction in serum alanine transaminase and no significant difference in serum aspartate transaminase and bilirubin in healthy individuals who consumed black plum.

Presser (2000) showed that the extract of black cherry improved the serum levels of total protein and albumin and he attributed this to its high content of phenolic and flavonoids. In another study, it was found that ingestion of black cherry extract protected the rat's liver from acetaminophen-induced liver damage in rats which is likely attributed to the

presence of phenolic acids such as chlorogenic acid and flavonoids **(Luna-Vázquez et al., 2013).**

Umar et al. (2019) reported that flavonoids reduced serum creatinine and bilirubin and enhanced aspartate transaminase activity in rats.

4. CONCLUSION

It can be concluded that consumption of black plum and black cherry juices improved the body weight and feed efficiency ratio in the cuprizone-induced rats, this may be due to their high content of fiber and polyphenols in addition to their low calories content in comparison with other fruits. The polyphenols of the two fruits revealed antioxidant activity and high reducing power in vitro. The juices of the two fruits or their mixture showed significant improvements in the liver enzymes, albumin, and creatinine in the serum of the MS rats. Also, the presence of the juice polyphenols especially anthocyanins has ameliorated the lipid profile in the MS rats and hence improved the metabolic disorders such as hypertriglyceridemia, dyslipidemia, and atherogenic indices which are important indicators in the diagnosis of the liver and cardiovascular diseases. Thus, our findings recommend using natural juices which are rich in polyphenols and low in calories such as black plum and black cherry instead of sugary drinks to maintain a normal weight and prevent the complication accompanied by multiple sclerosis cases.

REFERENCES:

- **A.O.A.C. (2015):** Association of Official Analytical Chemists, 17 th Ed Official Methods of Analysis , washing ton , D .C; U .S.
- **Abell,L.L.; Levy, B.B.;Brodie ,B.B.and Kendall,F.E.(1952)**: Simplified methods for the estimation of the total cholesterol in serum and demonstration of specificity. J Biol Chem,195:357-366.
- **Agbede , O .J and Ibitoye , A .A 2007 :** Chemical composition of black plum (Vitex doniana): An under-utilized fruit , Journal of Food, Agriculture & Environment ,5 (2) : 9 5 - 9 6 .
- **Ahmed. T.; Sadia ,H.; Khalid .A.;Batool .S. and anjua A(2010)**: Prunes and liver function: a clinical trial. Pak J Pharm Sci 23:463-466.

- **Ajenifujah-Solebo , S.Oand JO Aina .(2011)** : Physico-Chemical Properties And Sensory Evaluation Of Jam made from black-plum fruit (*Vitex doniana*) , Ajfand , 11 , 3:4772-4784.
- **Amarowicz, R., and Pegg , B .R (2019**): Natural antioxidants of plant origin , Advances in Food and Nutrition Research. Vol. 90, Academic Press, USA: 1-81.
- **Arefin , S .; Islam , T . and Hossain , T .(2015):** Proximate analysis, phytochemical screening and antioxidant activity of Tagetes erecta flower growing in coastal area of Bangladesh **.** Journal of Global Biosciences 4(4):2060-2066.
- **Arora, S and Itankar, P . (2018)**: Extraction, isolation and identification of flavonoid from Chenopodium album aerial parts. Journal of Traditional and Complementary Medicine :1-7.
- **Bartholomew, R. J., and Delaney, A. M. (1966):** Sulphonphthaleins as specific reagents for determination of albumin in serum. Proc. Aust. Ass. clin. Biochem., 1, 214.
- **Borges, A.R .; Aires, J .R.A .; Higino, T.M.M.; Graças, M.; Medeiros,F.; Citó, A.M.G.; Lopes ,J.A.D. and Figueiredo ,R .C.B.Q .(2012)**:Trypanocidal and cytotoxic Activities of essential oils from medicinal plants of Northeast of Brazil, Experimental Parasitology, 132, 123-128.
- **Buccolo , G . and David , H . (1973) :** Quantitative determination of serum triglyceride by use enzymes . Clin . Chem ., 19 : 476 -482.
- **Buonvicino , D .; Ranieri1 ,G .; Chiarugi , A . (2021)** : Cuprizone-Dependent De/Remyelination Responses and FunctionalCorrelates in Mouse Strains Adopted to Model Relapsing, Chronic and Progressive Experimental Autoimmune Encephalomyelitis , Neurotoxicity Research , 39(3) .
- **Cabrera-Banegil, M., Rodas, N. L., Losada, M. H. P., Cipollone, F. B., Espino, M. J. M., de la Pena, A. M. and Duran-Meras, I. (2020)**:Evolution of polyphenols content in plum fruits (Prunus salicina) with harvesting time by second-order excitation-emission fluorescence multivariate calibration. Microchemical Journal, 158, 105299.
- **Cannon, J. R. and Greenamyre, J. T. (2011)**: The Role of Environmental Exposures in Neurodegeneration and Neurodegenerative Diseases. Toxicological Sciences, 124(2), 225–250.

- **Cui,L.; Chu,S.and Chen,N.(2020):** The role of chemokines and chemokine receptors in multiple sclerosis. International Immunopharmacology, 83:1-11.
- **Darshan, S. K.; Yuriko, A. and Kevin D,L. (2018):** A Review of the Health Benefits of Cherries. Nutrients, 10, 368.
- **Dasgupta, S.; Yang, C.; Castro, L. M.; Tashima, A. K.; Ferro, E. S.; Moir, R. D.; . Willis , I.M. Fricker, L. D. (2016):** Analysis of the Yeast Peptidome and Comparison with the Human Peptidome. PLOS ONE, 11(9):1-26.
- **Donovan ,J.L.; Meyer ,A.S .and Waterhouse ,A .L: (1998):** Phenolicomposition and antioxidant activity of prunes and prune juice (Prunus domestica). J Agric Food Chem 46, 1247–1252.
- **Ferreira ,H.B.; Neves,B.; Guerra , I .; Moreira,A.; Melo,T.; Paiva,A.; Domingues, M .R (2020):** An overview of lipidomic analysis in different human matrices of multiple sclerosis, Multiple Sclerosis and Related Disorders.,44:1-12.
- **Fruchart , J.; Parra , H.; Cachera, C.; Clavey , V.and Bertrand ,M. (1982)**: Lipoproteins, apolipoproteins and coronary artery disease. , 12(1), 101–106.
- **Goncalves, A. C., Bento, C., Silva, B., Simoes, M., & Silva, L. R. (2019):** Nutrients, bioactive compounds and bioactivity: The health benefits of sweet cherries (Prunus avium L.). Current Nutrition & Food Science, 15(3), 208–227.
- **Goncalves, A. C.; Bento, C.; Silva, B. M.and Silva, L. R. (2017):** Sweet cherries from Fundao possess antidiabetic potential and protect human erythrocytes against oxidative damage. Food Research International, 95, 91–100.
- **Houot , O . (1985) :** Interpretation of Clinical Laboratory Tests , pp 220-234 , Edited by Siest g ., Schiele F . and Young D .S . Biomedical publications .
- **Igwe,O.E.and Charlton ,E.K.(2016)**: A Systematic Review on the Health Effects of Plums (Prunus domestica and Prunus salicina). Phytother Res. 30(5):701-731.
- **Imoisi , C ., Iyasele , J .; Imhontu , E .; Okhale, S .2021** : Phytochemical and Antioxidant Capability of Vitex doniana (Black Plum) Fruit , J. Chem. Soc. Nigeria, 46, 1: 191 –196.

- **Ittiyavirah , S .P and Hema ,S(2019)** : Ameliorating demyelination effect of curqfen in cuprizone induced mice model of multiple sclerosis , Pharmacy & Pharmacology International Journal , 7,1 :17-20.
- **Jaeger,N.B.; Parylak,L.S.and Gage,H.F.(2018)**: Mechanisms of dietary flavonoid action in neuronal function and neuroinflammation . Molecular Aspects of Medicine .61 :50-62.
- **Joshi,R.; Gangabhagirathi, R.; Venu, S.; Adhikari, S. and Mukherjee, T. (2012)**: Antioxidant activity and free radical scavenging reactions of gentisic acid: in-vitroand pulse radiolysis studies. Free Radical Research, 46(1), 11–20.
- **Kostner , G .(1976)** : Enzymatic determination of cholesterol in HDL fractions prepared by polyanion precipitation , Clinical Chemistry 22(5):695 .
- **Kunle , O .F and Egharevba , H.O. (2009)**: Preliminary studies on Vernonia ambigua: Phytochemistry and Antimicrobial Screening of the Whole Plant, Ethnobotanical Leaflets, 13, 1216-1221.
- **Li,Y.; Lai,P.; Chen,J .; Shen,H.; Tang,B.; Wu.,L. and M. Weng.(2016):** Extraction optimization of polyphenols, antioxidant and xanthine oxidase inhibitory activities from Prunus salicina Lindl, Food Sci. Technol., 36 :520-525.
- **Luna-Vázquez, F.; Ibarra-Alvarado, C.; Rojas-Molina, A.; Rojas-Molina, J.; Yahia, E.; Rivera-Pastrana, D.; Rojas-Molina, A.and Zavala-Sánchez, Á (2013)**: Nutraceutical Value of Black Cherry Prunus serotina Ehrh. Fruits, Antioxidant and Antihypertensive Properties. Molecules, 18(12) : 14597-14612 .
- **Martini, S.; Conte, A. and Tagliazucchi, D. (2017):** Phenolic compounds profile and antioxidant properties of six sweet cherry (Prunus avium) cultivars. Food Research International, 97, 15–26.
- **Navarro, M., Moreira, I., Arnaez, E., Quesada, S., Azofeifa, G., Vargas, F.and Chen, P. (2018)**: Polyphenolic characterization and antioxidant activity of Malus domestica and Prunus domestica cultivars from Costa Rica. *Foods*.*7*, 15.
- **Noratto, G.; Martino, H. S.D.; Simbo, S.; Byrne, D.; Mertens-Talcott, S. U. (2015)**: Consumption of polyphenol-rich peach and plum juice prevents risk

factors for obesity-related metabolic disorders and cardiovascular disease in Zucker rats. The Journal of Nutritional Biochemistry, 26(6), 633–641.

- **NRC (1995):** National Research Conical, Nutrition Requirements of LaboratoryAnimals. Forth Revised Edition, National Academy Press Washington , animals ,D.C : 29-30.
- **O'Loughlin, E.; Jacob, B .; Zeballos, G .; Manfre, p .; McCullough, A .; Gatto,T . N .; Tsuchiya, T .; Karkkainen, A .; Lehtimäki, K .; Kuosmanen, J.; Rosahl, W .T .; Varty, G .; E. Kennedy , M .; Mirescu, C. and Bardehle , S .(2020) :** C57BL6 mouse substrains demonstrate differences in susceptibility to the demyelinating effects of Cuprizone toxin ,cold spring harbor laboratory : 1-25 **.**
- **Omotoso, G.O.; Olajide, O.J.; Gbadamosi, I.T.; Adebayo, J.O.; Enaibe, B.U.; Akinola, O.B. and Owoyele, B.V. (2019)**: Cuprizone toxicity and Garcinia kola biflavonoid complex activity on hippocampal morphology and neurobehaviour. Heliyon, 5(7) , e02102.
- **Omotoso, O .G .; Olajide,J .O .; Gbadamosi,T .I .; Adebayo, O .J .; Enaibe,U .B .; Akinola, B .O. and B.V. Owoyele . (2019) :** Cuprizone toxicity and Garcinia kola biflavonoid complex activity on hippocampal morphology and neurobehaviour , Heliyon , 5(7).
- **Presser, A (2000):** Pharmacist's Guid-+e to Medicinal Herbs. Smart Publications, Petaluma, CA, p. 259- 260.
- **Rad,S.M.; Kumar,V.N.; Zucca,P.; Varoni,M.E.; Din,L.; Panzarini,E.; Rajkovic,J.et al.(2020):** Lifestyle, Oxidative Stress, and Antioxidants: Back and Forth in the Pathophysiology of Chroni Diseases. Frontiers in Physiology. Vol 11:1-21.
- **Rahmanzadeh, R., Brück, W., Minagar, A. and Sahraian, M.A.(2019)**: Multiple sclerosis pathogenesis:Missing51pieces of an old puzzle. Rev. Neurosci. 30, 67–83.
- **Rengasamy,K.R.R.; Khan,H.; Gowrishankar,S.; Lagoa, R. J.L.; Mahoomodally,F.M.; Suroowan,Z.S.; Tewari,D.; Zengin,G.; Hassan,S.T.S. and Pandian,S.K.(2019)**: The role of flavonoids in autoimmune diseases: Therapeutic updates, Pharmacology and Therapeutics.,194 :107-131.

- **Sahamishirazi, S.; Moehring, J.; Claupein, W.and Graeff-Hoenninger, S. (2017):** Quality assessment of 178 cultivars of plum regarding phenolic, anthocyanin and sugar content. *Food Chemistry, 214*: 694-701.
- **Tinker ,L.F.; Schneeman ,B.O.; Davis ,P.A.;Gallaher, D.D . and Waggoner ,C.R (1991)** :Consumption of prunes as a source of dietary fiber in men with mild hypercholesterolemia. Am J Clin Nutr 53, 1259–1265.
- **Umar , I .S.; Lawal,B .; Mohammed,A.B.; Obiekezie2,I.C.; Abdulsalam .; Adewuyi,H.; Babalola,B.S.and Ariyeloye ,D.S (2019)** : Antioxidant and Antimicrobial Activities of Naturally Occurring Flavonoids from M. heterophylla and the Safety Evaluation in Wistar Rats , Iranian Journal of Toxicology, 13 (4):39-44.
- **Whitaker J.F.(1969)**: A general colorimetric procedure for the estimation of enzymes which are linked to the NADH/NAD+ system. Clin. Chim. Acta. ,24:23–27.

تأثير عصير البرقوق الأسود والكرز الأسود على نسبة دهون الدم ووظائف الكبد والكلى في الفئران المصابة بالتصلب المتعدد الناجم عن الكوبريزون

السيد البدراوي يوسف ، عفاف هانم محمود رمضان ، هالة عزت الكواوي ، منى الحسينى ريحان *

المستخلص:

الغرض من هذه الدراسة هو معرفة تأثير استخدام عصائر البرقوق الأسود (Prunus salicina)وعصير الكرز الأسود (Prunus cerasus) في التخفيف من الآثار الجانبية الناتجة عن التصلب المتعدد (MS) في الفئران. تم إجراء التحليل الكيميائي والمسح الفيتوكيميائي للفاكهة بالإضافة إلى تقدير النشاط المضاد للأكسدة لعصير الفاكهة في المختبر. في التجربة البيولوجية، تم استخدام ثلاثين من الذكور البالغين من الجرذان البيضاء (وزنها ١٣٥ إلى ١٤٥ جم) ، ستة منهم كانت بمثابة كنترول طبيعي بقي على النظام الغذائي الأساسي خلال فترة التجربة. عولجت المجموعات المتبقية بكوبريزون بجرعة ٣ جم / كجم من الوجبة، تركت إحداها ككنترول موجب (MS control) بينما عولجت المجموعات الثلاث الأخرى يوميًا بعصائر البرقوق الأسود والكرز الأسود وخليطهم (١: ١ ح / ح) بجرعة ١٥ مل / كجم من وزن الجسم. باستخدام أنبوب المعدة.

تم حساب الزيادة في وزن الفئران ونسبة كفاءة الغذاء. في نهاية التجربة، تم ذبح الفئران وسحب دمائهم للتحليل. أظهرت النتائج أن نسبة زيادة الوزن وكفاءة الغذاء للمجموعة الضابطة الموجبة انخفضت بشكل معنوي مقارنة بالمجموعة الضابطة العادية بينما لوحظت زيادات معنوية في قيمها في المجموعات الثلاث المعالجة مقارنة بالمجموعة الإيجابية

أظهرت النتائج أن مستويات ALT وAST في الدم زادت بينما انخفض مستوى الألبومين في الدم بشكل ملحوظ في الكنترول الموجب. كما أظهرت المجموعات المعالجة بالعصائر تحسنًا معنويًا في مؤشرات وظائف الكبد هذه حيث لوحظ انخفاض معنوي في كل من ALT وAST وزيادة معنوية في ألبومين السيرم. أما بالنسبة للكرياتينين في الدم، وهو اختبار لوظائف الكلى، فقد أشارت النتائج إلى أن المجموعات المعالجة بالعصائر المختبرة أظهرت انخفاضًا ملحوظًا في الكرياتينين في الدم مقارنة بالكنترول الموجب عند $p < 0.05$.

من ناحية أخرى، لوحظ انخفاض كبير في مستويات سيرم الدم من الكوليسترول الكلي، والدهون الثلاثية، و LDL-c وزيادة معنوية في HDL-c في المجموعات المعالجة.

الخلاصة، تم تحقيق تحسن كبير في وظائف الكبد والكلى للفئران المصابة بالتصلب المتعدد باستخدام عصائر البرقوق الأسود والكرز الأسود أو خليطهما والذي ربما يُعزى إلى محتواهما من الفينولات والفلافونويد والأنثوسيانين.

الكلمات المفتاحية: البرقوق الأسود - الكرز الأسود - DPPH - تحليل الدهون - اختبارات وظائف الكبد – التصلب المتعدد

* قسم الاقتصاد المنزلى ، كلية التربية النوعية ، جامعة المنصورة ، مصر