Studying the effect of *Opuntia ficus- indica* juice on female rats with fibromyalgia - like condition

Aml F. EL-Gazar[1] , Eman S. Ibrahem[2], Alaa O.Aboraya[3] and Amr M. El-saied [4]

Nutrition and Food Sciences Dept., Faculty of Home Economics, Helwan University, Cairo-Egypt.

Abstract

Background: Fibromyalgia (FM) is a disorder characterized by widespread pain throughout the body, accompanied by other symptoms such as fatigue, sleep, mood disturbances, and cognitive dysfunction. *Opuntia ficus-indica* widely recognized as prickly pear, it distributed in many areas of the world because of its agronomic, and ecological benefits, besides its large amounts of functional, nutraceutical, and biological activities. **Obgective:** The main objective of the present study was to investigate the protective effect of *Opuntia ficus-indica* juice on a fibromyalgia-like condition induced by reserpine in female rats. twenty-five female rats were randomly divided into five equal groups (n=5 rats of each) as follow, negative control group and positive control group were fed only on the basal diet, while groups 3,4 and 5 were fed on basal diet and given orally *Opuntia ficus-indica juice* OFIJ for the experiential period 8 weeks at a dose of 100, 150 and 200 ml/kg of body weight, for all rats respectively, from the fourth week of the experiential period groups 2, 3, 4 and 5 were injected with reserpine for consecutive 3 days to induce fibromyalgia-like condition. **Materials and Methods:** the facial expression eye, nose, ear and whisker and analgesic effect of *Opuntia ficus-indica* on rats were determined, at the end of the experimental period 8weeks, Biochemical analysis was performed to the serum concentration of MDA and antioxidants enzymes. Histopathological of thighs muscles in rats were examined. **Results :** showed that groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* OFIJ had significant improvement of body weight gain, significantly reduced in malondialdehyde MDA while the antioxidants enzymes SOD , GPx , GSH and CAT were significantly increased compared to fibromyalgia-like condition female rats. accompanied by groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* OFIJ had a significant improvement Facial expression compared to fibromyalgia-like condition female rats . In addition Histopathological examination showed an obvious improvement in myocytes tissues of fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica* juice OFIJ. **Conclusio:** Finally, the existing study illustrated that *Opuntia ficus-indica* juice might improve the fibromyalgia-like condition in rats.

Keywords : Fibromyalgia , *Opuntia ficus-indica* , antioxidant and Facial expression.

1-Introduction

Fibromyalgia (FM) is characterized by generalized and continuous musculoskeletal pain as a leading symptom. Pain is considered chronic when it persists for at least three months. The pain can be described as a form of chronic widespread pain (CWP).CWP is "pain in at least 4 of 5 body regions (in at least 3 or 4 body quadrants)" accompanied by functional symptoms **(Nicholas *et al*., 2019)**. Functional symptoms include fatigue, insomnia and/or in somnolence, cognitive impairment, mood disorders, and stiffness of the joints and muscles. These symptoms have been present at a similar level for at least 3 months and are not better accounted for by any other diagnosis (**Dizner-Golab *et al*., 2023)**.

The management of FM requires a multidisciplinary approach combining both pharmacological and no pharmacological strategies. Among no pharmacological strategies, growing evidence suggests a potential beneficial role for nutrition. So summarizes the possible relationship between FM and nutrition exploring the available evidence on the effect of dietary interventions.

Opuntia Fruit *(Opuntia ficus-indica)* widely recognized as prickly pear, is native to Mexico and it is distributed in many areas of the world because of its socioeconomic, agronomic, and ecological benefits, besides its large amounts of functional, nutraceutical, and biological activities **(Abbas *et al*., 2022).** The Opuntia fruit consists of a thick peel (37%–67% fruit mass) surrounding a juicy pulp (30%–60%of fruit mass) with many small seeds (2%–10% of fruit mass). The fruit pulp can be consumed fresh or used to make a variety of processed foods, including juices, while seeds have a relatively high oil content **(Barba *et al*., 2020**). Several ingredients and bioactive compounds that show pharmacological properties have been identified in the fruit, including carbohydrates, lipids, proteins with their specific amino acids, vitamins, minerals, and phenolic compounds, as well as the pleasant flavor **(Barba *et al*., 2017)**. Those bioactive constituents provide antioxidant, anti-inflammatory, analgesic, anticancer, cardiovascular supportive, ant diabetic, gastro protective, hepatoprotective, and nephroprotective effects (Ramírez et al., 2020). effects on cognitive and memory function are also mentioned **(Abbas *et al*., 2022).** Health-promoting values are mainly due to the high antioxidant levels resulting from the presence of phenolic compounds,betacyanins, betalains, and selected vitamins being found in high contents in the Opuntia fruits **(Rahimi *et al*., 2019).**

Reserpine is an alkaloid extracted from the root of the Rauwolfia serpentina plant, which became commercially available in Western medicine in 1952 after being used for centuries in Indian medicine for a variety of illnesses, including schizophrenia **(López-Muñoz *et al*., 2004).** Reserpine was used as a first-line antihypertensive with clear efficacy **(Shamon and Perez,2016).** Reserpine is commonly used to induce FM in animals, effectively replicating key symptoms such as widespread pain, hypersensitivity, and mood disturbances **(AboTaleb *et al*., 2024)**.

2- Aim of the Study

The main objective of the present study was to investigate the protective effect of *Opuntia ficus-indica* juice on a fibromyalgia-like condition induced by reserpine in female rats.

3- Materials and Methods

3.1. Materials

3.1.1. *Opuntia ficus-indica juice* (OFIJ)

Opuntia ficus-indica fruits were purchased and identification in National Center for Agricultural Research, Cairo, Egypt.

3.1.2. Rats:

twenty-five adult female rats (Sprague Dawley Strain), weighed about 150±5g, were obtained from the Laboratory Animal Colony, Helwan, Egypt.

3.1.3. Diet:

Casein, cellulose, choline chloride, D-L methionine, vitamins and minerals, constituents, Starch, soybean oil, and sucrose were purchased from El-Gomhoriya Pharmaceutical Company, Cairo, Egypt.

3.1.4. Reserpine medication:

Reserpine medication in the form of tablets containing 0.25 mg Reserpine was purchased from the Gamma Trade Company for Pharmaceutical and Chemical, Dokki, Egypt.

3.1.5. Chemicals and Kits:

Chemical, and Kits for biochemical analysis were purchased from the Gamma Trade Company for Pharmaceutical and Chemical, Dokki, Egypt.

3.2. Methods

3.2.1. Preparation of Basal Diet:

The basal diet (AIN-93M) were consist of protein (14%), corn oil (5%), minerals mixture (3.5%), vitamins mixture (1%), fiber (5%), sucrose (10%), choline chloride (0.25%) and the remainder was corn starch up to 100%. These

constituents will be thoroughly mixed and formulated accorded to **(Reeves *et al* , 1993)**.

3.2.2. Preparation of *Opuntia ficus-indica juice* (OFIJ):

Fresh samples of *Opuntia ficus-indica* fruits were washed by cold running tap-water with gentle rubbing via gloved-hands to eliminate their thorns. Fruits mass without peels and seeds of arbitrarily combined samples (7 kg) had been grinded using a mill. The mixtures were steered in the mixer for 15 minutes and these mixtures were clean through a twofold layer of gauze to attain clear plant juice about 4 liters The obtained juice was stored in a refrigerator till oral administration **(Russell and Felker, 1987)**.

3.2.3. Preparation of Reserpine:

Reserpine was dissolved in distilled water with 0.5% acetic acid **(González *et al,* 2005)**.

3.2.4. Induction of fibromyalgia-like condition in rats:

A fibromyalgia-like condition in rats were induced by reserpine injection (1 mg/kg) subcutaneous for three consecutive days **(D'Amico *et al* , 2021)**.

3.2.5. Experimental Design and Grouping of Rats:

All rats (n = 25)were housed at a room temperature of 25 ± 2 °C, relative humidity of 50–55% and 12 hr. light/12 hr. dark cycles in the animal house of the Faculty of Home Economics, Helwan University, Egypt for one week for the acclimatization .After acclimatization period (one week).

Then all animals were randomly divided into five equal groups (n=5 rats of each) as follows, group (1) as normal rats (negative control) and group (2) fibromyalgia-like condition female rats (positive control) were fed only on the basal diet, while groups (3,4 and 5) were given orally Opuntia ficus-indica juice for the experimental period) 8 weeks (at a dose of 100, 150 and 200 ml/kg of body weight, for all rats respectively, from the fourth week of the experiential period groups 2, 3, 4 and 5 were injected with reserpine for consecutive 3 days to induce fibromyalgia-like condition after the induction the Facial expression were determined for all groups and at the end of experiential period an analgesic effect by hot plate was determined for all groups of rats.

3.2.6. Determination of Facial expression:

The grimace scale, a method for rating facial expression, is applied to the reserpine-induced fibromyalgia-like rat, which manifests nociplastic pain accorded to the described methods method by **Tanei *et al* , (2020)**.

3.2.6.1. Videotaping and image capture

Each groups rats was placed in glass cage ,Each animal was videotaped in the glass cage for 30 min using two high-resolution positioned in front of and behind glass cage , Still images of each animal's face were captured at approximately 3 min intervals from each 30 min video file , This procedure yielded a total of 5 images of each groups .

3.2.6.2. Image scoring

Scoring was conducted according to the method described by **Sotocina *et al*, (2011)**. The captured face images (5 images/group), Images were presented in random order to scorers. Ten trained scorers, who were blind to the treatment allocation, rated four separate action units in each image: (eye, nose, ear and whisker)change. Each action unit in each image was rated using a 4-point scale (0 = No symptoms, 1 = Moderate symptoms, 1.5 = Sever symptoms , 2= Very intense symptoms).

3.2.7. Biological evaluation:

Feed intake was recorded daily and animals were weighed at the begined and twice a week throughout the experimental period. Body weight gain and feed efficiency ratio were calculated at the end of the experiment (8 weeks) accorded to the method of **Chapman *et al* , (1959)**.

3.2.7.1. Determination of Feed Intake and Body Weight Gain and Relative of Body Weight Gain

The amount of feed intake (FI) for each rat was evaluated based on calculating the amount consumed daily for each group. To determine the change in body weight, rats were weighed before the experiment (IBW) and at the end of the experimental period (FBW). Next, we calculated the body weight gain (BWG) and the relative body weight gain (RGW%) as described by **Kratochvílova *et al* , (2002)** using the following formula:

BWG = Final Body Weight - Initial Body Weight

Relative of body weight gain %= BWG/IBW X 100

FER = Weight gain (g) / Feed intake (g)

3.2.7.2. Blood Collection and Serum Separation:

At the end of the experimental period (8weeks), rats were fasted overnight before scarifying and blood samples were collected from each rat and were centrifuged to obtain the serum for biochemical analysis.

- **Biochemical analysis:**

The biochemical determination were conducted at Graduate Research Labs, Postgraduate studies department of Nutrition and Food Science Dept., Faculty of Home Economics, Helwan University. The collected serum were used for the determination of:

3.2.7.2.1. Estimation of Malondialdehyde and Activities of Antioxidant Enzymes:

The serum concentration of MDA and the activity of catalase (CAT), superoxide dismutase (SOD), glutathione (GSH) and glutathione peroxides (GPx) enzymes were determined using commercial assaying kits (Cayman Practice ELISA Kits). The principal method for the determination of oxidative stress depends on colorimetric by quantifying thiobarbituric acid (TBA)

reactivity as malondialdehyde (MDA) in a spectrophotometer adjusted at 532 nm according to the described method by **De- Zwart *et al* , (1999)**.

The procedure that is used for the evaluation of CAT activity depends on the reaction of the enzyme with methanol in the presence of an optimal concentration of H2O2. The formaldehyde produced is measured spectrophotometrically at 540 nm as described by **(Wheeler *et al* , 1990)**.

The standard technique to assay the activity of SOD is that the kits used use an enzyme linked immunosorbent assaydouble antibody principle. The color change is measured spectrophotometrically at 450 nm as described by **(Wheeler *et al* , 1990)**. The serum activity of GSH and GPx was assayed according to the kit's instructions as described by **Ceballos-Picot *et al* , (1992)** using spectrophotometrically at 340nm.

3.2.7.3. Histopathological Examination

Following rat dissection, the thighs muscles were carefully removed from each rat, washed with normal saline for blood removal and immersed in neutral formaldehyde (10%). The submerged samples were then cleaned, washed and dehydrated in ascending grade alcohols. Afterword, specimens were cleared in Xylol, fixed and deeply in paraffin mass, sectioned to 4-6 microns in thickness and stained with the Heamatoxylin and Eosin stain for examination as described by **(Bancroft and Gamble , 2002)**.

Histopathological scoring in fibromyalgia-like condition female rats by using Image J as described by **(Dubuc *et al* , 2020)**.

3.2.7.4. Statistical analysis:

The obtained results were expressed as Mean ± SD. Data were evaluated statistically with computerized SPSS package program (SPSS 22.00 software for Windows) used one-way analysis of variance (ANOVA). Significant difference among means were estimated at $p<0.05$.

4- Results and Discussions

4.1. Effect of *Opuntia ficus-indica juice* (OFIJ) on IBW , FBW, BWG FI, FER and RWG in fibromyalgia-like condition female rats.

The effect of *Opuntia ficus-indica juice* (OFIJ) at levels 100 , 150 ,200 ml on Initial Body Weight (IBW) , Final Body Weight (FBW) , Body Weight gain (BWG) , Feed intake (FI) , Feed efficiency ratio (FER) , and Relative Body Weight Gain (RWG) in fibromyalgia-like condition female rats were shown **in Table (1)** The current results reveled that there was a non-significant difference in the mean values of IBW in group (2) fibromyalgia-like condition female rats (positive control) and group (1) as normal rats (negative control). while treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had significant decrease ($P<0.05$) in the mean values of IBW (156.40 ± 5.64 , 156.80 ± 3.83 and 155.60 ± 5.32 g) respectively as compared to group (2) fibromyalgia-like condition female rats (positive control)

Concerning that group (2) fibromyalgia-like condition female rats (positive control) had a significant increase ($P<0.05$) in the mean values of FBW (194.80 ± 4.32 g) compared to group (1) as normal rats (negative control). while treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had significant decrease ($P<0.05$) in the mean values of FBW (184.60 ± 3.65 , 175.00 ± 3.40 and 165.80 ± 2.59 g) respectively as compared to group (2) fibromyalgia-like condition female rats (positive control).

That group (2) fibromyalgia-like condition female rats (positive control) had a significant increase ($P<0.05$) in the mean values of BWG (37.00 ± 8.09 g) compared to group (1) as normal rats (negative control) . while treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had significant decrease ($P<0.05$) in the mean values of BWG (28.20 ± 3.63 , 18.20 ± 5.26 and 10.20 ± 5.45 g) respectively as compared to group (2) fibromyalgia-like condition female rats (positive control).

The data illustrated that there was a non-significant difference in the mean values of group (1) as normal rats (negative control) and group (2) fibromyalgia-like condition female rats (positive control) in FI. While treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had significant decrease ($P<0.05$) in the mean values of (FI) (15.40± 0.55, 13.60± 0.55 and 11.20± 0.84 g) respectively as compared to group (2) fibromyalgia-like condition female rats (positive control).

On the other hand that group (2) fibromyalgia-like condition female rats (positive control) had a significant increase ($P<0.05$) in the mean values of FER (1.88± 0.39) compared to group (1) as normal rats (negative control).while treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had significant decrease ($P<0.05$) in the mean values of FER (1.83± 0.27 , 1.34± 0.44 and 0.91± 0.48) respectively as compared to group (2) fibromyalgia-like condition female rats (positive control).

On the other wise data illustrated that the fibromyalgia-like condition female rats (positive control group) had a significant increase ($P<0.05$) in the mean values of RWG (23.66± 5.80 %) compared to group (1) as normal rats (negative control). while treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had significant decrease ($P<0.05$) in the mean values of RWG (18.10± 2.81 , 11.66± 3.64 and 6.64± 3.70 %) respectively as compared to fibromyalgia-like condition female rats (positive control group).

Result illustrated that group (2) fibromyalgia-like condition female rats (positive control) and fed on a normal diet had a significant increase ($P<0.05$) in the mean values of FER , FBW, BWG and RWG compared to group (1) as normal rats (negative control) this due to reduced mobility rats with Fibromyalgia , This result agree with **Aloush , (2019)** reported that there is a strong relationship between FMS and obesity due to the role of obesity in inflammation and chronic pain. Obese patients with FMS have more pain, reduced mobility and function and they are more depressive and use more medication **(Di Majo *et al*., 2024)**. In line with this results increased in the mean values of body weight in rats with Fibromyalgia .on the same line **Okifuji and Hare, (2015)** found the FMS symptoms are related to body weight, with participants with higher body weight having a higher burden of pain and a higher severity of FMS associated symptoms.

While treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had a significant decrease ($P<0.05$) in the mean values of FER , FBW, BWG and RWG as comport to fibromyalgia-like condition female rats (positive control group) .on the same line **Terzo *et al* , (2021)** Observed that rats fed the HFD and treated with indicaxanthin, extracted from the yellow cultivar of *Opuntia ficus-indica* fruit gained less weight than those fed the HFD alone. In addition **Verón *et al* , (2019)** OFI juice fermented with the potentially probiotic strain Lactobacillus plantarum S-811 was reported to show significant reduction in body weight gain in obese rats. Studied the effect of *Opuntia ficus-indica* in a dietary model of liver steatosis created by feeding rats a high-fat diet. The results demonstrated that the hepatic lipid profile was negatively

affected as a consequence of high-fat diet fed **(Bouazza *et al* , 2016).** OFI juice fermented with the potentially probiotic strain Lactobacillus plantarum S-811 was reported to show significant reduction in body weight gain in obese rats **(Verón *et al* , 2019).** Observed that rats fed the HFD and treated with indicaxanthin, extracted from the yellow cultivar of *Opuntia ficus-indica* fruit gained less weight than those fed the HFD alone **(Terzo *et al* , 2021)**. Our findings unveil for the first time that OFI effectively curbed the increase in body weight and concomitantly reduced the food-intake with respect to HFD rats. This action of OFIF on food intake could be due to multifaceted and synergic mechanisms, involving modulation of both leptin resistance **(Di Majo *et al* , 2024).**

Finally , fibromyalgia-like condition female rats , fed on basal diet and given orally Opuntia ficus-indica juice (OFIJ) at level of 200 ml had highly significant effects on IBW , FBW, BWG , FI, FER and RWG .

Table 1: Effect of *Opuntia ficus-indica* juice (OFIJ) on IBE,FBW, BWG, FI, FER and RWG in fibromyalgia-like condition female rats.

Parameters Groups		Parameter as Mean ± SD					
		IBW (g)	FBW (g)	BWG (g)	FI (g)	FER	RWG (%)
Negative control group		155.00 ± 3.81 [a]	160.60 ± 3.05 [e]	5.60 ± 2.61 [d]	18.80± 0.84 [a]	0.29± 0.13 [c]	3.63± 1.74[d]
Positive control group		157.20 ± 4.32 [a]	194.80 ± 4.32[a]	37.00 ± 8.09 [a]	19.60± 0.55 [a]	1.88± 0.39 [a]	23.66± 5.80[a]
Treated groups with OFIJ at levels of:	100 ml	156.40 ± 5.64 [a]	184.60 ± 3.65[b]	28.20 ± 3.63 [b]	15.40± 0.55 [b]	1.83± 0.27 [a]	18.10± 2.81[b]
	150ml	156.80 ± 3.83 [a]	175.00 ± 3.40[c]	18.20 ± 5.26[c]	13.60± 0.55[c]	1.34± 0.44 [b]	11.66± 3.64[c]
	200ml	155.60 ± 5.32 [a]	165.80 ± 2.59 [d]	10.20 ± 5.45 [d]	11.20± 0.84 [d]	0.91± 0.48 [b]	6.64± 3.70[d]

*Values are expressed as means ± SD

*Values at the same column with different letters are significant at $P<0.05$.

* Initial Body Weight (IBW) , Final Body Weight (FBW) , Body Weight gain (BWG) , Feed intake (FI) , Feed efficiency ratio (FER) , and Relative Body Weight Gain (RWG).

4.2. Effect of *Opuntia ficus-indica* juice (OFIJ) on serum concentration of MDA and activity of CAT, SOD, GSH and GPx enzymes in fibromyalgia-like condition female rats.

The effects of *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml on lipid peroxidation as indicated by serum MDA level and activity of CAT, SOD, GSH and GPx in group (1) as normal rats (negative control) , group (2) fibromyalgia-like condition female rats (positive control) and treated

groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) represents in **Table (٢)** group (2) fibromyalgia-like condition female rats (positive control) had a significant increase (P<0.05) in the mean values of MDA (164.80± 3.96 nmol/ml) as comport to group (1) as normal rats (negative control) . While treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had significant decrease (P<0.05) in the mean values of the activity of MDA (144.20± 3.77 , 124.80± 3.96 and 108.20± 5.45 nmol/ml) respectively as compared to group (2) fibromyalgia-like condition female rats (positive control).

group (2) fibromyalgia-like condition female rats (positive control) had significant decrease (P<0.05) in the mean values of the activity of CAT (93.20 ± 6.30 nmol/ml) , SOD (450.00± 22.36 ng/ml) GSH (2.28 ± 0.19 mmol/ml) and GPx (24.60 ± 3.05 nmol/ml) as comport to group (1) as normal rats (negative control) .While treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml had a significant increase (P<0.05) in the mean values of CAT (106.80 ± 2.39 , 116.00 ± 2.92 and 125.60 ± 3.05 nmol/ml) SOD (534.00± 24.08 , 644.00± 36.47 and 644.00± 36.47 ng/ml) GSH (2.80 ± 0.15 , 4.30 ± 0.35 and 5.20 ± 0.15 mmol/ml) and GPx (34.60 ± 3.21 , 34.60 ± 3.21 and 54.00 ± 2.92 nmol/ml) respectively as compared to group (2) fibromyalgia-like condition female rats (positive control).

In the present study indicated a significant amelioration in fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica* juice (OFIJ) at levels 100, 150 and 200 ml in the mean values of serum MDA levels and activities of CAT, SOD, GSH and GPx enzymes . There are correlation between serum lipids peroxidation products as indicated by MDA and the activity of antioxidant enzymes , which play an important role in the antioxidant system . The increase in serum MDA and the decrease in serum activity of antioxidant enzymes , as observed in group (2) fibromyalgia-like condition female rats (positive control) and fed on basal diet , can lead to the excessive availability of superoxide and peroxy1 radicals .resulting in the propagation our results agreed with **Samad *et al* , (2021)** who reported that Reserpine (Res)-induced depletion of monoamines and altered neurotransmission and produces oxidative stress with a reduced level glutathione (GSH) **(Singh *et al* , 2020)**. MDA levels increase during oxy-inflammation **(Pizzimenti *et al* , 2013)**.

In contrast , the present study documented that the fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica* juice (OFIJ) at levels 100, 150 and 200 ml had significant effects on decreasing level of MDA and increasing activities of antioxidant enzymes CAT, SOD, GSH and GPx as comport to group (2) fibromyalgia-like condition female rats (positive control). Accordingly to our study can demonstrate that *Opuntia ficus-indica* juice (OFIJ) reduced oxidative stress in rats. it was in agreement with **El-Hawary *et al* , (2020)** All OFI extracts were able to reduce

oxidative stress in the brain where they demonstrated a significant decrease in oxidative stress marker MDA level and significant increase in GSH, SOD and CAT levels revealing substantial antioxidant activities . in vivo our results clearly show how OFI administration also reduced the HFD-induced increase of brain lipid peroxidation, significantly reducing MDA levels **(Di Majo *et al* , 2024)**. Further more **Khouloud *et al* , (2018)** indicated the *Opuntia ficus-indica* juice has an antioxidant capacity for catching free radicals.oxidative stress markers the MDA demonstrate a significant decrease after supplementation of *Opuntia ficus-indica* juice .However, prickly pear vinegar treatment was able to significantly prevent the changes observed in SOD and GPX activities **(Bouazza *et al* , 2016).** OFI is to be rich in many antioxidant phytochemicals such as polyphenols, betalains, and carotenoids **(Belhadj Slimen *et al* , 2021).** OFI juice (red-purple variety) showed a protection effect oxidative stress in rats **(Mohamed and Fayed, 2019).**

Table 2: Effect of *Opuntia ficus-indica* juice (OFIJ) on serum concentration of MDA and activity of CAT, SOD, GSH and GPx enzymes in fibromyalgia-like condition female rats.

Parameters Groups		Parameter as Mean ± SD				
		MDA (nmol/ml)	CAT (nmol/ml)	SOD (ng/ml)	GSH (mmol/ml)	GPx (nmol/ml)
Negative control group		87.60± 5.59 [d]	139.40 ± 4.16 [a]	1041.40± 34.42 [a]	5.78 ± 0.19 [a]	65.20 ± 3.27 [a]
Positive control group		164.80± 3.96 [a]	93.20 ± 6.30 [e]	450.00± 22.36 [d]	2.28 ± 0.19 [e]	24.60 ± 3.05 [e]
Treated groups with OFIJ at levels of:	100 Ml	144.20± 3.77 [b]	106.80 ± 2.39[d]	534.00± 24.08 [d]	2.80 ± 0.15 [d]	34.60 ± 3.21 [d]
	150 Ml	124.80± 3.96 [c]	116.00 ± 2.92[c]	644.00± 36.47[c]	4.30 ± 0.35[c]	43.60 ± 3.05[c]
	200 Ml	108.20± 5.45 [d]	125.60 ± 3.05 [b]	752.00± 39.62 [b]	5.20 ± 0.15 [b]	54.00 ± 2.92 [b]

*Values are expressed as means ± SD

*Values at the same column with different letters are significant at P<0.05.

* Malondialdehyde (MDA) , Catalase (CAT) , Superoxide Dismutase (SOD) , Reduced Glutathione (GSH) and Glutathione Peroxidase (GPx).

4.3. Effect of *Opuntia ficus-indica* juice (OFIJ) on Determination of Facial expression in fibromyalgia-like condition female rats.

The effect of *Opuntia ficus-indica juice* (OFIJ) at levels 100 , 150 ,200 ml on Determination of Facial expression in fibromyalgia-like condition female rats were shown **in Table (3) and Figure (١) .** group (2) fibromyalgia-like condition female rats (positive control) had significant happened changes in facial expression (P<0.05) in the mean values of Eye , Nose, Ear and Whisker (2.00 ± 0.00) respectively compared to group (1) as normal rats (negative

control) . on the other side treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 200 ml had highly significant improve ($P<0.05$) in the mean values of Facial expression Eye , Nose, Ear and Whisker Eye (0.56 ± 0. 56), Nose (0. 63 ± 0. 48), Ear (0.49 ± 0.38) Whisker (0. 57 ± 0.39) , on the other side treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100 and 150 ml had significant improve ($P<0.05$) in the mean values of Facial expression Eye , Nose, Ear and Whisker Eye (1.63 ± 0.15, 1.16 ± 0. 28), Nose (1.47 ± 0. 14 , 1.26), Ear (1.59 ± 0. 19, 1.24 ± 0.10) Whisker (1.53 ± 0.16, 1.10 ± 0. 21) respectively as compared to group (2) fibromyalgia-like condition female rats (positive control).

After fibromyalgia-like condition in rats were induced by reserpine injection (1 mg/kg) subcutaneous for three consecutive days .Preliminary experiments were conducted to collect a representative image set of facial expressions for both group (1) as normal rats (negative control) , The fibromyalgia-like condition female rats (positive control group) and treated groups (fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* OFIJ) at levels 100, 150 and 200 ml . The representative images are shown in Fig.(2)by using rated four separate action units in each image: (eye, nose, ear and whisker) change. Each action unit in each image was rated using a 4-point scale 0 = No symptoms, 1 = Moderate symptoms, 1.5 = Sever symptoms , 2= Very intense symptoms which presented as statistical data in table (13). group (2) fibromyalgia-like condition female rats (positive control) had Very intense symptoms in facial expression of Eye , Nose, Ear and Whisker respectively compared group (1) as normal rats (negative control). on the other wise treated groups fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 200 ml had Moderate symptoms while *Opuntia ficus-indica juice* (OFIJ) at level 100 and 150 ml had Severe symptoms of Facial expression Eye , Nose, Ear and Whisker , respectively as compared to group (2) fibromyalgia-like condition female rats (positive control).

Our results indicated a significant improve of Facial expression in fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica* juice (OFIJ) at levels 100, 150 and 200 ml as comport to group (2) fibromyalgia-like condition female rats (positive control) . There are a significant correlation of Facial expression in fibromyalgia so group (2) fibromyalgia-like condition female rats (positive control) had significant happened changes in facial expression in the mean values of the Facial expression this result accordant to **Nagakura *et al* , (2019)** the present study result showed the rat grimace scale (RGS), a facial expression-dependent

measure developed for quantifying spontaneous pain, to the rat with reserpine-induced myalgia. The reserpine-induced myalgia rats exhibited a significant increase in the RGS score, which was sustained for 2 weeks or more after the induction of fibromyalgia-like state by reserpine injection. The present study The ratings of the orbital tightening, nose, cheek flattening, and changes in characteristics of ears and whiskers by three raters, who were blinded to the treatment allocated to rats, demonstrated substantial, long-lasting change in facial expression of rats. All raters independently indicated that rat grimace scale (RGS) in score is significantly elevated with this methodology in reserpine-induced fibromyalgia-like rats **(Tanei *et al* , 2020)**. On other hand, Fibromyalgia is a chronic pain syndrome that is defined by generalized pain for more than 3 months and the presence of more than 10 tender points **(Wolfe *et al* , 1990)**. In addition to disturbed sleep, distress and pronounced fatigue .Pain in fibromyalgia is consistently felt in the musculature and is related to sensitization of central nervous system (CNS) pain pathways **(Staud and Rodriguez, 2006)**.

Reported by **Akkol *et al* , (2020)**. This study investigated the sedative and anxiolytic effects of the extracts prepared from the fruits of *O. ficus indica* The results showed that *O. ficus indica* had sedative and anxiolytic effects .the currently observed ability of OFI treatment to remarkably counteract cognitive and affective dysfunctions could be, at least in part, due to its anti-oxidative potential **(Attanzio *et al* , 2018)**. Health-promoting values are mainly due to the high antioxidant levels resulting from the presence of phenolic compounds, betacyanins, betalains, and selected vitamins being found in high contents in the Opuntia fruits **(Rahimi *et al* , 2019)** . on the other hand *Opuntia ficus indica* fruit as a source of natural liquid sweetener cactus fruit juice laden with total phenolic, total flavonoids, vitamin C, vitamin E, and β-carotene can safeguard the body against oxidative stress **(El-Beltagy *et al* , 2023)**. It also exhibited analgesic effects on the central and peripheral **(Benattia *et al* , 2019)** .

Table 3 : Effect of *Opuntia ficus-indica* juice (OFIJ) on Determination of Facial expression in fibromyalgia-like condition female rats.

Parameters / Groups		Facial Expression Mean ± SD			
		Eye	Nose	Ear	Whisker
Negative control group		0.00 ± 0.00 ^{e}	0.00 ± 0.00 ^{d}	0.00 ± 0.00 ^{e}	0.00 ± 0.00 ^{e}
Positive control group		2.00 ± 0.00 ^{a}	2.00 ± 0.00 ^{a}	2.00 ± 0.00 ^{a}	2.00 ± 0.00 ^{a}
Treated groups with OFIJ at levels of:	100 Ml	1.63 ± 0.15 ^{b}	1.47 ± 0. 14 ^{b}	1.59 ± 0. 19 ^{b}	1.53 ± 0.16 ^{b}
	150 Ml	1.16 ± 0. 28 ^{c}	1.26 ± 0. 08 ^{b}	1.24 ± 0.10 ^{c}	1.10 ± 0. 21 ^{c}
	200 Ml	0.56 ± 0. 56 ^{d}	0. 63 ± 0. 48 ^{c}	0.49 ± 0.38 ^{d}	0. 57 ± 0.39 ^{d}

* Values are expressed as means ± SD

* Values at the same column with different letters are significant at $P<0.05$.

* Eye, Nose , Ear and Whisker.

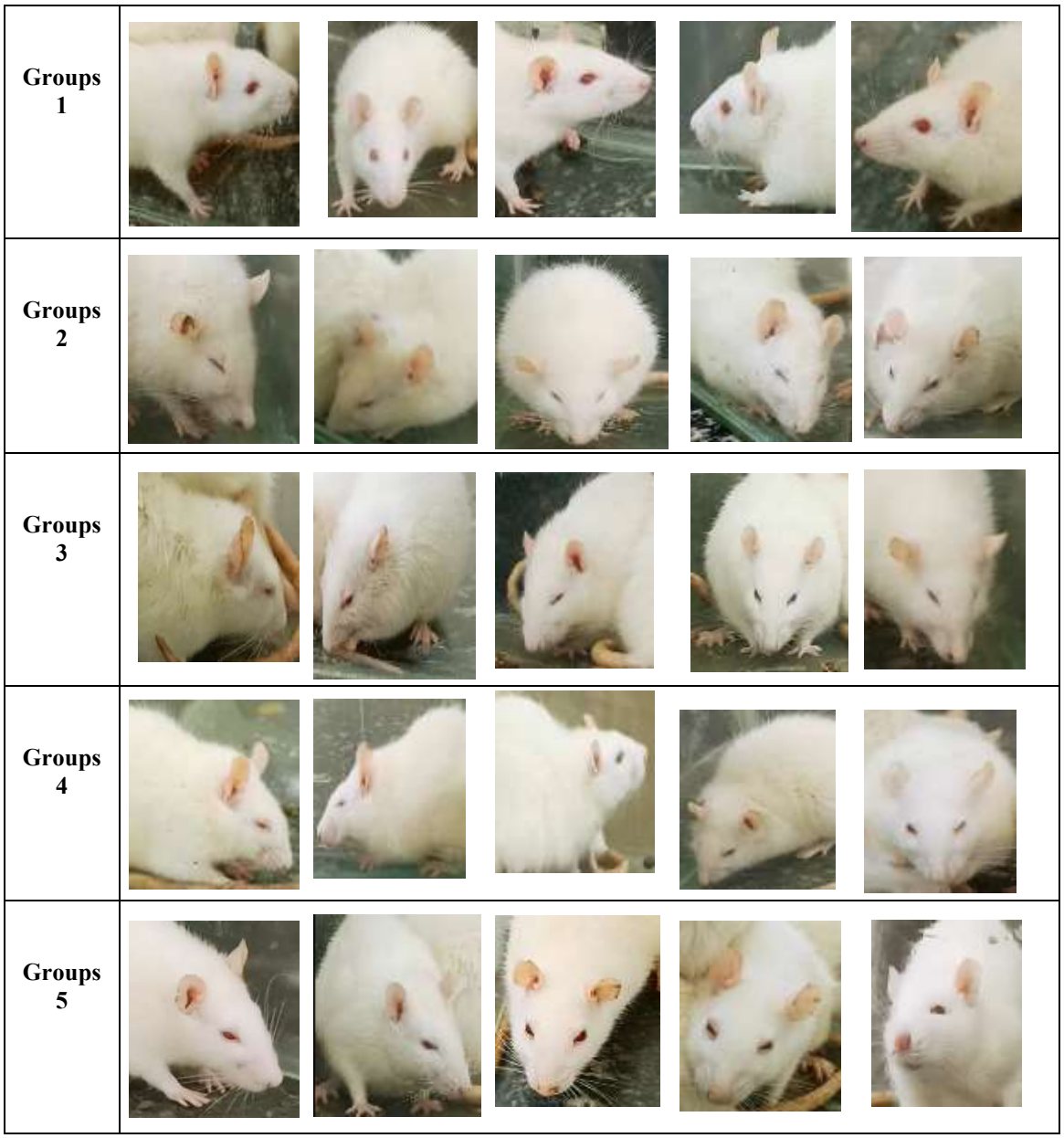

Figure 1 : Effect of *Opuntia ficus-indica* juice (OFIJ) on rating facial expression in fibromyalgia-like condition female rats.

4.4. Histopathological Examination

This report provides a detailed histological examination of skeletal muscle tissues from experimental rat groups. Microscopic evaluation was performed to assess the structural integrity and pathological alterations in muscle fibers under various treatments.

1- Group (1) as normal rats (negative control)

Microscopic examination in figer (30) revealed normal histological architecture of skeletal fibers . Muscle fibers were intact, with clear striations and peripheral nuclei. No signs of necrosis, fibrosis, or edema were present, indicating a healthy muscle structure

2- Group (2) fibromyalgia-like condition female rats (positive control)

Figer (3) showed severe histopathological alterations in positive control (group 2). Focal necrosis was evident, with formation of fibrous connective tissue fibrotic star-shaped regions . Additionally, marked interstitial edema was observed between muscle fibers, indicating tissue injury and inflammatory response.

3- (Group 3) – fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* OFIJ) at level 100 ml

Microscopic examination in figer (٤) revealed Moderate improvement was seen in group 3 compared to Group 2. Some muscle fibers regained normal structure. Edema and fibrotic changes were present but to a lesser extent, suggesting partial therapeutic efficacy at this dosage.

4- (Group 4) – fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* OFIJ) at level 150 ml

Further histological recovery was noted in figer (٥) . Most muscle fibers appeared near-normal, with minimal fibrotic regions and reduced interstitial edema. The structure showed signs of progressive repair and regeneration.

5- (Group 5) – fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* OFIJ) at level 200 ml

This group exhibited nearly normal muscle architecture, the compared to group (2) fibromyalgia-like condition female rats (positive control). Muscle fibers were well-aligned, with minor or no pathological findings, suggesting a strong protective or regenerative effect at the highest treatment dose.

The indicated a significant improve in Histological structure of skeletal fibers in fibromyalgia-like condition female rats , fed on basal diet and given orally *Opuntia ficus-indica juice* (OFIJ) at levels 100, 150 and 200 ml as comport to group (2) fibromyalgia-like condition female rats (positive control). There are correlation between fibromyalgia and Histological structure of myocytes by Reserpine in group (2) fibromyalgia-like condition female rats (positive control). Had significant happened changes in Histological structure of myocytes which accordant to **Favero *et al* , (2017)** Fibromyalgia is a

chronic syndrome characterized by widespread musculoskeletal pain and an extensive array of other symptoms including disordered sleep, fatigue, depression and anxiety. Important factors involved in the pathogenic process of fibromyalgia are inflammation and oxidative stress .The animals treated with reserpine showed moderate alterations at hind limb skeletal muscles level and had difficulty in moving, together with significant morphological and ultrastructural alterations and expression of inflammatory and oxidative stress markers in the gastrocnemius muscle. The present study Reserpine induces musculoskeletal deficits similar to FM, as shown by impaired motor activity of rat's hind-limb muscles .Skeletal muscle atrophy was recorded in the form of alteration of the muscle weight and diameter of myotubes. Reserpine also causes significant musculoskeletal ultrastructural alterations **(Favero *et al* , 2017)**. Reported by **Favero *et al* , (2017)** Reserpine also caused a reduction in locomotor activity that had been related not only to long-lasting muscular mechanical hyperalgesia and tactile allodynia. On the other hand The main somatic symptoms of fibromyalgia syndrome (FMS) are chronic musculoskeletal pain, stiffness, and fatigue, all of which are related to the muscle system and its functioning **(Umay *et al* , 2020)**. And it was shown that patients with FMS had a considerable reduction in functional performance and muscle strength as compared with healthy individuals **(Larsson *et al* , 2018)**.

Reported by **Kuti ,(2004)** *Opuntia ficus indica* is known for its high content in polyphenols exhibiting antioxidant and anti-inflammatory properties. Health beneficial effects of cactus polyphenols might be conditioned by their antioxidant and radical scavenging activities. *Opuntia ficus-indica* cladodes are rich in nicotiflorin which, through anti-inflammatory and neuroprotective mechanism **(El-Mostafa *et al* , 2014)**. Moreover, OFIJ reduced muscle-damage markers **(Abedelmalek *et al* , 2022)** . Moreover, the characteristic betalains of the OFI fruit have been reported to have health-promoting properties **(Tesoriere *et al* , 2008)** . It has been shown that the consumption of fresh OFI fruit significantly decreases oxidative stress and inflammatory markers, and is associated with an improved antioxidant status in healthy subjects **(Attanzio *et al* , 2018)**. An example may be found in a study by **Khouloud ,(2018)**, that provided evidence of a reduced exercise-related oxidative stress and muscle damage and improved aerobic performance after 2 weeks of OFI supplementation. These findings suggest that OFI supplementation may be used to improve recovery function following exercise.

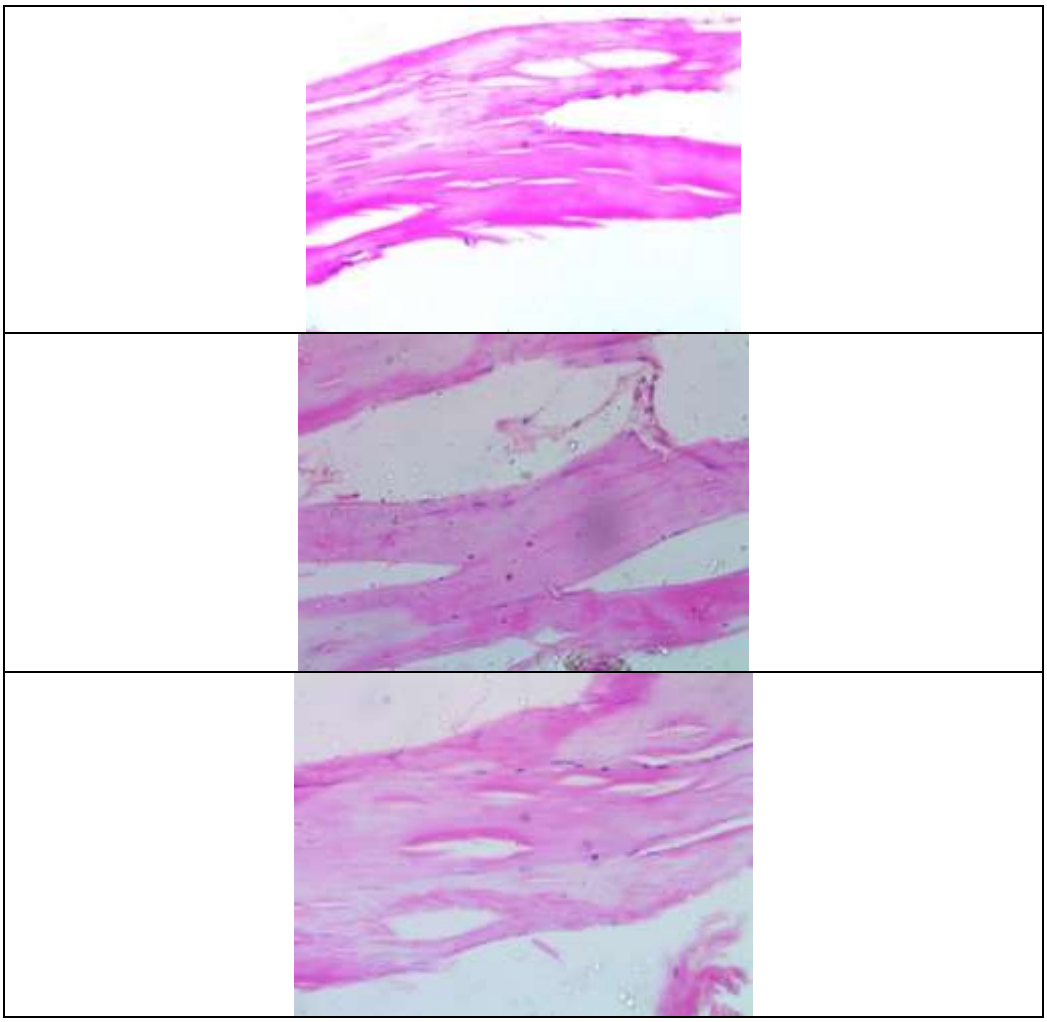

Figure 2 : photomicrograph showing normal Histological structure of muscle fiber from group 1 (H and E stain, X400)

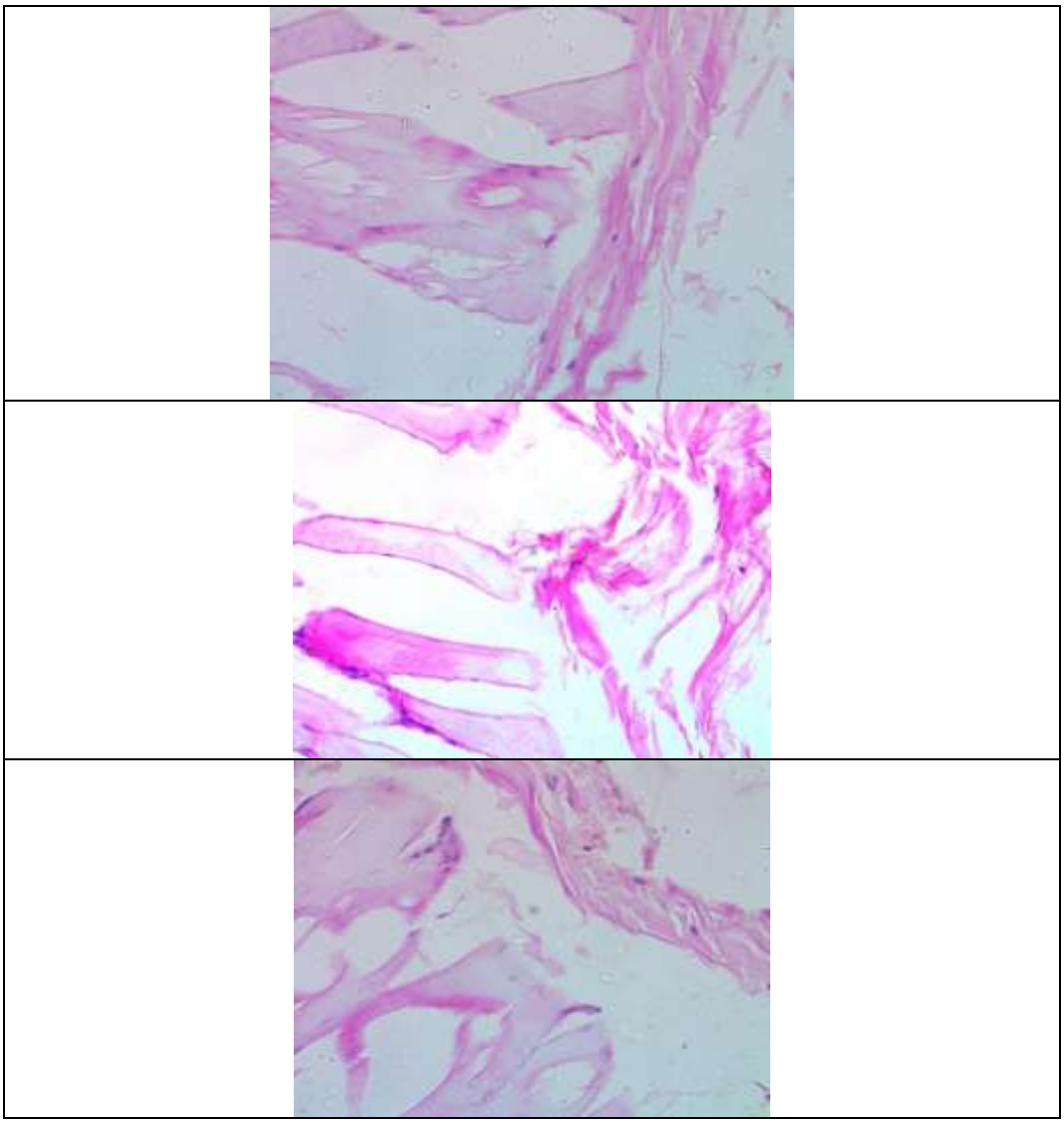

Figure 3 : photomicrograph showing fibrous connective tissue formation (star) with edema between muscle fibers from group 2 (H and E stain, X400)

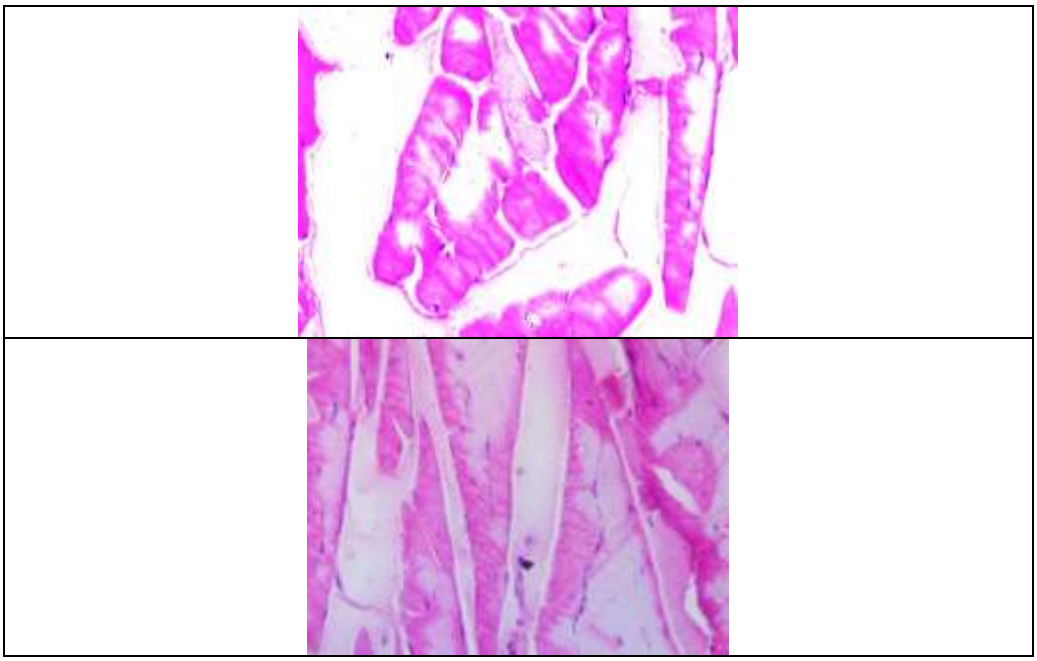

Figure 4 : photomicrograph showing improve of edema in Histological structure of myocytes from group 3 (H and E stain, X400)

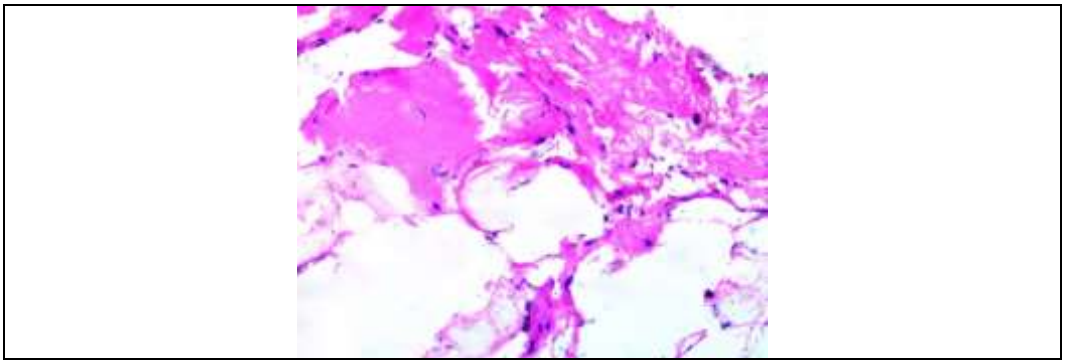

Figure 5 : : photomicrograph showing improve in inflammatory cells and edema of Histological structure of myocytes from group 4 (H and E stain, X400)

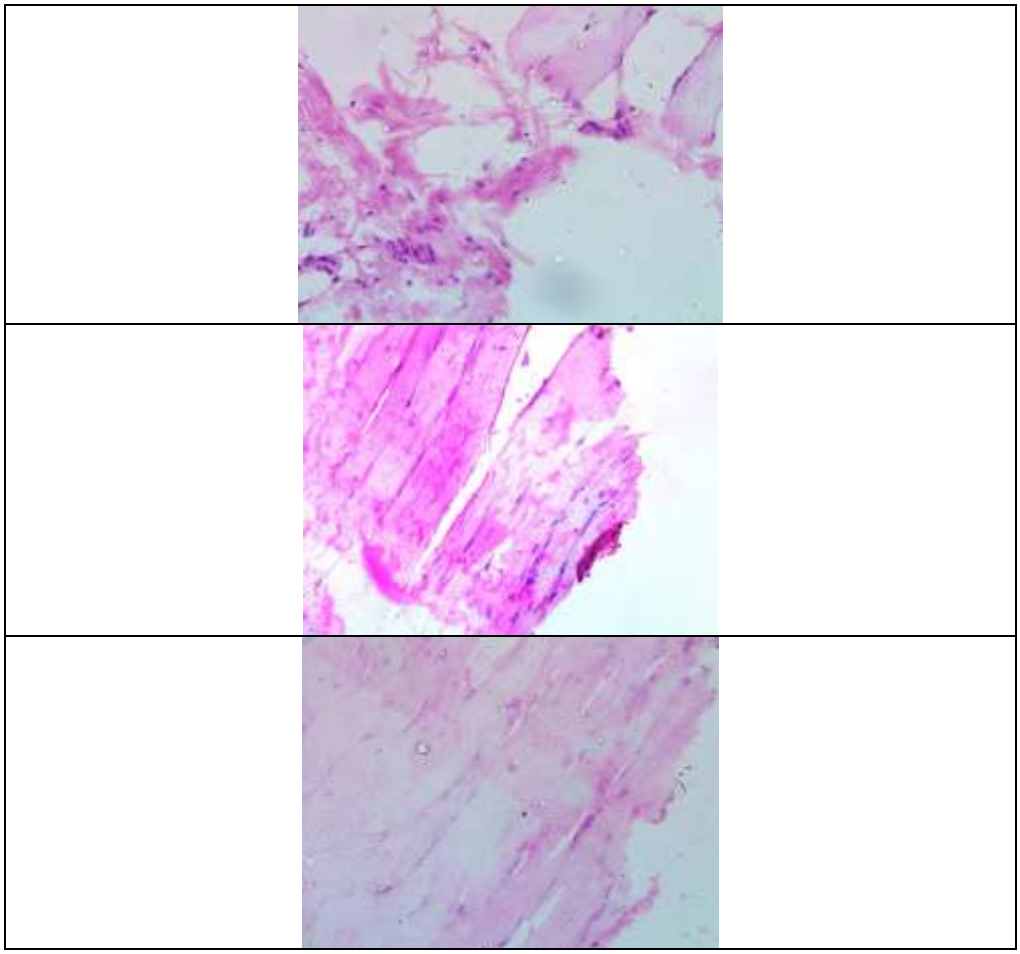

Figure 6 : photomicrograph showing improve of Histological structure of skeletal fibers from group5 (H and Estain,X400).

Table 4 : The effect of Opuntia ficus-indica juice (OFIJ) on Histopathological scoring in fibromyalgia-like condition female rats.

Parameters Groups		Facial Expression Mean ± SD					
		Muscle Fibers	Edema	Necrosis	Fibrosis	Inflammatory Cells	Total Score (0–5)
Negative control group		0 (Normal)	0	0	0	0	0 – No damage
Positive control group		1 (Damaged)	1	1	1	1	5 – Severe damage
Treated groups with OFIJ at levels of:	100 Ml	1 (Partially affected)	1	0	1	0	3 – Moderate damage
	150 Ml	0 (Mostly intact)	0	0	1	0	1 – Minimal damage
	200 Ml	0 (Normal)	0	0	0	0	0 – Fully recovered

This table summarizes the histopathological scoring for each experimental group. Each parameter is scored as 0(normal) or 1 (abnormal), and the total score indicates the severity of tissue damage (0 to 5).

5- References

- **Abbas Y., Ezzat I., El Hefnawy M. and Abdel-Sattar E. (2022):** An overview and update on the chemical composition and potential health benefits of Opuntia ficus-indica (L.) Miller. Journal of Food Biochemistry, 46(11), e14310.
- **Abedelmalek S., Aloui K., Boussetta N., Alahmadi B., Zouch M., Chtourou H. and Souissi N. (2022):** Does Opuntia ficus-indica Juice Supplementation Improve Biochemical and Cardiovascular Response to a 6-Minute Walk Test in Type 2 Diabetic Patients?. *Medicina*, *58*(11), 1561.
- **AboTaleb H., Hindi A., Abd El-Aziz S., Alturkistani A., Halawani M., Al-Thepyani A. and Alghamdi S. (2024):** Evaluation of reserpine-induced fibromyalgia in mice: A comparative behavioral, neurochemical, and histological assessment of two doses. IBRO Neuroscience Reports.
- **Akkol K., Ilhan M., Karpuz B., Genç Y. and Sobarzo-Sánchez E. (2020):** Sedative and anxiolytic activities of Opuntia ficus indica (L.) Mill.: An experimental assessment in mice. *Molecules*, *25*(8), 1844.
- **Aloush V. (2019):**Fibromyalgia, obesity and all that lies in between. *Harefuah*, *158*(9), 587-588.
- **Attanzio A., Tesoriere L., Vasto S., Pintaudi M., Livrea A. and Allegra M. (2018):** Short-term cactus pear [Opuntia ficus-indica (L.) Mill] fruit supplementation ameliorates the inflammatory profile and is associated with improved antioxidant status among healthy humans. *Food & nutrition research*, *62*.
- **Bancroft J. and Gamble M. (2002):** Theory and practice of histological techniques,5th ed. John D. Bancroft, Marilyn Gamble, London, New York and Philadelphia.
- **Barba J., Putnik P., Kovačević D., Poojary M., Roohinejad S.,Lorenzo M. and Koubaa M. (2017):** Impact of conventional and non-conventional processing on prickly pear (Opuntia spp.) and their derived products: From preservation of beverages to valorization of by-products.Trends in Food Science & Technology, 67, 260–270.
- **Barba J., Garcia C., Fessard A., Munekata E., Lorenzo M., Aboudia A., Ouadia A. and Remize F. (2020):** Opuntia ficus-indica edible parts: A food and nutritional security perspective. Food Reviews International,38(5), 930–952.

- **Belhadj Slimen I., Najar T. and Abderrabba M. (2021):** Bioactive compounds of prickly pear [Opuntia ficus-indica (L.) Mill.]. *Bioactive compounds in underutilized vegetables and legumes*, 171-209.
- **Benattia K., Arrar Z., Dergal F. and Khabbal Y. (2019):** Pharmaco-analytical study and phytochemical profile of hydroethanolic extract of Algerian prickly pear (Opuntia ficus-indica. L). *Current Pharmaceutical Biotechnology*, *20*(9), 696-706.
- **Bouazza A., Bitam A., Amiali M., Bounihi A., Yargui L., and Koceir A. (2016):** Effect of fruit vinegars on liver damage and oxidative stress in high-fat-fed rats. Pharmaceutical biology, 54(2), 260-265.
- **Ceballos-Picot I., Trivier M., Nicole A., Sinet M. and Thevenin M. (1992):** Age correlated modifications of copper-zinc superoxide dismutase and glutathione-related enzyme activities in human erythrocytes. Clinical Chemistry. 38(1): 66-70.
- **Chapman G., Gastilla R., and Campbell A. (1959):** Evaluation of protein in foods: 1- A Method for the determination of protein efficiency ratio. Can. J. Biochem. Phys; 37:679- 86.
- **D'Amico R., Fusco R., Siracusa R., Impellizzeri D., Peritore F., Gugliandolo E. and Di Paola R. (2021):** Inhibition of P2X7 purinergic receptor ameliorates fibromyalgia syndrome by suppressing NLRP3 pathway. International Journal of Molecular Sciences, 22(12), 6471.
- **De-Zwart L., Meerman H., Commandeur N. and Vermeulen P. (1999):** Biomarkers of Free Radical Damage Applications in Experimental Animals and Humans, Free Rad. Biol. Med. 26:202-226.
- **Di Majo D., Ricciardi N., Di Liberto V., Allegra M., Frinchi M., Urone G. and Gambino G. (2024):** The remarkable impact of Opuntia Ficus Indica fruit administration on metabolic syndrome: Correlations between cognitive functions, oxidative stress and lipid dysmetabolism in the high-fat, diet-fed rat model. *Biomedicine & Pharmacotherapy*, *177*, 117028.
- **Dizner-Golab A., Lisowska B. and Kosson D. (2023):** Fibromyalgia–etiology, diagnosis and treatment including perioperative management in patients with fibromyalgia. *Reumatologia*, *61*(2), 137.
- **Dubuc V., Laverty S., Richard H., Doré M., and Theoret, C. (2020):** Development of a computer-based quantification method for immunohistochemically-stained tissues and its application to study mast cells in equine wound healing (proof of concept). *BMC veterinary research*, *16*(1), 228.

- **El-Beltagy F., Rashed H., Abdelaziz K. and Abou-El-magd F. (2023):** Opuntia ficus indica fruit alleviates the cerebellar neurotoxicity induced by monosodium glutamate and aspartame in female rats and their pups. *Journal of Medical and Life Science*, *5*(4), 251-281.
- **El-Hawary S., Sobeh M., Badr K., Abdelfattah A., Ali Y., El-Tantawy E. and Wink M. (2020):** HPLC-PDA-MS/MS profiling of secondary metabolites from Opuntia ficus-indica cladode, peel and fruit pulp extracts and their antioxidant, neuroprotective effect in rats with aluminum chloride induced neurotoxicity. *Saudi Journal of Biological Sciences*, *27*(10), 2829-2838.
- **El-Mostafa K., El Kharrassi Y., Badreddine A., Andreoletti P., Vamecq J., El Kebbaj S. and Cherkaoui-Malki M. (2014):** Nopal cactus (Opuntia ficus-indica) as a source of bioactive compounds for nutrition, health and disease. *Molecules*, *19*(9), 14879-14901.
- **Favero G., Trapletti V., Bonomini F., Stacchiotti A., Lavazza A., Rodella F. and Rezzani, R. (2017):** Oral supplementation of melatonin protects against fibromyalgia-related skeletal muscle alterations in reserpine-induced myalgia rats. *International Journal of Molecular Sciences*, *18*(7), 1389.
- **González S., Mena A., Lastres-Becker I., Serrano A., de Yébenes G., Ramos A. and Fernández-Ruiz, J. (2005):** Cannabinoid CB1 receptors in the basal ganglia and motor response to activation or blockade of these receptors in parkin-null mice. *Brain research*, *1046*(1-2), 195-206.
- **Khouloud A., Abedelmalek S., Chtourou H. and Souissi N. (2018):** The effect of Opuntia ficus-indica juice supplementation on oxidative stress, cardiovascular parameters, and biochemical markers following yo-yo Intermittent recovery test. Food Science & Nutrition, 6(2), 259-268.
- **Kratochvílova M., Hyankova L., Knizetova H., Fiedler J. and Urban F (2002):** Growth curve analysis in cattle from early maturity and mature body size viewpoints. Czech J. Anim. Science 47 4: 125–132.
- **Kuti O. (2004):** Antioxidant compounds from four Opuntia cactus pear fruit varieties. *Food chemistry*, *85*(4), 527-533.
- **López-Muñoz F., Bhatara S., Alamo C. and Cuenca E. (2004):** Historical approach to reserpine discovery and its introduction in psychiatry. *Actas espanolas de psiquiatria*, *32*(6), 387-395.
- **Mohamed S. and Fayed M. (2019):** Natural functional juice of prickly cactus pear (*Opuntia ficus-indica* (L.) Mill.) ameliorate the

oxidative stress in male rats. *International Journal of Advances in Medical Sciences*, *4*(7), 1–10.

- **Nagakura Y., Miwa M., Yoshida M., Miura R., Tanei S., Tsuji M. and Takeda, H. (2019):** Spontaneous pain-associated facial expression and efficacy of clinically used drugs in the reserpine-induced rat model of fibromyalgia. *European Journal of Pharmacology*, *864*, 172716.
- **Nicholas M., Vlaeyen J. W., Rief W., Barke A., Aziz Q., Benoliel R . and Treede D. (2019):** The IASP classification of chronic pain for ICD-11: chronic primary pain. *Pain*, *160*(1), 28-37.
- **Okifuji A., and Hare D. (2015):** The association between chronic pain and obesity. *Journal of pain research*, 399-408.
- **Pizzimenti S., Ciamporcero E., Daga M., Pettazzoni P., Arcaro A., Cetrangolo G. and Barrera G. (2013):** Interaction of aldehydes derived from lipid peroxidation and membrane proteins. *Frontiers in physiology*, *4*, 242.
- **Rahimi P., Abedimanesh S., Mesbah-Namin A., and Ostadrahimi A. (2019):** Betalains, the nature-inspired pigments, in health and diseases. *Critical reviews in food science and nutrition*, *59*(18), 2949-2978.
- **Reeves P., Nielsen F., and Fahmy, G. (1993):** AIN-93. Purified diets for laboratory rodents: Final reports of the American Institute of Nutrition adhoe 9 writing committee of reformulation of the AIN-76 A Rodent Diet. J. Nutr., 123: 1939-1951.
- **Russell E. and Felker P. (1987):** The prickly-pears (Opuntia spp., Cactaceae): A source of human and animal food in semiarid regions. Econ. Bot.; 41: 433- 445.
- **Samad N., Khaliq S., Alam M., Yasmin F., Ahmad S., Mustafa S. and Raza U. (2021):** Tryptophan lessens reserpine induced anxiety, depression and memory impairment by modulating oxidative stress and serotonergic activity. *Pakistan journal of pharmaceutical sciences*, *34*.
- **Shamon D. and Perez I. (2016):** Blood pressure-lowering efficacy of reserpine for primary hypertension. *Cochrane Database of Systematic Reviews*, (12).

  Singh L., Kaur A., Garg S., Singh P. and Bhatti R. (2020): Protective effect of esculetin, natural coumarin in mice model of fibromyalgia: targeting pro-inflammatory cytokines and MAO-A. *Neurochemical Research*, *45*, 2364-2374.
- **Sotocina G., Sorge E., Zaloum A., Tuttle H., Martin J., Wieskopf S. and Mogil S. (2011):** The Rat Grimace Scale: a partially automated

method for quantifying pain in the laboratory rat via facial expressions. *Molecular pain*, *7*, 1744-8069.

- **Staud R. and Rodriguez E. (2006):** Mechanisms of disease: pain in fibromyalgia syndrome. *Nature clinical practice Rheumatology*, *2*(2), 90-98.
- **Tanei S., Miwa M., Yoshida M., Miura R., and Nagakura, Y. (2020):** The method simulating spontaneous pain in patients with nociplastic pain using rats with fibromyalgia-like condition. MethodsX, 7, 100826.
- **Terzo S., Attanzio A., Calvi P., Mulè F., Tesoriere L., Allegra M. and Amato A. (2021):** Indicaxanthin from Opuntia ficus-indica fruit ameliorates glucose dysmetabolism and counteracts insulin resistance in high-fat-diet-fed mice. *Antioxidants*, *11*(1), 80.
- **Tesoriere L., Fazzari M., Angileri F., Gentile C., and Livrea A. (2008):** In vitro digestion of betalainic foods. Stability and bioaccessibility of betaxanthins and betacyanins and antioxidative potential of food digesta. *Journal of agricultural and food chemistry*, *56*(22), 10487-10492.
- **Umay E., Gundogdu I., and Ozturk A. (2020):** What happens to muscles in fibromyalgia syndrome. *Irish Journal of Medical Science (1971-)*, *189*, 749-756.
- **Verón E., Cano G., Fabersani E., Sanz Y., Isla I., Espinar F. and Torres S. (2019):** Cactus pear (Opuntia ficus-indica) juice fermented with autochthonous Lactobacillus plantarum S-811. Food & function, 10(2), 1085-1097.
- **Wheeler R., Salzman A., Elsayed M., Omaye T. and Korte W. (1990):** Automated assays for superoxide dismutase, catalase, glutathione peroxidase, and glutathione reductase activity. Analytical biochemistry, 184(2), 193-199.
- **Wolfe F., Smythe A., Yunus B., Bennett M., Bombardier C., Goldenberg L. and Sheon P. (1990):** The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology*, *33*(2), 160-172.

دراسة تأثير التين الشوكي على إناث الفئران المصابة بحالة شبيهة بالفيبروميالجيا

امل فوزي الجزار – الاء اسامة ابورية – ايمان سامي ابراهيم– عمرو محمد السعيد

المستخلص العربي

الألم العضلي الليفي هو اضطراب يتميز بألم منتشر في جميع أنحاء الجسم، مصحوبًا بأعراض أخرى كالتعب واضطرابات النوم والمزاج وضعف الإدراك . يُعرف نبات التين الشوكي على نطاق واسع ، وهو منتشر في العديد من مناطق العالم نظرًا لفوائده الزراعية والبيئية، بالإضافة إلى أنشطته الوظيفية والغذائية والبيولوجية. **الهدف :** كان الهدف الرئيسي من هذه الدراسة هو دراسة التأثير الوقائي لعصير التين الشوكي على حالة شبيهة بالألم العضلي الليفي، ناتجة عن الحقن بالريسيربين ، لدى إناث الفئران تم تقسيم خمسة وعشرين أنثى من الفئران بشكل عشوائي إلى خمس مجموعات متساوية (ن = ٥ فئران من كل مجموعة) على النحو التالي، تم تغذية المجموعة الضابطة الغير معامله والمجموعة الضابطة الإيجابية المصابه بالألم العضلي الليفي على النظام الغذائي الأساسي فقط، في حين تم إعطاء المجموعات ٣ و ٤ و ٥ عن طريق الفم عصير عصير التين الشوكي و على النظام الغذائي الأساسي لمدة 8 أسابيع بجرعة ١٠٠ و ١٥٠ و ٢٠٠ مل / كجم من وزن الجسم. بعد أربعة أسابيع، تم حقن المجموعات ٢ و ٣ و ٤ و ٥ بالريسيربين لمدة ٣ أيام متتالية لتحفيز حالة تشبه الألم العضلي الليفي في الفئران. **المواد و الخامات :** بعد ذلك تم تحديد تعبير الوجه العين، الأنف، الأذن والشارب والتأثير الألم على الفئران بواسطة الصفيحة الساخنة لجميع مجموعات الفئران. وفي نهاية الفترة التجريبية ٨ أسابيع أُجري تحليل كيميائي حيوي لتركيز مالونديالدهيد في المصل، ونشاط إنزيم الكاتالاز ، الانزيمات المضادات للأكسدة و الفحص الهستولوجي لعضلات الفخدين في الفئران .**النتائج:** أظهرت النتائج أن المجموعات المعالجة (إناث الفئران المصابة حالة تشبه الألم العضلي الليفي والتي تغذت على النظام الغذائي الأساسي وأعطيت عصير التين الشوكي عن طريق الفم قد تحسنت من حيث زيادة وزن الجسم ، وانخفاضا ملحوظا في المالونديالدهيد في حين زاددت الانزيمات المضادات للأكسدة سوبر أوكسيد ديسموتاز و بيروكسيديز والكاتلاز والجلوتاثيون بشكلا ملحوظا مقارنة بالفئران المصابة بحالة الألم العضلي الليفي والتي تغذت على النظام الغذائي الأساسي فقط. من ناحية أخرى، أظهرت مجموعات إناث الفئران المصابة بحالة الالم العضلي الليفي ، والتي تغذت على نظام غذائي أساسي وأعطيت عصير التين الشوكي عن طريق الفم تحسنًا كبيرًا في تعبيرات الوجه مقارنةً بالفئران الإناث المصابة بحالة الالم العضلي الليفي . بالإضافة إلى ذلك، أظهر الفحص النسيجي تحسنًا واضحًا في أنسجة الخلايا العضلية لإناث الفئران المصابة بحالة الالم العضلي الليفي والتي تغذت على نظام غذائي أساسي وأعطيت عصير التين الشوكي عن طريق الفم . **الاستنتاج :** وأخيرًا، أوضحت الدراسة الحالية أن عصير التين الشوكي قد يحسن حالة الالم العضلي الليفي في الفئران.

الكلمات المفتاحية: الفيبروميالجيا - التين الشوكي - مضادات الأكسدة - تعبيرات الوجه.