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Evaluation of Artichoke-Supported Tofu Cheese on Chemical Structure and some of Blood Biological Parameters of Male Rats after Feeding for 28 Days

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ABSTRACT

The study was conducted in the laboratories of Food Science-Tikrit University included the manufacture of cheese from soybean milk and its fortified with the addition of dry artichoke plant at 0.2 and 0.4g/100g soybean cheese. Chemical and sensory assay were made of cheese and cheese supported with artichoke immediately after the manufacturing process. Biochemical tests for serum of Rat groups fed diet of soy cheese were also detected the liver and kidney organs tissues after 28-day feeding. The results of the chemical analysis of processed soybean cheese showed a decrease in moisture and increased in protein and ash in the treatments that were supported by artichoke. The sensory evaluation also showed the superiority of artichoke soybean cheese with a concentration of 0.4 g/ 100 g cheese compared to other treatments. The results of the biochemical study showed a significant decrease ($p \leq 0.05$) in cholesterol, triglycerides, LDL, glucose, urea and creatinine conducted on the blood of rats groups for the two treatments supported by artichoke compared with the non-treated. The histopathological pictures of the liver and kidney were showed superiority of the treatments supported with artichoke and appeared clearly with control group compared to non-treated with its.

Keywords: Soybean cheese (tofu); artichoke; lipid profile; liver enzymes.

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INTRODUCTION

The medicinal plants was beginning to use in the treatment some of disease in human at the current century, the development taking place in the programs of the World Health Organization (WHO) in the fields of chemistry and the discovery of a cure for several diseases, where they found that a number of manufactured chemical drugs have some negative effects that appear only after a long period of treatment. Therefore, recent studies have pointed to the role of medicinal plants as antioxidants and an alternative to some drugs and chemotherapy, as treatment with medicinal plants and herbs has occupied a large place and space in medicine and pharmacology [1]. The researchers were focused on functional foods through making a natural source an alternative treatment or prevention many diseases. these sources may be have some unsaturated fats, proteins, dietary fibers and others, including soybeans that have an antioxidant activity to protect tissues from free radicals, also has an effective and distinct role in regulating the ratio Blood sugar enhances kidney and liver functions, lowers cholesterol and blood pressure, and reduces cancer [2]. Soy milk is a material rich in unsaturated linoleic fatty acid, which works to reduce the level of cholesterol in the blood, and this milk does not contain lactose sugar found in animal milk, and thus is useful for patients with lactose intolerance syndrome [3] Artichoke contains insulin useful for diabetics. Artichoke was use in the field of making medicines because its medical importance in treating many diseases as flower heads. In addition, the leaves was contain the most important phenolic compounds, which is the important Cynarin in treating liver and gallbladder diseases and lowering cholesterol in the blood and thus preventing or reducing injury Arteriosclerosis [4]. Artichoke materials also caused in stimulates the bile solution production and improves fat digestion [5]. Also, previous studies indicated that fortification of cheese with spices improved the nutritional properties of cheese, as it was observed to increase the period of storage and improve the quality of cheese and flavor of fortified cheese compared to unsorted cheese [6].

The aim of this study was to manufacture of soybean cheese (Tofu), fortified with artichoke powder, and detected the cheese chemically structure, and sensory characterizes. Further to detrition for laboratory Rats to estimate the effects on the lipid profile and liver enzyme with the liver and kidney tissues histopathologic exam.

MATERIALS AND METHODS

Manufacture of soy cheese: Soy cheese is made by following the steps mentioned before [7].and chemical tests for soybean cheese Moisture was determined according to the method of Ling(2008) with a weight of 10 g of cheese dried in an electric oven at a temperature of 105 ° C until the weight remained constant. The ash was estimated by the direct burning method described in [8]. It was followed the Gerber method mentioned by [9], then read the fat column as a percentage of the fat in the cheese. The protein was assaying the procedure that mentioned by [10] and extract the protein percentage by multiplying the total nitrogen ratio by the adult conversion factor. 6.25. The ratio of carbohydrates was calculated mathematically according to what [11] mentioned by the difference method

Carbohydrate Rat (% -100 = Ash + Protein + Fat + Moisture).

Cheese sensory evaluation: The sensory evaluation of all the cheese transactions was conducted by a number of lecturers from the Department of Food Science at Tikrit University using the sensory evaluation schedule proposed by [13]. It was awarded for the flavor and flavor qualities 40 degrees and the strength and composition qualities 60 degrees.

Animals of Experiment:

A total of 20 adult of Albino Sprague-Dawley of male rats at the age of 3-4 months were used with weights ranging from 170-190 g, was randomly divided into 4 groups at 5 Rats and placed in a stainless-steel gage. The diet was prepared according the basil diet requirement [12]. Treatments were arranged using a randomized block design. The diet was fed for an additional 28 days. The following treatments were administered *ad libitum* in the ration: T1 Rats fed the basil diet only as control. T2) Rats fed a replacement of 150 g of soybean cheese T3) Rats fed a replacement of 150g of Soybean cheese fortified with 0.2g artichoke /100 g cheese T4) Rats fed a replacement of 150g of Soybean cheese fortified with 0.4g artichoke /100 g cheese.

At 28 days of age, 4 Rats were selected from each animal groups; 5 ml of blood were collected (via wing bleed) without anticoagulant to obtain serum. Tubes were kept in ice and protected from light until plasma was separated by centrifugation.

The following parameters were determined : cholesterol, triglycerides, high-density lipoproteins, low-density lipoproteins, very low-density lipoproteins, enzyme Alanine transaminase (ALT), Aspartate aminotransferase (AST) and alkaline phosphatase (ALP) has been estimated were determined in animal serums only according to the method [14] [15] .

Histological examination: The tissue histopathological sections for of liver and kidneys Rats were conducted to illustrate the modified in tissues after treatment with Tofu improved with artichoke at 0.2 and 0.4g/100 g of Tofu cheese [16].

Statistical Analysis: The results of the experiments were analyzed using the Linear Model General [17] to study the effect of factors on the complete random design CRD [18] All statements of significance are based on the 0.05 level of probability.

RESULTS AND DISCUSSION

Table (I) shows the chemical specifications of soybean milk used in soybean cheese production. As the percentage of both fat was 2.13%, carbohydrates 3.65%, protein 3.33%, humidity 90.30%, ash 0.59%, and these results are consistent with what the researcher [19] found in his study on the soy milk components that reached the percentage of fat, ash and moisture (2,150.50. , 90.22%), respectively.

Table (I) Chemical soybean milk ingredients used in soy cheese production

Component	lipid	Carbohydrates	Protein	Humidity	Ash
(%)	2.13	3.65	3.33	90.30	0.59
L.S. D	0.15	0.24	0.29	1.35	0.08

Table (II) shows the chemical composition of both soybean cheese and artichoke-supported soybean cheese, as it is noted from the table that the results of moisture content immediately after manufacturing were 68.1%, protein (18.2%), fat (9.72%), ash (0.736%), and carbohydrates (3.244%) This result is consistent with the Iraqi standards for the year 1988, as it stated that the percentage of moisture in soft cheese should not be less than 50%. These results also agree with the findings of [7] on the proportion of protein in soybean cheese (15-19%) and carbohydrate levels of up to 4%.

Table (II) shows the percentage (%) of the chemical analysis of soy cheese and cheese backed with artichoke

Tests / Treatments	Moisture	protein	lipid	ash	carbohydrate
Control	68.1	18.2	9.72	0.76	3.244
A1	67.8	18.3	9.72	0.928	3.259
A2	67.5	18.4	9.74	1.096	3.264

- The numbers in the table refer to three-repeat rates
- (A1) = Concentrated artichoke 0.2 g / 100 cheese, and (A2) = concentration artichoke 0.4 g / 100 cheese)

When comparing the percentage of moisture in soybean cheese with soybean cheese supplemented with artichoke (A1, A2), it is noted that the parameters for which the artichoke was used and with both concentrations decreased the humidity of soy cheese (control treatment) that recorded the highest values as it reached (68.1%). The reason is due to the high percentage of solid materials in dry artichoke powder that have absorbed moisture from the cheese. It is also noted that there is an increase in the percentage of protein supplemented with artichoke and both concentrations, and the reason may also be due to the slight increase in the percentage of protein in the fortified cheese than soybean cheese because the fortified cheese has a lower level of moisture than soy cheese, which leads to a high concentration of solids in artichoke-supported soy cheese Including protein.

The results also showed an increase in the ash content of artichoke-supported soybean cheese when compared to soybean cheese and the artichoke-backed cheese was recorded at a concentration of 0.4g / 100g soybean cheese with the highest ash content (1.096%). Perhaps the reason is due to the presence of mineral elements in the dry artichoke plant as well as the effect of salts that work on a decrease in the level of moisture in cheese, which leads to a high percentage of total solids, including ash. This corresponds to the findings of the researchers [20] in their study of a decrease in the moisture values of the two types of cheese compared to the two control factors, and this may be due to the addition of citric acid, which caused a decrease in the pH values, and notes that the percentages of the rest of the ingredients are protein and fat Ash has slightly increased its values compared to two control treatments, and the reason for this may be due to a decrease in humidity due to a decrease in pH values, which caused more moisture to come out with the whey.

Table (III) shows the results of the sensory evaluation of processed and artichoke-soybean cheese with a concentration of 0.2 and 0.4 g / 100 g soybean cheese one day after the cheese-making process, and the results showed the sensory evaluation grades of artichoke-supported soy cheese (A2) the highest sensory evaluation levels while The results of the unsupported tofu cheese scored the lowest sensory evaluation score and the reason may be attributed to the role of effective flavor compounds found in artichoke and these results correspond to what the researcher reached [6], where it was found that the cheese added to the artichoke recorded the best results for the arbitrators.

Table (III) Sensory evaluation of soybean cheese fortified with medicinal plants

Treatments	Taste 20	Flavor 20	Composition 20	Texture 20	Appearance 10	Color 10	Total 100
Control	11	12	14	15	7	7	66
A1	13	15	14	14	7	7	70
A2	14	16	15	15	7	7	74

Table (IV) indicates the results of the statistical analysis of the blood tests of rats at the beginning and end of the experiment for both cholesterol and triglycerides and low- and high-density lipoproteins (HDL, LDL, VLDL). The results showed that there were significant decreases at the level (P≤0.05). For both cholesterol and triglycerides and low density lipoproteins for the coefficients (A1, A2) compared to the negative control and positive control at the end of the experiment, as well as if there were significant decreases in the supported factors at the end of the experiment when compared to the beginning of the experiment.

An increase in the rate of decrease was observed with an increase in the concentration of the reinforced artichoke and may be attributed to the artichoke in a combination of antioxidants, phenols, fibers, volatile fatty acids, unsaturated fatty acids and lack of cholesterol in their composition, and this is consistent with what the researchers [21] found in their study. However, artichoke is considered effective to reduce arteriosclerosis, which works to reduce the manufacture of triglycerides and fatty acids in the liver, thus reducing their level in the serum. Perhaps the reason is attributed to the decrease in active compounds in the soybean plant such as Soy soponin and isofiavoe, each of which contains Aglycoes and glycosides, which are soluble in alcohol, which works to reduce cholesterol and saponins, it is an effective compound in reducing cholesterol, as it is a binary binding component that binds bile acids to cholesterol and reduces its level in the blood, in addition to the unsaturated fatty acids it contains. Cholesterol Free This is what the researchers find [22]. and recorded the highest increase in HDL in the treatment (A2), which recorded the highest values 69 (Mg / dl) compared to the rest of the treatments, and may be due to the presence of antioxidants, poly phenol compounds and Tannins) and volatile oils that stimulate digestive enzymes and this corresponds to its findings The researcher [23], agrees [24] in their study that the regularly consumed artichoke extract may promote benign "good" cholesterol in adults Suffering from high cholesterol in the blood where artichoke contains luteolin-7-β-D-rutinoside. It is an antioxidant that blocks the formation of cholesterol.

Table (IV) Effect of different treatments on some biochemical criteria (mg / 100 ml) In the blood serum of male rats

Tests / Treatments	TC		TG		HDL	
	beginning experiment	end of experiment	beginning experiment	end of experiment	beginning experiment	end of experiment
Negative control	b 150±2.3	b 155±2.1	b 60±2.8	b 65±2.3	ab 63±0.3	ab 62±0.25
Positive control	ba 190±2.1	a 201±2.2	a 70±2.1	a 72±2.5	b 54±0.2	b 51±0.2
A1	b 148±1.8	cb 143±1.2	bc 58±1.3	bc 56±1.2	ab 66.4±0.2	ab 68.6±0.3
A2	cb 145±1.7	c 140±0.8	cb 55±1.1	c 50±1.0	ab 67±0.3	a 69±0.1
Tests / Treatments	**LDL**		**VLDL**		**glucose**	
	beginning experiment	end of experiment	beginning experiment	end of experiment	beginning experiment	end of experiment
Negative control	b 75±1.2	b 80±1.1	ab 12±1.2	ab 13±1.2	b 99.5±1.87	b 99±1.87
Positive control	a 122±1.1	a 135.6±1.2	a 14±1.1	a 14.4±1.1	a 108±2.25	a 111.16±2.11
A1	bc 70±1.0	cb 63.2±0.9	ba 11.6±1.0	ba 11.2±0.9	cb 77.6±1.9	cb 74.66±1.3
A2	cb 67±0.9	c 61±0.8	b 11±0.9	b 10±0.7	cb 71.40±1.2	c 64.50±1.1

- Differences in lowercase letters indicate a significant effect at (P≤0.05).

Table (IV) shows glucose tests in the blood of rats, the results showed that there were significant decreases in the coefficients (A1, A2) at the beginning and end of the experiment when compared to the negative and positive control, and the treatment was recorded with soybean cheese backed with artichoke (A2) the lowest values were recorded (64.50) The positive control treatment recorded the highest values recorded (111.16Mg / dl) and may be due to the low presence of sugars in soybean cheese and artichoke, as well as the presence of phenolic acids, the most important of which is caffeic acid, derivatives of dicaffeoylquinic acid derivatives. Flavonoids, the most important of which are flavone glycosides and volatile oils, the most important of which are Sesquiterpenes, β-selinene, and caryophyllene (major) eugenol, phenylacetaldehyde, and phenylacetolesterol, tyrosolesterol, polysaccharides, inulin and this is consistent with the findings of the researchers [25] Likewise, the researchers [26] in their study that artichoke leaf extract may help reduce blood sugar levels as eating boiled artichoke in a meal lowers blood sugar levels and stimulates insulin action after 30 minutes of eating. It is worth noting that this effect was only seen in healthy adults who did not have metabolic syndrome. However, it was found that artichoke extract slows the activity of alpha glucosidase, an enzyme that divides starch into glucose, which may affect blood sugar.

Table (V) indicates the tests for creatinine and urea level in the blood of laboratory rats and also shows a comparison of results between the beginning and end of the experiment. The results showed the creatinine analysis at the end of the experiment about the presence of significant decreases of coefficients (A1, A2) when compared with negative and positive control. Positive control has the highest values (Mg / dl 0.72). The results also showed (Urea) analysis at the end of the experiment about the presence of significant decreases of coefficients (A1, A2) when compared with negative and positive control (A2) recorded the lowest values where (Mg / dl 30.33) was recorded. The positive control treatment with hypercholesterolemia was recorded at the highest values (Mg / dl 43.66), and the results show that eating soybean cheese and artichoke had a positive effect on the activity and work of the kidney functions. Note that all results were within the normal range of creatinine and urea presence in the blood and perhaps the reason was attributed by [27] to artichoke containing a high content of fibers, phenolic compounds, magnesium, chromium, vitamin C, folic acid, biotin, manganese, potassium, niacin vitamins, riboflavin, thiamin and vitamin A. It can be used to prevent many diseases, such as cardiovascular disease, kidney disorders, liver, eczema, diabetes, and hepatocellular regeneration. This is consistent with the findings of the researchers [28]. However, phenolic compounds improve the liver and kidney tissues and reduce urea and creatinine levels in the blood.

Table (V) Effect of different treatments on creatinine and urea level at the beginning and end of the experiment

Tests / Treatments	Creatinin		Urea	
	beginning of experiment	end of experiment	beginning of experiment	end of experiment
Negative control	ab 0.65±0.001	ab 0.66±0.001	b 36±1.7	b 38.33±1.8
Positive control	a 0.7±0.001	a 0.72±0.0001	a 40±1.7	a 43.66±1.9
A1	b 0.59±0.001	b 0.58±0.001	cb 33±1.5	cb 32.33±1.4
A2	cb 0.52±0.001	c 0.48±0.0001	cb 32±1.6	c 30.33±1.3

Differences in lowercase letters indicate a significant effect at the (P≤0.05) level.

Table (VI) indicates the results of the statistical analysis of liver enzymes (AST, ALT, ALP) in the blood of rats at the end of the experiment, as well as the interference between the beginning and end of the experiment and the differences in the small letters indicate the presence of significant differences at the level of (P≤0.05). Significant decreases in all liver enzymes at the end of the experiment (AST, ALT, ALP) for coefficients (A1, A2) when compared to negative and positive control, as well as slight significant decreases were observed for all liver enzymes in two treatments (A1, A2) except for negative and positive control at the end of the experiment When compared to the results of the beginning of the experiment. This is in line with the researcher's findings [4]. In their study of the most important compounds found in artichoke, including phenolin, which is the cynarin, it is important in treating liver and gallbladder diseases and lowering cholesterol in the blood, thus preventing or reducing the incidence of atherosclerosis. Artichoke extract has importance in It protects the liver from damage and promotes the growth of new tissues, as it increases the production of bile, which helps to remove harmful toxins from the liver. The findings [29] agree in their study that the artichoke extract given to rats improved the functions and liver enzymes.

Table (VI) Effect of different treatments on the efficacy of some blood enzymes (IU / liter) for male rats

Tests	AST	ALT	ALP

Treatments	beginning of experiment	end of experiment	beginning of experiment	end of experiment	beginning of experiment	end of experiment
Negative control	b 104±0.8	b 105±0.8	b 31±2.1	a 34±1.9	b 216.6±2.2	b 218±2.1
Positive control	a 107±0.7	a 111±0.8	a 35±2.1	a 37±2.0	a 219±2.1	a 221±2.2
A1	bc 102±0.6	cb 101.33±0.7	cb 32.33±1.6	cb 31.66±1.5	cb 208±2.0	cb 206.6±1.7
A2	cb 101±0.5	c 97.55±0.4	cb 31.33±1.5	c 30±1.5	cb 206.3±1.9	c 204±1.5

- Differences in lowercase letters indicate a significant effect at the (P≤0.05) level.

Histological examinations: (Figure 1) shows the results of histological examinations of the College (Negative Control). The college cortex showed its contents on the glomeruli with capillary blood lymphoid inside the Bowman's purse and appeared spherically in shape and low-lying, surrounded by the conservative space and Bowman's wallet and around it large numbers of nearby twisted tubules with pyramidal pigmented cells balloon Red and distal convoluted tubules with large cavity cells.

(Figure 1) shows the results of histological examination of the kidney of a rat group of positive control animals. The results showed that the cortex contains blood vessels congested around the renal glomeruli and the near and distant convoluted tubules.

(Figure 1) shows the results of microscopic examination of the rat college of the group of experimental animals that fed on artichoke-supported soy cheese (A1). The kidney cortex contained natural renal glomeruli and synthesis surrounded by nearby and distant tubules of natural shapes.

(Figure 1) shows the results of microscopic examination of the rat college of the group of experimental animals in treatment (A2). The total cortex emerged naturally, with the presence of liposome renal glomerulus partially, and their total pronouncement. Also, the presence of lymphocytes stimulated the formation of defensive cells.

It is clear from the results above that the kidney tissue showed in the treatments that have been fortifying cheese with artichoke, the appearance of a clear improvement in the shape and structure of the kidney in general compared to my treatment (negative and positive control) and the reason for that may be due to the presence of antioxidants and phenolic compounds in soy and artichoke and the results are consistent with what has been reached mechanism [4]. In their study, the phenolic compounds present in artichoke have an important role in improving kidney and live.

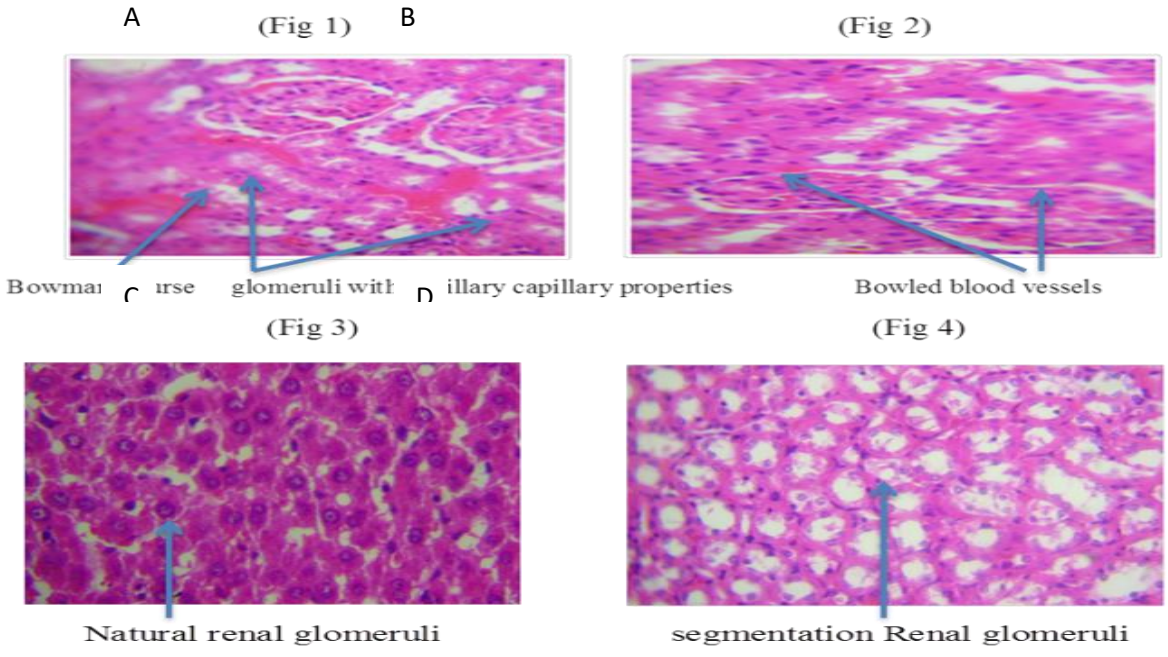

Fig.1: Histological changes in kidney after treatment with soybean cheese supplement with artichoke plant to concentration of 0.2 and 0.4 g\100g^{-1}. (A and B) kidney sections from negative and positive control, (C and D) kidney sections from soybean cheese supplement with artichoke plant to concentration of 0.2 and 0.4 g\100g^{-1} (Haematoxylin & Eosin× 40).

Histological results of the liver: (Figure 2) shows the histological examination of the liver of a rat of negative control groups, where the results showed that some hepatocytes have limited enlargement with a dark pigment cytoplasm and a dark central coloring of the pigment with a blue color with red blood cells filled with red blood cells.

(Figure 2) shows a microscopic examination of the liver tissue of the rat groups of positive control animals with hypercholesterolemia. The results showed the emergence of severe blood congestion with lateral hemolysis in which lymphocyte infiltration around the vessels and their containment of white blood cells with observation of cover cells in sinusoidal sinusoids between rows Liver cells

(Figure 2) shows the histological examination of a rat liver from the groups of rats fed to soybean cheese fortified with artichoke (A1). The results showed that the liver contained blood sinusoids surrounded by hepatic cells that appeared in groups stacked with each other and the appearance of the liver naturally.

(Figure 8) shows a histological examination of a liver of a rat group of rats fed on artichoke-supported soybean cheese (A2). The results showed that hepatic cells appeared naturally and equipotential adjacent to each other and those cells were adjacent to the sinusoidal hematopoiesis that had cover cells.

The results show that the liver tissue has a negative impact on the livers of rats in (positive control), where cases of hemorrhagic and slight degeneration have been observed in some liver cells, and the reason may be attributed to this to feed the rats in these transactions on a diet rich in animal fats throughout the trial period that led to The high level of cholesterol and triglycerides in the blood of rats and the low presence of antioxidants, which increases the exposure of rats to oxidative stress. These results were consistent with the findings of the researcher [30]. Liver tissue and cells. The reason may be attributed to the presence of antioxidants and phenolic compounds in soy cheese and artichoke, which accelerate the cellular repair process and stimulate tissue cells to secrete chemical attraction factors to attract inflammatory cells. These results also are consistent with what the researchers reached [21] in their study of the active compounds of the artichoke plant represented by the presence of phenolic acids, Flavonoids and Terpenoids that act as natural antioxidants and improve liver tissue and tissue. Also, they agree [29] in their study that some antioxidants present in artichoke such as cynarin and silymarin - are responsible for improving liver tissue.

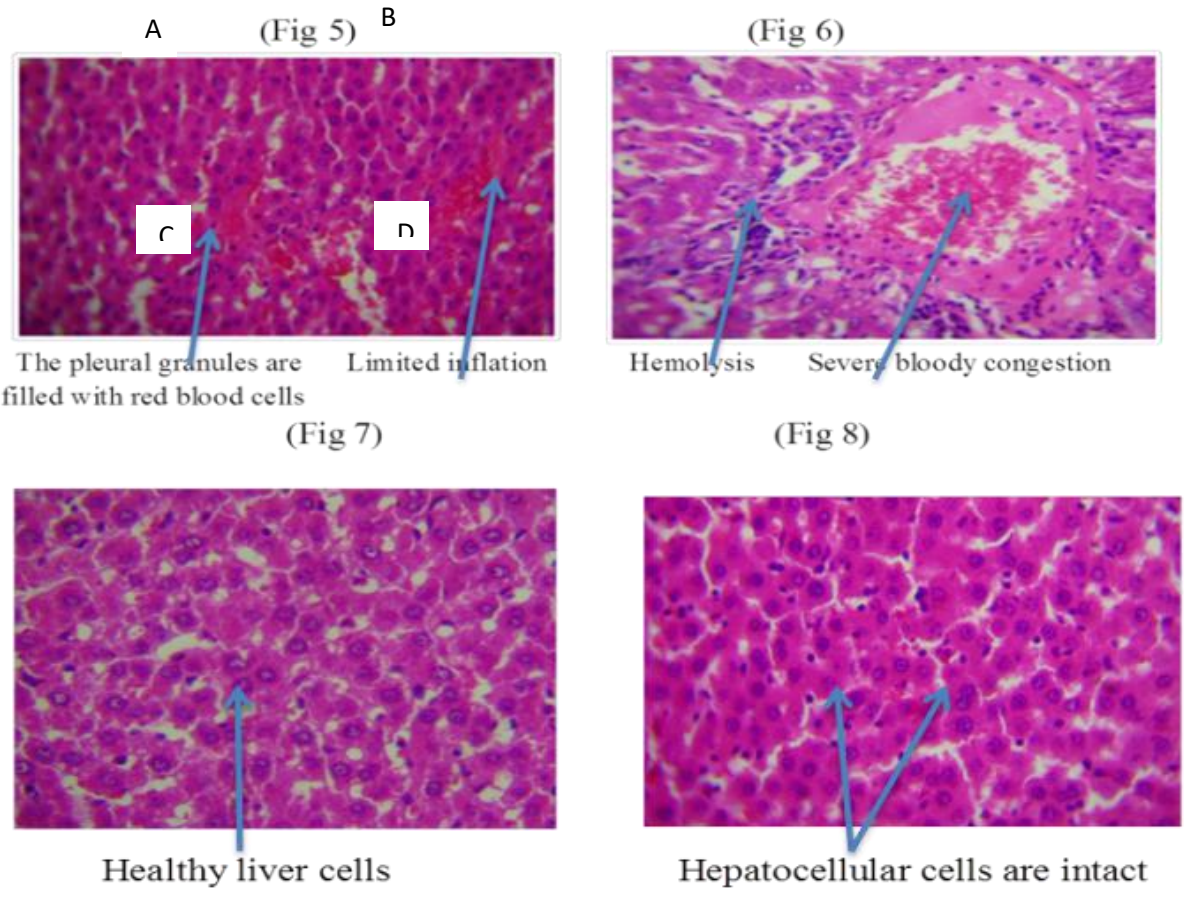

Fig.2: Histological changes in liver after treatment with soybean cheese supplement with artichoke at 0.2 and 0.4g/100g^{-1}. (A and B) kidney sections from negative and positive control, (C and D) liver sections from soybean cheese supplement with artichoke at 0.2 and 0.4g/100g^{-1} (Haematoxylin & Eosin× 40).

CONCLUSION

The results were showed the effective of soybean cheese supplement with artichoke plant on the chemical composition of manufactured cheese. The nutrition experiments its effects on efficacy of creatinine, urea and AST, ALT and ALP level in laboratory animals. They were certificate by the histological test for liver and kidney.

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Ethics: The authors declare their responsibility for any of the ethical issues that may arise after the publication of this manuscript.

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