

CHEMICAL AND TECHNOLOGICAL STUDIES ON SOME FOODS CHEMICAL, TECHNOLOGICAL AND BIOLOGICAL STUDIES ON ARTICHOKE (*Cynara scolymus* L.) FRUIT

ABSTRACT

The present study was performed to find out the possibility of taking all the benefits of artichoke receptacle and bracts which is considered as a by product of artichoke industry (about 60% residues). The receptacle and bracts have high nutritional value and contain high source of dietary fiber, mineral content, phenolic compounds (antioxidants) which is used as alternative natural source for synthetic antioxidants in industry. Also, studying the possibility of using artichoke receptacle powder and bracts extracts on hepatic diseases, cholesterol and on the biological and histopathological effects in experimental rats which have hepatic injury and fibrosis induced by CCl₄.

The obtained results showed that artichoke bracts which can reach ~ 60% of the industrial manipulation of artichoke can be considered a good source of natural antioxidant in food additives concerns associated of the use synthetic antioxidants.

Results should also that artichoke bracts extracts has antimicrobial activities. Biological studies showed that the used doses can suppress the onset of liver fibrosis, total bilirubin and reducing blood cholesterol.

So, it could be recommended that, using artichoke receptacle and bracts either in fresh and extracts or in a powder for manufacturing of food products for its high content of anti oxidants and its positive effect on hepatic and blood lipid diseases and significant effect on the health of the people. For this reason, we also recommend to increase the cultivation area of artichoke.

دراسات كيميائية وتكنولوجية على بعض الأغذية دراسة كيميائية وتكنولوجية وبيولوجية على ثمرة الخرشوف

الخلاصة

وقد أجريت هذه الدراسة بهدف إمكانية الاستفادة من أجزاء ثمرة الخرشوف والمتمثلة فى التخت النورى والقنابات والتي تعتبر كمخلفات عند تصنيع الخرشوف حيث تمثل 60% من مخلفات التصنيع وهى ذات قيمة غذائية عالية ومصدر جيد للألياف الغذائية والأملاح المعدنية والمركبات الفينولية (كمواد مضادة للأكسدة) والتي يمكن استخدامها كمصدر جيد لمضادات الأكسدة الطبيعية ويمكن أن تكون بديلا لمضادات الأكسدة الصناعية فى التصنيع الغذائى. كما إستهدفت الدراسة أيضا دراسة إمكانية الاستفادة من مسحوق التخت والقنابات ومستخلصاتها على مرضى الكبد والكوليسترول وتأثيرها البيولوجية والهستوباثولوجية على فئران التجارب المحدث لها تسمم كبدى (تليف كبدى) بواسطة رابع كلوريد الكربون (CCl4). للوصول الى ذلك الهدف قد اشتملت الدراسة على النقاط التالية:

واظهرت النتائج ان قنابات الخرشوف التى قد تمثل اكثر من 60% من حجم نورة الخرشوف والتى قد تعد مشكلة تلوث عند تصنيع الخرشوف تعتبر مصدر جيد لمضادات الاكسدة الطبيعية التى تضاف الى بعض الاغذية كبديل لمضادات الاكسدة الصناعية.

كما أظهرت النتائج أيضا أن مستخلصات قنابات الخرشوف قد يكون لمضادات الاكسدة بها نشاط مضاد للميكروبات والدراسة البيولوجية أوضحت ان الجرعات المستخدمة من مسحوق التخت والقنابات ومستخلصاتها تقلل أو تحسن من مرض التليف الكبدى والصفراء وتخفيض الكوليسترول.

من النتائج المتحصل عليها يمكن أن نوصى بإضافة نورة الخرشوف المتمثلة فى التخت والقنابات سواء كمسحوق او مستخلص للأغذية المصنعة كبديل لمضادات الأكسدة الصناعية بالإضافة إلى أنها قد يكون لها تأثيرات إيجابية على صحة الكبد والمرارة وخفض الكوليسترول و أيضا لقيمتها الغذائية العالية. كما أن مضادات الأكسدة بها قد يكون لها تأثير مثبط للميكروبات والجرعات المستخدمة من قنابات وتخت الخرشوف ومستخلصاتها قد يؤدي إلى تحسن يتوقف على الجرعة فى تحسين وظائف الكبد والمرارة وخفض نسبة الكوليسترول فى الدم. وعلى ذلك أيضا نوصى بزيادة المساحة المنزرعة من الخرشوف للاستفادة منه غذائيا وصناعيا.

CONTENTS

1. INTRODUCTION	1
AIM OF INVESTIGATION	4
2. REVIEW OF LITERATURE.....	6
2.1. Chemical composition of artichoke	6
2.1.1. Gross chemical composition.....	6
2.1.2. Mineral contents	8
2.2. Amino acid composition and protein quality	9
2.3. Active compounds of artichoke (<i>Cynara scolymus</i> L.)	10
2.4. Extraction of antioxidants from artichoke	12
2.4.1. Effect of extracting solvents	12
2.4.2. Isolation and identification of polyphenolic substances from artichoke.....	13
2.4.3. Artichoke as a source of antioxidants.....	16
2.5. Antimicrobial activity of artichoke <i>Cynara scolymus</i> L. extract.....	18
2.6. Artichoke as a potential source of health.....	20
2.7. Biological effects of artichoke.....	23
2.7.1. Effect of artichoke on quantity of food intake and body weight gain.....	23
2.7.2. Effect of artichoke on gastrointestinal tract.....	26
2.7.3. Effect of artichoke on lipid profile	28
2.7.4. Effect of artichoke on the liver	35
3. MATERIALS AND METHODS	42
3.1. Material	42
3.2. Methods.....	42
3.2.1. Preparation of the samples.....	42
3.2.1.1. Preparation of artichoke powdered receptacle and bracts.....	42

3.2.1.2.	Preparation of artichoke extracts	43
3.2.2.	Analytical methods	44
3.2.2.1.	Chemical composition of artichoke receptacle ad bracts.....	44
3.2.2.2.	Determination of total and reducing sugars.....	45
3.2.2.3.	Determination of inulin in artichoke receptacle and bracts.....	45
3.2.2.4.	Determination of dietary fibers.....	46
3.2.2.5.	Determination of mineral contents	47
3.2.2.6.	Determination of nitrogenous constituents of artichoke receptacle and bracts.....	47
3.2.2.7.	Determination of amino acids composition and protein quality	48
3.2.2.8.	Determination of antinutritional factors	50
3.2.2.9.	Polyphenols compounds analysis	51
3.2.2.10.	Antimicrobial activity assay	53
3.2.3.	Technological methods	55
3.2.3.1.	Beef burger preparation	55
3.2.3.2.	Sensory evaluation of fried burger	56
3.2.3.3.	Determination of proxidation-inhibiting activity of artichoke bracts	56
3.3.	Biological evaluation	57
3.3.1.	Experimental animals and diets.....	57
3.3.2.	Determination of body weight gain and feed efficiency ratio	61
3.3.3.	Blood serum analysis	62
3.3.3.1.	Blood sampling.....	6c2
3.3.3.2.	Analysis of serum lipids	62
3.3.3.3.	Analysis of liver function	64
3.3.3.	Histopathological examination	66

4. Results and Discussion.....	67
4.1. Chemical composition of artichoke (<i>Cynara scolymus</i> L.).....	67
4.2. Total reducing, non-reducing sugars and inulin of artichoke receptacle and bracts (g/100 g).....	68
4.3. Dietary fiber contents of artichoke receptacle and bracts	69
4.4. Mineral contents of artichoke receptacle and bracts	70
4.4.1. Major elements	70
4.4.2. Trace elements	72
4.5. Nitrogenous constituents of artichoke receptacle and bracts	73
4.6. Amino acid composition and protein quality of artichoke receptacle and bracts.....	74
4.6.1. Amino acid composition.....	74
4.6.2. The chemical score	76
4.6.3. Protein efficiency ratio and biological value.....	79
4.7. Ant-nutritional factors of artichoke receptacle and bracts	81
4.8. Extraction of natural antioxidants from artichoke receptacle and bracts.....	82
4.8.1. Effect of different solvents on total polyphenol contents extracted from artichoke receptacle and bracts.....	82
4.8.2. HPLC analysis of polyphenols extracted from artichoke receptacle and bracts.....	84
4.9. Detection of antimicrobial activity of phenolic compounds from artichoke bracts extracts.....	
4.9.1. Antimicrobial activities of artichoke bracts extracts	87
4.10. Technological application.....	90

4.10.1. Effect of supplementing different levels of artichoke bracts powder as antioxidants on the quality of beef burger	90
4.10.1.1. Chemical composition of raw and fried beef burger supplemented with artichoke bracts powder at different levels	91
4.10.1.2. Sensory evaluation of beef burger	94
4.10.2. Effect of adding artichoke bracts powder as natural antioxidants compared by BHA (200 ppm) to beef burger on its peroxide value during frozen storage at -20°C for 6 months.....	97
4.1.10.3. Effect of adding artichoke bracts powder as natural antioxidant compared by BHA (200 ppm) to beef burger on its thiobarbituric acid (TBA) value during frozen storage at -20°C for 6 months.....	99
4.11. Biological evaluation	102
4.11.1. Effect of feeding at different levels of artichoke (receptacle, bracts powder and bracts extracts) on body weight gain%, daily food intake, food efficiency ratio and faecal output in hepatotoxic rats feed for 8 weeks.....	102
4.11.2. Effect of feeding at different levels of artichoke (bracts, receptacle powder and bracts extracts) on the relative organs weight to body weight ratio in hepatotoxic rates feed for 8 weeks	105
4.11.3. Effect of feeding at different levels of artichoke (bracts, receptacle powder and bracts extracts) on serum lipid concentration (mg/dL) of cirrhotic rats feed for 8 weeks.....	107

4.11.4. Effect of artichoke bracts, receptacle powder and bracts extracts at the different doses on liver function of heaptotoxic rats	110
4.11.4.1. Effect of feeding at different levels of artichoke (bracts, receptacle powder and bracts extracts) on the concentration of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) I μ /L in the serum of cirrhotic rats	110
4.11.4.2. Effect of feeding at different levels of artichoke (bracts, receptacle powder and bracts extracts) on the concentration of total protein and total bilirubin in the serum of cirrhotic rats	113
4.12. Histopathological results	116
5. Summary and Conclusion.....	125
6. References.....	136
Arabic Summary	

LIST OF ABBREVIATIONS

AB	Artichoke bracts
ABW	Artichoke blanching water
AE	Artichoke extracts
ALE	Artichoke leaves extract
ALT	Alanine amino transferase
AOAC	Association of official analytical chemistry
AST	Aspartate amino transferase
b.wt.	Body weight
BA	Blanched artichoke
BHA	Butyl Hydroxy anisole
BHT	Butyl hydroxyl toluene
BU	Brabender unit
BV	Biological value
BWG	Body weight gain
C.S	Cross section
CA	Caffeic acid
CCL4	Carbon tetrachloride
CHD	Coronary heart disease
C-PER	Computed protein efficiency ratio
DAA	Dispensable amino acid
Di-CaA	Dicalfeoylquinic acid
dL	Deciliter
DM	Dry matter
FAO	Food and Agriculture Organization.
FER	Food efficiency ratio
FI	Food intake
G.O.T.	Glutamic-oxaloacetic transaminase
G.P.T	Glutamic-pyruvic transaminase
gm	Gram
GSH	Glutathion
H & E	Haematoxylin and Eosin
HDL-C	High-density lipoprotein cholesterol

HMG-CoA	Hydroxymethyl glutaryl coenzyme A
HPLC	High performance liquid chromatograph
hr	Hour
I.D.F.	Insoluble dietary fiber
IAA	Indispensable amino acid
IU	International unit
Kcal	Kilocalory
kg	Kilogram
L	Liter
LDL-C	Low-density lipoprotein cholesterol
LPC	leaf protein concentrate
Mg	Microgram
mg	Milligram
min	Minute
ml	Milliliter
N.S.q	Non significant
O.D.	Optical density
ppm	Part per million
PV	Peroxide value
RA	Raw artichoke
S.D.F.	Soluble dietary fiber
TBA	Thiobarbituric acid
TC	Total cholesterol
TDF	Total dietary fiber
TG	Triglycerides
TIU	Trypsin inhibitor unit.
U/L	Unit per liter
V	Volume
WHO	World Health Organization