

## EFFECT OF INFESTATION WITH CERTAIN SUCKING INSECTS ON AMINO AND FATTY ACIDS CONTENTS IN LEAVES OF TWO LOCAL GLOBE ARTICHOKE CULTIVARS

Fadel , A . M.

Plant Protection Res. Inst., Agric. Res. Center, Dokki Giza 12618, Egypt

### ABSTRACT

Amino and fatty acid contents in leaves of two local globe artichoke cultivars (Cordoan and Hybride c.v.s. ) were estimated in response to infestation with certain piercing sucking insect pests , ( included five aphid species , in addition to *Bemisia tabaci* Genn., *Empoasca decipiens* Paoli. and *Thrips tabaci* L .

The aphid populations ( included *A . fabae* L . , *A .gossypii* Glov . , *Macrosiphum euphorbiae* ( T . ), *Myzus persicae* (Sulzer) , *M . solani* ( Kalt . ) were the highest number on globe artichoke leaves of both cultivars during the tested seasons , followed by *B . tabaci* adults , while *E . decipiens* and *T . tabaci* populations were the lowest ones .

Amino and fatty acids in plant leaves were isolated and identified the percent measurements of its fractions for infested and uninfested leaves were estimated and effect of these infestations on the content of amino and fatty acids in plant leaves were discussed . 17 amino acids , 16 fatty acids were isolated from two local globe artichoke cultivars ; Cordoon and Hybride c.v.s. Chemical analysis showed that infestation caused a deficiency in some essential and non- essential acids , as well as in fatty acids concentrations . Recorded decreases in some analyzed amino acids ranged in infested leaf samples between: 6.21- 46.6 % and 4.8 – 33.3 % , while ranged in some fatty acids: 14.9-76.6% and 4.3-87.5%, respectively in the two tested cultivars . A complete reduction (100%) appeared affected these infestations, in both 2 fatty acids; Caprylic and Trydecylic in Cordoon cv., and 4 fatty acids , the two later, Margaric, X 2 in Hybride cv.

Also, an increase showed, in some of this amino acids concentrations in infested leaves, where it ranged in some of both essential and non- essential amino acids: 20.8-69.6% and 3.75 - 68.1%, while ranged in fatty acids: 5.1-67.7% and 18.7-92.8% respectively in the two tested cultivars, when compared with those of uninfested leaves samples. Great increase in some amino and fatty acids break-out in infested leaves sample, acted in Proline 138.2%, in two fatty acids; Undecylic (500%) and Ricinoic (205.8%) each in Hybride cv., no changes were recorded in Histidine in Cordoon and in Lauric fatty acid in Hybride cv.

### INTRODUCTION

Globe artichoke *Cynara scolymus* L. is infested severely with certain piercing sucking insects such as Aphid species ( included *A.fabae* L . , *A .gossypii* Glov., *Macrosiphum euphorbiae* (T.) , *Myzus persicae* (Sulzer) and *Macrosiphum solani* (Kalt.)) , *Bemisia tabaci* Genn., *Empoasca decipiens* L. and *Thrips tabaci* Lind. (Barbagallo 1974, Apablaza 1984, Foddai et.al.1991). The main contents of these plants might sever affected the insect infestations especially with the previous mentioned piercing sucking insects which considered the most important pests on globe artichoke grown under Egyptian conditions ( Afify et al. , 2004 ) .

Protein and fat, as the major components in globe artichoke, According to Abd El- Moaty et. al. (1993) protein isolates of globe artichoke containing not



less than 13 % protein ( N %x 6.25 ) on dry weight bases . No available reports on the routes of globe artichoke protein and fat contents affected insect infestation other than through the usual route of chemical analysis traits, such done by Macleod *et al.* (1982) who studied the aroma volatiles of *C. Scolymus*, Adzet and Puigmacia (1985), offer research on the hepatotropic activity of *C. Scolymus* extracts, Muller *et. al.* (1988) mentioned that globe artichoke contains chromium (7.6ppm), Zaposohnaya *et. al.* (1992) and Mossi *et. al.* (1999) studied the chemical composition and medical usage of globe artichoke .On the contrary, Sanford and Karl (1995), studied the effects of different plant epicuticular lipids on insect herbivores in Arizona USA.

This study aims to follow the chemical changes that happens for each amino and fatty acids during the infestation with the main piercing sucking insects in leaf contents of two local globe artichoke cultivars ( Cordon and Hybride ) .

## MATERIALS AND METHODS

To evaluate the influence of infestation with certain piercing sucking insect pests on amino and fatty acids contents in globe artichoke cultivars namely , Cordon and Hybride were cultivated on the 20<sup>th</sup> of August in Zeinean region, Giza, Egypt. All usual agricultural practices were followed in the field. To have a source of uninfested plants with the insect pests, a set of globe artichoke plants were selected and covered with mousline (as control) . To determine the population density of the piercing sucking insect pests ( i.e. Aphis , Whitefly , Jassids and Thrips ) on globe artichoke plants , Twenty five of infested leaves of each cultivar were collected weekly at random during season 2003-2004 . Each sample was investigated and the number of each tested insect species was counted and recorded . In addition to additional samples were collected from each globe artichoke cultivar of infested and uninfested plants . Each sample consists of ten leaves were collected from five plants , 120 day after planting of the two tested cultivars , and prepared for analyzing their contents of available amino and fatty acids using the methods described by the A.O.A.C. ( 1990 ) . The percentages of amino acids in the leaves were determined in infested and uninfested samples using the gas liquid chromatography GLC method as described by Landawlt and Guiochen (1964). Leaf blades of infested and uninfested samples were dried for at least 72 hr. at room temperature and 100 – 200 mg. material was hydrolysed in 0.5 ml. 3 N mercaptoethanol sulphoric acid in a sealed tube at 110 C° for 22 hr. After hydrolysis, 0.5 ml. 2N NaOH was added to the sample, which was then diluted with 2 ml. distilled water. The sample (100 µl) was then analysed on a Beckman amino acid analyser "119 CL".

Perkin- Elmer gas Liquid chromatography (GLC), series 8300 available was used for detecting the fatty acids percents through the leaf tissues.

## RESULTS AND DISCUSSION

During the course of this study five species of aphids ( *Aphis fabae* L . , *A . gossypii* Glov . , *Macrosiphum euphorbiae* (T.), *Myzeus persicae* (Sulzer) and *M. solani* ( Kalt. ),the cotton whitefly , *Bemisia tabaci*



*Empoasca decipiens* and *Thrips tabaci* were recorded on globe artichoke plants. The changes of the previously mentioned insect population densities were approximately the same on both tested cultivars (Figure 1). The average number of each insect population was estimated and summarized in Table 1. The obtained results obviously indicated that aphid species appear to be the most prevalent insects on globe artichoke plants of the two tested cultivar.

**Table (1) : Weekly mean population of certain piercing sucking insect pests on globe artichoke leaves in Zenein region Giza during eason 2003-2004.**

Date		Mean number / 25 leavesa			
Month	Week	<i>Aphis spp.</i>	<i>B. tabaci</i>	<i>E. decipiens</i>	<i>T. tabaci</i>
Sep.	4 <sup>th</sup>	10.7	6.0	0	0
Oct.	1 <sup>st</sup>	18.3	8.3	2.7	2.0
	2 <sup>nd</sup>	37.0	10.0	4.0	2.0
	3 <sup>rd</sup>	44.6	22.3	4.0	1.3
	4 <sup>th</sup>	46.4	19.7	3.3	0
	5 <sup>th</sup>	89.3	24.0	4.0	1.0
Nov.	1 <sup>st</sup>	101.0	28.0	4.0	2.0
	2 <sup>nd</sup>	201.0	36.0	5.0	0
	3 <sup>rd</sup>	310.0	42.0	4.3	2.0
	4 <sup>th</sup>	410.0	32.3	5.0	3.0
Dec.	1 <sup>st</sup>	440.0	34.7	3.7	4.0
	2 <sup>nd</sup>	481.0	47.0	2.0	3.0
	3 <sup>rd</sup>	331.3	21.0	2.0	0
	4 <sup>th</sup>	326.0	12.0	2.0	0
	5 <sup>th</sup>	413.7	10	0	0
Jan.	1 <sup>st</sup>	590.0	6.0	1.0	0
	2 <sup>nd</sup>	673.7	4.7	1.0	0
	3 <sup>rd</sup>	400.0	4.2	1.0	2.3
	4 <sup>th</sup>	339.0	3.0	2.0	2.0
	5 <sup>th</sup>	228.0	3.0	2.0	0
Feb.	1 <sup>st</sup>	172.4	2.7	0	2.0
	2 <sup>nd</sup>	182.3	2.0	3.0	2.0
	3 <sup>rd</sup>	120.0	3.0	2.0	0
	4 <sup>th</sup>	108.0	3.7	3.0	0
Mean		253.07***	16.06*	2.54 <sup>NS</sup>	1.19 <sup>NS</sup>
L.S.D. 0.05		18.23	5.60	1.84	0.86

High significant\*\*\*

Significant\*

No significant (NS)

The cotton whitefly, *B. tabaci* was most frequently observed also on leaves while *E. decipiens* and *T. tabaci* were recorded in very few numbers. Tracing the population of aphids species on leaves; individuals tended to appear almost three weeks after leaf appearance and considerable numbers were usually recoded in during the 4<sup>th</sup> week of September. Then, its population increased with a rapid rate during October - November. showing its peak on the 2<sup>nd</sup> week of January. 2004 (673.7 individuals per 25 leaves). Then- after, aphid population, decreased gradually till the end of season. Highly significant variations existed between weekly populations of aphids on leaves during the mentioned season. These results are similar to those recorded by Barbagallo (1974) and Apablaza (1984) that aphids fauna are most commonly found in eastern Sicily on globe artichoke, Foddai et. al.



(1991) add that the aphidborne, caused serious damage on artichoke in Italy. *B. tabaci* population was generally found occupying the second rank as piercing sucking insects on globe artichoke leaves. It was clear that relatively low numbers of the whiteflies occurred on leaves during the 4<sup>th</sup> week of September and tending to increase in November till mid- December., 2003. Then, it declined down gradually till the end of the season . Significant variation existed between the whiteflies weekly counts during the season. *E. decipiens* and *T.tabaci* population were found in relatively few numbers in this season. Its population usually started to appear through the 1<sup>st</sup> week of October and disappeared in some weeks during the tested season. Analysis of variance shows that the weekly mean number of the two later insects were not significant during the growing season. The accumulated mean numbers were 253.07, 16.06, 2.54 and 1.19 individuals per 25 leaves in 2003/2004 for the four piercing sucking insects, respectively.

Chemical analysis was made to evaluate the concentrations of amino and fatty acids contents in infested and unfested leaves .

The obtained results are shown in (Tables 2 & 3). It can be noticed that some essential and non-essential amino acids ( EAA & NEAA ) in the infested leaves negatively affected by infestation with these piercing sucking insects . On the opposite , other of these amino acids components has a positive effect , in both cultivar leaves of globe artichoke .

Table (2) :Amino acids concentration in infested ( with piercing sucking insect pests ) and unfested leaves of the two test local globe artichoke cultivars ( Cordoon c.v. and Hybride).

Amino acids %	Cordoon c.v.			Hybride c.v.		
	Uninfested leaves	Infested leaves	Difference %	Uninfested leaves	Infested leaves	Difference %
<b>Essential amino acids</b>						
Valine	16.9	13.8	- 18.3	20.4	15.7	- 23
Threonine	3.2	4.2	+ 31.2	4.1	3.9	- 4.8
Isoleucine	3.5	5.1	+ 45.7	4.4	6.3	+ 43.1
Leucine	17.7	16.6	- 6.21	8.8	14.8	+ 68.1
Methionine	2.5	1.6	- 36	2.6	2.1	- 19.2
Phenylalanine	5	9	+ 44.4	8.	8.3	+ 3.75
Histidine	1.5	1.5	0	1.4	1.2	- 14.2
Lysine	1.5	1.4	- 6.66	1.7	1.4	- 17.6
Mean of decreases			- 16.79			-15.76
Mean of increases			+ 40.43			+ 38.31
<b>Non- essential amino acids</b>						
Alanine	18.3	16.6	- 9.28	22.1	16.8	- 23.9
Glycine	6	3.2	- 46.6	4.9	3.7	- 24.4
Serine	4.5	4.2	- 6.66	7.5	5.1	- 32
Proline	6.6	11.2	+ 69.6	3.4	8.1	+138.2
Cysteine	2.4	2.9	+ 20.8	1.9	2.4	+ 26.3
Gamma-amino butyric	0.7	1.1	+ 57.1	1.2	0.8	- 33.3
Aspartic	3.8	2.9	- 23.6	3.9	4.6	+ 17.9
Glutamic	3	2.6	- 13.33	2.2	2.6	+ 18.18
Tyrosine	3.7	2.3	- 37.8	1.7	2.5	+ 47.05
Mean of decreases			- 34.06			- 20.90
Mean of increases			+ 89.6			+ 49.52
Total mean of decreases			- 50.85			- 36.66
Total mean of increases			+130.03			+ 87.83



With respect to Cordoon c.v. cultivar ; chemical analysis obviously indicated that infestation with the insect pests caused reduction of four EAA : [ Methionine ( 36.0 % ) , followed by Valine( 18.3 % ) , Lysine ( 6.66 % ) and Leucine ( 6.21% ) ] . On contrary , the EAA's : Isoleucine , Phenylalanine and Threonine were increased in infested leaves with 45.7 , 44.4 and 31.2 % in comparison with uninfested leaves ( control ) . Also , the occurrence of six NEAA'S : ( Glycine , Tyrosine , Aspartic , Glutamic , Alanine and Serine ) were decreased the reduction percentage were represented by -46.6 , 37.8 , 23.6 , 13.33 , 9.28 and 6.66 % respectively

**Table (3): Fatty acids concentration in infested ( with piercing sucking insect pests ) and uninfested leaves of the two test local globe artichoke cultivars ( Cordoon c.v. and Hybride).**

Fatty acids	Carbon No.	Cordoon c.v.			Hybride c.v.		
		Uninfested leaves	Infested leaves	Difference %	Uninfested leaves	Infested leaves	Difference %
Caprylic (Octanoic)	C8	0.1	0	- 100	0.6	0	- 100
Capric (Decanoic)	C10	.6	.14	- 76.6	0.8	0.1	- 87.5
Undecylic (Hendecanoic)	C11	.4	.11	- 72.5	0.2	1.2	+500.0
Lauric (Dodecanoic)	C12	1.6	2.5	+56.2	1.9	1.9	0
Trydecylic (Tridecanoic)	C13	1.2	0	-100	1.8	0	- 100
Myristic (Tetradecanoic)	C14	9.8	10.3	+ 5.1	3.2	3.8	+18.7
Pentadecylic (Pentadecanoic)	C15	3.5	2.1	- 40.0	2.3	2.2	- 4.3
Palmitic (Hexadecanoic)	C16	22.0	36.9	+67.7	43.0	36.7	-14.6
Palmitoleic (cis-9-Hexadecanoic)	C16'	4.1	2.5	- 39.0	1.4	2.7	+92.8
Margaric (Heptadecanoic)	C17	2.4	1.7	- 29.1	5.7	0	- 100
Stearic (Octadecanoic)	C18	8.7	7.4	- 14.9	8.5	7.2	- 15.2
Oleic (cis-9-Octadecanoic)	C18'	19.1	14.7	- 23.0	13.2	12.1	- 8.3
Elaidic (trans-9-Octadecanoic)	C18''	8.8	9.5	+ 7.9	9.3	17.0	+82.7
Ricinoic (12-Hydroxy-cis-9 Octadecanoic)	C18'''	3.8	5.4	+42.1	3.4	10.4	+205.8
X1	X1	7.7	3.9	- 49.3	2.8	4.7	+67.8
X2	X2	6.6	2.8	- 57.5	2.0	0	- 100
<b>Mean of decreases</b>				- 54.71			-58.87
<b>Mean of increases</b>				+35.80			+161.3

In infested Hybride c.v. leaves , five EAA'S ( Valine , Methionine , Lysine , Histidine and Threonine ) were decreased and the reduction percentage were -23.0 , 19.2 , 17.6 , 14.2 and 4.8 % ) respectively . While, the occurrence percentage of Leucine , Isoleucine and Phenylalanine were increased ( 68.1 , 43.1 and 3.75 % ) respectively. On the other hand; the infestation with piercing sucking insects caused a great increase as 138.2 % in the NEAA ; Proline. where its percentage increased from 3.4 % in the uninfested leaves to 8.1 % in infested ones per sample.

Moreover, an increase presented in NEAA' S ; Tyrosine , Cystene , Glutamic and Aspartic as 47.05 % , 26.3 , 18.8 and 17.9 % respectively affected by these infestations . Similar results are given by Hussein *et al.*

(1999) in Egypt, who studied all levels of essential amino acids found in the leaf protein concentrates prepared from different globe artichoke leaves.

Detailed fatty acids analysis for each infested and uninfested leaves of the two tested globe artichoke cultivars are reported in Table (3). The same trend of sixteen fatty acids identified in the leaves of each Cordoon and Hybride cv.s, was noticed. On Cordoon cv., a complete reduction (100 %) showed with Caprylic <C 8> and Trydecylic <C 13> acids. Lowest decrease observed in Stearic <C18> acid as 14.9 %. Also, marked deficiency recorded as 76.6, 72.5, 40.0, 39.0, 29.1, 23.0, 49.3 and 57.5 % in the content of eight fatty acids; Capric, Undecylic, Pentadecylic, Palmitoleic, Margaric, Oleic, X1 and X2 acids. The highest increase was recorded as 67.7 % in Palmitic <C16> acid, followed by Lauric <C12> 56.2 % and Ricinoieic <C18'''> 42.1 %. A lowest increase was 5.1, 7.9 % in Myristic <C14> and Elaidic <C18''> acids, respectively. On Hybride cv., a complete reduction (100 %) recorded with Caprylic < C 8 > and Trydecylic < C 13 >, Margaric <C17> and X2 <CX2> acids. Lowest decrease observed in Pentadecylic <C15> and Oleic <C18'> acids as 4.3 & 8.3 %. Three fatty acids; Capric <C10>, Palmitic <C16> and Stearic <C18> presented 87.5, 14.6 & 15.2 %, where its percent decreased from 0.8, 43.0 and 8.5 % in the uninfested leaves to 0.1, 36.7 and 7.2 % in infested leaves, respectively. Great increase, 500, 205.8 % were recorded in the two fatty acids, Undecylic <C11> and Ricinoieic < C18'''> in the infested leaves, respectively. The lowest increase showed 18.7 % in Myristic <C14> acid. Three fatty acids; Palmitoleic <C16'>, Elaidic <C18''> and X1<CX1> presented 92.8, 82.7 & 67.8 % where its percent increased from 1.4, 9.3 & 2.8 to 2.7 , 17.0 and 4.7 % in infested leaves, respectively. No evidence change appeared in the leaf content of Lauric fatty acid in both the infested and uninfested samples.

Results of chemical analysis might indicate that Hybride cv. seemed to be the less susceptible globe artichoke cultivar to the piercing sucking insect infestation than Cordoon cv., as the former exhibited the least reduction of each the total amino acid decrease 36.66 % and an increase 87.83 % and the second one had 50.85 & 130.03 %, respectively, While the Hybride was the most susceptible cultivar to these infestation as it presented the higher of each the total fatty acid decrease 58.87 % and increase 161.30 % than 54.71 & 35.80 % respectively in Cordoon cv. leaves . This is a first report from Egypt reviewed the contents of both leaf amino and fatty acids affected the infestation with certain sucking insects on two local globe artichoke cultivars to improve the crop by control insect pests and emphasize the natural plant (RAPD) importance of globe artichoke for the public health and prophylaxis.



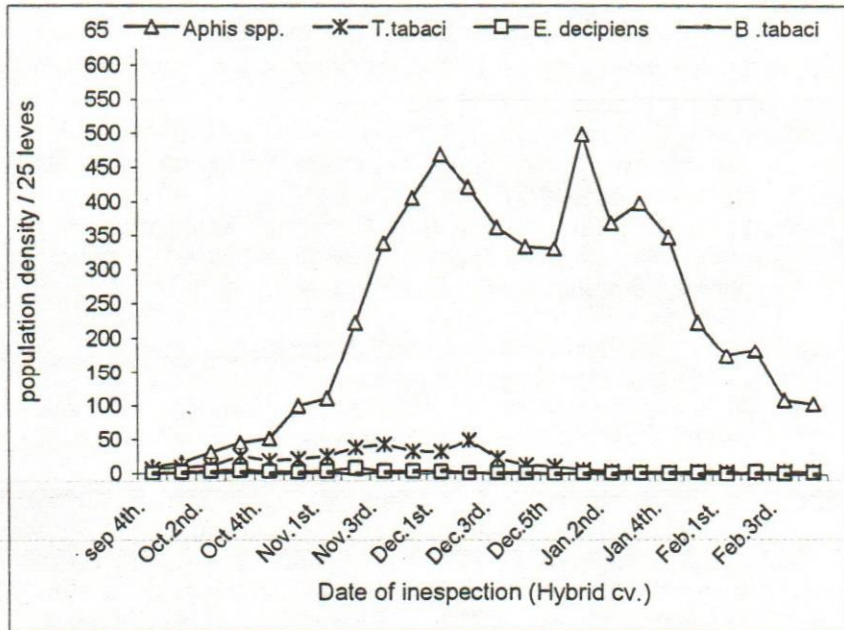
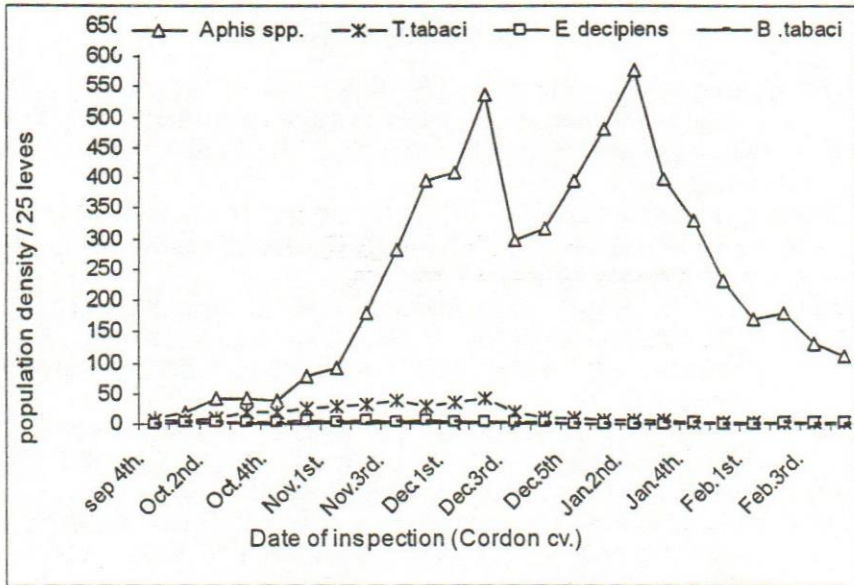


Figure 1: Population fluctuation of aphid, white fly, jassid and thrips on cordon and hybrid cultivars.

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أثر الإصابة ببعض الحشرات الماصة على تركيز الأحماض الأمينية والدهنية  
في أوراق صنفين من الخرشوف المحلى  
عبد العزيز محمد فاضل  
الدقي - جيزة - ١٢٦١٨ مصر - معهد بحوث وقاية النباتات - مركز البحوث الزراعية

تعتبر كلا من الأحماض الأمينية والدهنية في أوراق نبات الخرشوف من أهم  
مكوناته الطبيعية التي تم تقديرها في عينات أوراق الصنفين المحليين الكوردون والهجين  
المصابة وغير المصابة ببعض الآفات الحشرية الثاقبة الماصة، والتي شملت خمس أنواع من  
المن وهي من الفول ومن القطن والبطيخ ومن الأيفوربيا زمن الخوخ الأخضر ومن البطاطس  
بالإضافة إلى ذبابة القطن والطماطم البيضاء ونطاط أوراق القطن والبطاطس وترس البصل  
والقطن .

وقد أوضحت الدراسة أن تعداد المن كان أعلى كثافة من الحشرات الثاقبة الماصة  
الأخرى . هذا وقد تم عزل وتعريف ١٧ حامض أميني ، ١٦ حامض دهني من أوراق الصنفين  
المختارين . بالإضافة الى تسجيل قياساتها المنوية وأوضح التحليل الكيماوي أن الإصابة بتلك  
الحشرات الثاقبة الماصة تسبب نقص في بعض الأحماض الأمينية الأساسية وغير الأساسية ،  
وكذلك الحال في تركيز الأحماض الدهنية وقد تراوح ذلك النقص في حالة الأحماض الامينية  
الأساسية و غير الأساسية وكذلك الحال في تركيز الأحماض الدهنيه وقد تراوح النقص في  
حالة الأحماض الأمينية الأساسية و غير الأساسية بين : (٦,٢ - ٤٦,٦ % ) ،  
( ٤,٨ - ٣٣,٣ % ) للصنفين المختارين، بينما تراوح النقص بالأحماض الدهنية بين : (١٤,٩ -  
٧٦,٦ % ) ، ( ٤,٣ - ٨٧,٥ % ) في كلا الصنفين المختارين على التوالي ، و ذلك بالمقارنة  
بنتائج عينات الأوراق السليمة ( على أساس الوزن الجاف) .

