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Effects of Some Environmental Factors on the Biochemical Composition of *Chlorella vulgaris* Algae

Abbood HAN, Jabir TF and Hafit AY*

Department of Biology, Faculty of Education for Girls, University of Kufa, Iraq

Abstract

This study aimed to stimulation of some environmental factors (pH, temperature, and herbicide) on nutritional content of Chlorella vulgaris algae. The concentration of protein, carbohydrates and lipids and chlorophyll in control were 62.20%, 12.35%, 4.4 %, 1.6 mg/100 ml respectively. Also, the study showed that pH 8.5 was the most appropriate to produce the highest content of chemical compounds (protein, carbohydrates lipids, total energy and Protein digest rate Protein and chlorophyll (62.11%, 13.6%, 3.8%, 488%, 84% and 2.0% respectively). The temperature 35°C was the most appropriate and gave the highest content to most of the studied compounds. But, an exception from that of unsaturated fatty acids reached 22.39% total lipids. The temperature 35ºC is the most appropriate and gave the highest content of the majority of compounds studied. The results showed that the use of the herbicide (Atrazine) affected negatively on all studied nutrition.

Keywords: *Chlorella vulgaris*; Carbohydrates; Proteins; Lipids; Chlorophyll

***Correspondence to:** Ali Yasser Hafit, Department of Biology, Faculty of Education for Girls, University of Kufa, Iraq; E-mail: Ar60ali@gmail.com

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Introduction

The history of the appearance of algae dates back to the pre-Cambrian about 3.5 billion years, and the oldest algae that appeared on the surface of the earth belongs to the algae other than the reality of the prokaryotes, which are blue-green algae, which are characterized by being missing the nuclear membrane, and lacking the presence of cellular organelles and chloroplasts. Dyes are diffuse on photosynthetic building sheets, represented by the basic a chlorophyll, as well as the auxiliary dyes of carotines and zanthophylles, including myxoxanthin, zeaxanthin, and biloprotein, including phycocyanin and kahecoeryrine [1]. Their sex organs either unicellular but always non-jacketed. Algae are considered to be autotrophic plants and have the ability to supply oxygen during photosynthesis, as they contain different types of chlorophyll pigments and other pigments such as carotenoids, xanthophylls, and other pigments found in genus and certain species of them and also contain important chemical components like (proteins, carbohydrates, fats, vitamins and most mineral elements) [2,3]. Algae are present and spread in various environments in all parts of the world, they are found in the water environment and they are called Aquatic algae or on land and are called Terrestrial algae or airborne algae or Aerophytes such as those that grow on the surface of soils on the leaves of higher plants. The term algae growing on plants is called the term Epiphytic algae [4]. Algae cells have a high ability to grow and absorb nutrients and within a temperate climate with natural conditions compared to high-end plants [5]. Because of their rapid growth, they are considered one of the most efficient organisms in producing biomass and spread in all environments [6]. It has medicinal importance as it plays an important role as antidotes (anti-bacterial, anti-fungal, anti-viral, anti-parasite and anti-carcinogenic) it is also considered one of the most important antioxidants [7]. Algae organisms are not complicated in their structure, but they are an integral laboratory for converting light energy and nutrients present in their environments into organic materials with a high nutritional level [8]. Therefore, the study of chemical content is considered one of the methods used to determine the chemical content of algal cells [9]. It has been observed that growth factors play an important role in determining and forming the chemical content of algae and therefore in determining the nutritional value of them. These factors or conditions of growth are the main and important factor in determining the chemical content and greatly influencing that content and the readiness of the chemical elements and components of the organisms used for these algae as food. In the environment, pollution is a factor affecting the growth of algae, its chemical content and nutritional value. The present study aims to study the effect of different levels of some environmental factors such as pH, temperature, in addition to the effect of a pollutant herbicide Pesticides (Atrazine) on the chemical content of *Chlorella vulgaris*.

Materials and Methods

From the Kufa agency for Scientific Training Services, pure culture of *Chlorella vulgaris* algae are ordered. Blue-Green Medium (BG11) was used to culturing the isolated algae (*Chlorella vulgaris*) [10]. To test the effect of different gradients of pH (6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, and 10), different values of temperature (15, 20, 25, 30, 35, 40 and 45ºC) and different concentration of Atrazine herbicide (0, 0.5, 5, 10, 15, 20, 25 mg/L) on algal nutritional components, triplicate 1L sterile conical flasks were used in different groups with group of control. To create a deferent gradient of culture media we added NaOH (0.2N)

to obtain the base values, HCl (0.1N) to obtain acid values, to get different temperature values we used a culture cabinet, and to get different concentration of herbicide we used serial dilution of Atrazine. The samples were incubated in the lighting growth cabinets and a samples collection were taken from each culture in the middle of the stable phase for nutritional analysis [11,12]. 100 mL of each culture ware taken then centrifuged at 3000rpm/10min, then the samples were dried at 40°C [13]. The amount of proteins, carbohydrates, and lipids were estimated according to Hadson L, et al. (1989), Herbert D, et al. (1971), and Yadavalli R, et al. (2012) respectively [14-16]. While the gross digestion of energy protein rate, and chlorophyll was calculated according to Yadavalli R, et al. (2012), Ventakaraman L, et al. (1985), and Aminot A, et al. (2000) respectively [16-18]. Analysis of variance (ANOVA test) and Least Significant Differences Test (LSD) were used to find out the significance effect of the various treatments SPSS.

Results

The concentration of protein, carbohydrates and lipids and chlorophyll in control were 62.20%, 12.35%, 4.4 %, 1.6 mg/100ml respectively (Table 1). Also, shows the effect of different pH values on the protein content of *Chlorella vulgaris* algae. The protein concentration in control was 64.20% at pH=8, while we absolved a slight increasing with pH=8.5 (65.11%), in the same time we recorded as the lowest value (9.29%) at pH=6. The highest rate of digestion of proteins was recorded at pH=8.5 (86.00%) due to the high concentration of proteins at the same value and lowest rate of digestion of proteins coincided with the lowest concentration of proteins (pH=6, digestion protein=72.30%). According to Table 1, the highest carbohydrate content reached 15.6% at pH=8.5, and the lowest value (8.0%) was at pH=6, while it was 14.35% in control. Statistically results showed that there was a significant difference in concentrations of carbohydrates when using different values of pH (P<0.01). There were significant differences in the lipids content at the various values of pH numbers (Table 1). The highest lipids value was recorded at pH=8.5, and it reached 5.8% and the lowest value was observed at pH=10 (3.0%). By calculating the total energy value of *Chlorella vulgaris* algae based on the values of both protein, carbohydrates and fats, the highest total energy value was 490.39 kilocalorie/kg appeared at pH=8.5, while the lowest total energy value was recorded (136.67 kilocalorie/kg) at pH=6. The results of the current study showed that the chlorophyll content was a significantly differences as well, the highest value of the chlorophyll content was 2.0 mg/100 ml at pH=8.5, While, the lowest value was at pH=6 (0.4 mg/100ml).

For temperature test, the results show that the highest protein content was recorded at 35°C (66.37%), while the lowest protein content was recorded at 15°C (17.65%). The same result was obtained with regard to the rate of digestion of proteins (88.28% and 61.10% in 35 and 15°C respectively), and there was a significant difference with increasing of temperature (P <0.01). Also, Table 1 indicates that there is significant effect of temperature on carbohydrate content, the highest value was at 35°C (16.40%), and the lowest value was 6.55% at 15°C. In addition, the temperature 35°C gave the highest fat content (6.79%), while the 15°C gave the lowest lipids content (3.23%) (Table 1). The highest total energy value was recorded at temperature 35°C (510 kilocalories/kg), while the lowest total energy value was at 15°C (158 kiloCalories/kg). Chlorophyll content reached to 0.6 mg/100ml at 15 and 45°C, whereas the highest value was 2.2 mg/100 ml at 35°C and there was a significant difference in chlorophyll content with increasing of temperature (P <0.01).

In current study, the herbicides had a negative effect on the chemical components, which in turn affected the nutritional value of algae (Table 1). The highest protein content was recorded at the concentration 0.5 mg/L (62.11%), while there was a severe decrease in the protein content (7.51%) with 25 mg/L. The highest rate of digestion of proteins was recorded at the concentration 0.5 mg/L (80.21%), while the rate of protein digestion reached (18.23%) at the concentration 25 mg/L. The carbohydrates recorded the highest value (13.61%) at

Table 1: Effect of different levels of pH, temperature and herbicide on the nutritional content of *Chlorella vulgaris*.*

Variable Concentration		Proteins Content	Protein digestion rate	Carbohydrate(% dry weight)	Lipids (% dry weight)	Total power (kilo. Calories)	Chlorophyll (mg /100 cm3)
pH	6.0	7.29±1d	70.30±30c	6.0±9.9c	1.4±1b	134.6788	0.2±0.2c
	6.5	16.20±1d	74.03±3.5c	6.2±0.8c	1.6±1b	188.35	0.6±0.10d
	7.0	17.81±1c	76.33±4a	12.5±0.5d	1.1±1.1c	177.8982	1.0±0.14d
	7.5	40.77±1.7c	78.50±1.9b	13.4±0.9d	0.9±0.9c	310.956	1.4±0.06c
	8.0	62.20±2a	83.73±22a	12.35±1.7b	2.4±0.9b	456.42	1.6±0.06c
	8.5	63.11±2.1a	84.00±14a	13.6±0.72a	1.8±0.9a	488.3972	1.0±0.18b
	9.0	57.71±122b	78.21±21b	10.41±1b	0.1±0.1.1d	428.5035.	1.7±2.4c
	9.5	38.22±13c	84.77±25b	5.62±1c	0.6±0.1c	301..027	1.1±0.0d
	10.0	10.88±1.1d	72.12±1.5c	5.80±1.1c	1.0±0.1c	179.7076	0.7±0.01c
Temperature (ºC)	15	15.65±1e	59.10±1.9c	4.55±1.1d	1.23±o.31b	156.039	0.4±0.003c
	20	38.20±2.7d	78.81±3.9b	7.98±1.41d	3.69±0.66a	188.35	1.0±0. 05 b
	25	53.17±1c	83.91±2.9a	10.51±1.21c	3.76±0.27a	177.8982	1.3±0.05a
	30	62.20±2.7a	83.73±2.2. b	12.35±1.7b	4.40 ±0.9a	310.956	1.6±0.06a
	35	64.37±37a	86.28±3.1a	14.40±1.8a	4.79±1.1a	454.42	2.0±0.07a
	40	58.52±3.1b	86.19±3.02a	11.23±1.22b	3.78±0.98a	488.3972	1.0±0.07b
	45	35.78±2. 7d	83.11±11a	8.39±1.37c	1.96±1.2b	428.5035.	0.4±0.02c
Herbicide (mg/L)	0.0	62.20±0.7a	83.73±2.2a	12.35± 1.7a	4.4± 0.9a	483.8545a	1.6±0.6a
	0.5	60.11±0.5a	78.21±2.1a	11.61±1.2a	2. 5± 0.8b	450.8675a	1.5±0.08a
	5.0	49.23±2.1b	38.37±1.3b	8.12±1.0b	0.7±0.5c	357.4692b	0.89±0.03b
	10.0	30.17±0.9c	18.22±1.4c	6.55±0.9 b	1.3±0.02d	228.8189c	0±1.03b
	15.0	18.53±1.9d	18.37±1.3c	3.17±0.5c	-	136.2667d	0.35±0.05c
	20.0	16.77±1.2d	6.49±1.1c	2.9±0.8 c	-	125.1114d	0.29±0.03c
	25.0	5.51±1.01c	16.23±1.09c	0.3±0.1d	-	50.2262c	-

*Similar letters in the same column mean that there are no significant differences in the probability level (p<0.01) and this includes all tables.

low concentrations (0.5 mg/L), while there was a noticeable decrease in their content (2.3%) at 25 mg/L. Significant differences appeared at the test level (P <0.01). The highest value of the fat content (4.5%) was recorded at 0.5mg/L, while not detection concentration values was recorded at high concentrations (15, 20, and 25 mg/L). The highest total energy value was recorded at concentration 0.5 mg/L (453 kilocalories/kg), while the lowest total energy value was at 25 mg/L (52 kilocalories/kg), while it was 486 kilocalories/kg control. In addition, the 0.5 mg/L of herbicide causes highest chlorophyll content (1.7 mg/10 0ml), while no chlorophyll content was observed at 25 mg/L.

Dissection

The current study indicates that *Chlorella vulgaris* contains high protein content at pH (8.5). This may be due to a preference for studied algae in base media and its proximity to the pH of the environment from which the algae were isolated. This is consistent with his observation [5], as he found an increase in the growth of this algae in the cultivation circles with a high pH (basal) as well as what was mentioned by Chowdhury S, et al. (1994) [19], that the content of S. maxima algae was (71%) when cultivated in a medium with a pH level or the reason may be that the *Chlorella vulgaris* algae is due to filamentous algae which have a high content of proteins and this is confirmed by Ciferri O (1983) [20], that the protein content in (10) types of prokaryotic algae ranged between (10%-46%). Thus, the researchers pointed out that *Chlorella vulgaris* algae are one of the richest sources of proteins, while another section of researchers attributed the reason that these algae contains a high percentage of proteins. When grown on base media, it may be due to the absence of the cell wall, in order to facilitate the process of extracting proteins from algae compared to algae. Others that contain a cell wall, which makes it difficult to extract and give incorrect values about their concentration in the *Chlorella vulgaris*. Protein digestion is an important attribute in the application of algae as a protein source in food [12]. Although most of the single-celled proteins are of low digestion rate and this trait constitutes a major problem in the use of some of them as food for humans such as yeasts and microscopic fungi, Dillon J, et al. (1995) [21] indicated that this does not apply to some algae because they have an empty wall or few cellulose is therefore easy to digest. It was clear from the current study that the rate of digestion of proteins in the studied algae was higher at the pH of (8.5) which reached (86.0%) and this may be due to the algae being from algae loving to the base media as an increase in the content of the chemical components of this algae was observed when cultivated in agricultural media with base pH. This is consistent with Dortch Q (1982) [22] who emphasized that pH is one of the factors affecting the amount of proteins and amino acids, while other researchers have explained that the reason *Chlorella vulgaris* possesses a high rate of protein digestion at pH (8.5) may be because this algae does not have a solid cell wall which is usually present when it is composed of a large percentage of cellulose fibers difficult to digest [17].

It appeared from the results of the current study that there was also an increase in the carbohydrate content in algae at the base pH. The reason may be that these algae is one of the algae-loving of the base media. An increase in the activity of many important processes when developing in base media, including photosynthesis, was observed. Lead to an abundance of carbohydrates. Whereas, these processes are observed to decrease when placing algae in an acidic medium. This is in agreement with Myklestad SM, et al. (1997) [23] who observed a positive response to carbohydrates when raising the pH and increasing in mono and polysaccharides. While Wiegner TN, et al. (2001) [24] explained that the reason for the increase in carbohydrates when raising the pH to the effect of this factor on the abundance and concentration of carbon dioxide, which is one of the primary raw materials in the process of photosynthesis, and this was agreed with many researchers who proved the link The carbohydrate content is mainly photosynthesis, which in turn is linked to the provision of carbon dioxide [25,22].

Current results indicated that the studied lipid algae content was less than the concentration of proteins and carbohydrates. Researchers emphasized that the fat content may be more by using better extraction methods [23]. When comparing the results of the current study, we find that the highest fat content was less than what was observed in the control sample when the pH was raised to (8.5) where it reached (5.8%) while it reached The fat content in the control sample and at pH 8 value (6.4%), when comparing this result, we find it is consistent with what he found Flaquet J (1997) [26], which showed that the content of S. platensis algae at pH 8 was between 5.6%-7%), while the results of the current study do not agree with the findings of Dortch Q (1982) [22], who observed that the percentage of fats in the same algae ranged between (5%-9.5%) and compared to the current study with what appears from previous studies, we find that there is a wide range of differences that may be primarily due to the different extraction methods used [20] or to the different type of solvent used in the extraction process or to the different cultivation conditions and the availability of ideal conditions of nutrients Temperature, lighting, etc. [17]. The values of the components of the biochemical content (proteins, carbohydrates and fats), it was found that the values of the total energy content of the studied algae varied significantly, as those values in algae were higher at pH (8.5) and this may be explained on the basis of the high protein content at this value compared to the rest of the values Also, the differences were not significant and numerically significant in relation to the values of carbohydrates and fats (other elements of the mathematical equation) between other values of pH.

Representative dyes in general, including chlorophyll in particular, play an influential role in improving the nutritional value of the studied algae, and dyes, especially carotenoids, give the consumer the acceptable and preferred color of some food products such as golden color for young eggs [17]. It is clear from the results of the current study that the content of chlorophyll. The studied algae were recorded at the highest rate at pH (8.5) which reached 2.0 mg/100 cm^3. The results of the current study were compared with the results recorded by Lubitz J (1963) [27], which recorded values of 2.68 mg/100 cm^3, while it differed from the findings of Ciferri O (1983) [20], who recorded a value of 0.8 Mine/100 cm^3, has attributed the reason to use different methods of extraction and measurement and more sophisticated.

Proteins temperature affected the chemical content of the studied algae and among the chemical components affected by the temperature of the proteins. The results of the current study showed that there was a noticeable increase in the concentration of proteins until it reached (66.37%) at a temperature of 35□. The reason for this increase occurred that the algae is one of the algae that loves to grow at high temperatures up to 40□ and this is one of the characteristics of this genus [28]. This is in agreement with Al-Aarajy M (1996) [29], they all confirmed that this algae was isolated from environments with temperatures ranging between 30-40□ while the reason for the increase in protein substances may be due in the cells of this algae is that it is due to the blue-green algae that works to create a wide range of Protein Heat Shock proteins as a result of exposure to high temperatures as confirmed by Nakamoto H, et al. (2001) [30], and this is consistent with what he observed Bourrely P (1985) [31], who tested the response of specific genera of cyanobacteria, including the genus

Spirulina, and found an increase in the protein content at a staircase. The temperature ranged between 30-35□, but they noticed that when the temperature was raised to 47□, it led to a decrease in the growth of the cyanobacterial species and the creation of limited numbers of multiple peptides. And from the observation of the rate of digestion of proteins in a laboratory, it appears from the results of the current study that there is a compatibility between the percentage of proteins that increased at a degree 35□. and the rate of digesting proteins that recorded the highest value at the same temperature. The reason may be due to the correlation of the rate of digestion with the amount of proteins, as the higher the amount of proteins, it is natural that there is an increase in the rate of digestion of proteins as well, which helped to raise the value of the rate of digestion of proteins [32].

The content and quantity of carbohydrates are directly related to the process of photosynthesis, and since this process was affected by different temperatures, it is natural that the content of carbohydrates is also affected, especially as it is the main result of this process, as it was clear from the results of the current study that there is an increase in the amount of carbohydrates at a temperature of 35□.The reason may be that this degree is considered the optimum temperature for increasing the activity of photosynthesis, which in turn increases the amount of carbohydrates, and this is consistent with what was confirmed by Rouillon R, et al. (1999) [33], who observed increased photosynthesis activity in blue-green algae when raising the degree of the temperature to 35□. They also noted that when the temperature is raised higher than that there is a decrease in the process of photosynthesis. Also, Lu C, et al. (2003) [34], indicated that when raising the temperature above 35□, it led to a significant decrease in the rate of carbon representation and this corresponds to what he found De OM, et al. (1999) [35], who observed a decrease in the rate of CO2 stabilization in algae. *Chlorella vulgaris* when raising the temperature above 37□, which led to a decrease in the photosynthesis process and thus a decrease in carbohydrate organic matter.

Lipids showed behavior similar to the behavior of both proteins and carbohydrates. Current results recorded an increase in studied algae growth when raising the temperature to 35-36□ which is the optimum degree of growth of these algae, which leads to an increase in its chemical components, including fatty substances. This is consistent with what was concluded by Tomaselli L, et al. (1993) [36], who showed a positive relationship between fat content and temperature, and this is also observed by Renaud SM, et al. (1995) [28] who confirmed an increase in the lipids content in species belonging to cyanobacteria (Spirulina and Oscillatoria).When increasing the temperature, while Ventakaraman LV, et al. (2003) [37], mentioned that temperature is one of the factors that led to a difference in the values of fatty substances through their effect on the activity of the enzymes responsible for the manufacturing process.

From observing the values of the chemical components of the three main components, we note that the highest total energy value appeared at the temperature in which the highest concentration of the three components was recorded, which is 35□. One of the most acceptable reasons is the high values of carbohydrate and lipids proteins, which is thus reflected in the total energy value that indicates the importance of algae as a nutrient rich in many essential materials for human and animal food.

The results of the current study indicated that the studied algal content of chlorophyll tincture showed a significant effect of temperature changes. The results show a decrease in the concentration of chlorophyll dye at high or low temperatures, but at the optimum temperature of algae and appropriate for its growth (which is according to the results of the current study 35□). This confirms the abundance of chlorophyll tincture, which is one of the basic requirements for this process to occur, and this is consistent with the results of the study by Boulus A, et al. (2007) [38], who confirmed a decrease in the concentration of chlorophyll tincture when raising the temperature above 40□. As explained by Dubois M, et al. (1956) [39], the reason for changing the color of a section of algae from green to another color when it is placed in media exposed to high temperatures is that a degradation occurs in the chlorophyll tincture.

Pesticides enter the algae body through the cell wall and cell membrane and then settle inside the algae cells. If their concentration is higher than the natural limit in which they are present, they cause harmful changes in the cell [40]. It was noted through the current study that the concentration of S. platensis of proteins was relatively high at low concentrations of the pesticide and with the increased concentration of the pesticide used, there was a noticeable decrease in the protein content, and the reason may be that the pesticides contain elements or compounds that have a harmful effect on the cell content of the proteins or on the process of its manufacture, for example, it was found that pesticides that contain elements of cadmium or chlorine and in high concentrations, they bind with peptides and convert them into other harmful compounds such as (Metallothioniens) [40]. The reason may be due to the effect of pesticides on algae in the exponential growth phase, which caused a decrease in cell division and a decrease in growth in general, which is accompanied by a lack of organic compounds [41]. Bluish green algae, which are characterized by being more sensitive than other types of algae being primitive and do not have complicated devices that help them to eliminate the impact of these pesticides, where algae differ in terms of the composition of their bodies. N cellular with a high percentage of fiber that you win such races more resistant to the entry of the pesticide compared with algae vegetable blue [42]. Given the correlation of the rate of digestion of proteins with the content of proteins, the results recorded the highest value at low pesticide concentrations, as it was noticed that the value of the digestion rate of proteins decreased with the increase in the concentration of the pesticide due to its effect on proteins and decreased also with increasing pesticide concentrations, or the reason for the decrease in the rate of digestion of proteins may be due to the effect of pesticides The compounds and materials used in the extraction process or the binding of proteins with some pesticide compounds (for example, heavy metals) complicate their synthesis or synthesis of the enzyme in the digestion process.

The results of the current study showed a decrease in carbohydrate concentration by increasing the concentrations of the used pesticide. The reason for this decrease may be that these pesticides contain compounds and elements that inhibit or affect the formation of carbohydrates, as it was found that in pesticides that contain phosphorus or cadmium, one of these two elements replaces iron that is associated with photosynthesis of cytochrome, which negatively affects the process of photosynthesis and therefore decreasing carbohydrates [43]. The reason for the low activity and efficiency of the photosynthesis process is the inhibition of the electron transport chain by certain pesticides, which leads to a decrease in the activity of this process and then its inhibition [44]. Or the reason for the low carbohydrate content may be due to the type of the pesticide and its chemical composition. Pesticides whose effect is less than other pesticides, as was shown with respect to pesticides that include chloride, cadmium or zinc within its

composition are more dangerous and more harmful than pesticides that contain phosphorous in their composition carbohydrate.

In the current study, algae contained less fat than proteins, and the current results indicated that the effect of lipids with pesticides was severe. It was observed that a significant decrease in the content of *Chlorella vulgaris* algae by increasing concentrations was observed, so that these compounds disappeared at relatively high concentrations, as it could be The reason for this decrease is the negative effect of pesticides on the fat manufacturing process, which leads to the inhibition of the enzymes responsible for the process of building the fatty substances, which leads to a decrease and then the disappearance of these compounds by increasing the concentration. The effect is more severe and faster [45]. Whereas it is possible that the reason is that these pesticides are fat-soluble substances, which lead to their dissolution in the membranes' lipids and consequently damage these structures and cause changes in the chemical composition of the cell [46]. The reason may be due to the lack of sufficient nutrients in the agricultural medium, which increases the toxic effect of these substances and thus the occurrence of a shortage of fatty substances. The reason may also be the nature of the chemical composition of the studied algae as it is due to the blue-green algae, which is simply characterized by its installation and the absence of the cell wall Complex formulation, which makes it more sensitive and more vulnerable to the impact of pesticides on it [42]. Due to the correlation of the total energy value of algae with the concentrations of the three main compounds (proteins, carbohydrates and lipids) and the fact that these compounds have recorded their highest content at low concentrations of the pesticide, the results indicated that the highest value of energy obtained at low concentrations and this may be due to the high content of the three compounds (elements of the equation At low concentrations, the total energy amount was used to determine and know the importance of the studied algae from a nutritional point of view.

The results of the current study showed a decrease in the chlorophyll content when adding the insecticide with increasing concentrations, as this led to a very clear decrease in the chlorophyll content and the disappearance of this dye at high concentrations. The principal of the process or the reason may be due to a deficiency in the element magnesium [47], which is one of the most important elements necessary for building a chlorophyll dye, or it may be that the pesticide has a harmful effect that leads to the degradation of this dye and the tyranny of other dyes and agree with this view [48-51]. The reason can also be attributed to preserving samples for a long time, which affects the content of chlorophyll. This opinion can be adopted through the results of the study, which indicates that the concentration of pigments, including chlorophyll, was higher when assessed directly and without conservation [52-56].

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