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Synthesis of Liquid Organic Fertilizers from the Waste of Fishs

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Abstract: The research tackles a new study of preparing liquid organic fertilizers to be used in the agricultural sector which are more active than the traditional solid organic ones. These fertilizers are extracted from fish waste the manufacturing of such fertilizers is characterized by low cost easy preparation and the availability of the raw material in our country Iraq. The wastes which are namely (guts and other wastes) are grinded mechanically then by using the phosphoric acid they are chemically dissolved. That is done under certain and controlled conditions concerning the temperature the hydrogen index (pH) and the existence of air (oxygen). After preparing several samples under various conditions the nitrogen, phosphorus and potassium rates were measured by using the (NPK) measures of some of the already prepared samples. It was proved that they contain considerable amounts of these three elements which are necessary for growing and soil and they could be used on a large scale in the agriculture sector. The research included a new study for the preparation of liquid organic fertilizers for use in the agricultural sector more effective than conventional solid organic fertilizers. These fertilizers are extracted from fish waste. These residues are subject to a mechanical digestion process followed by chemical digestion using phosphoric acid with certain conditions such as temperature, pH (acid function) and air (oxygen) being observed. After the preparation of several models and different conditions the ratio of nitrogen, phosphorus and potassium was measured using the NPK, manganese, iron and sulfur measurements as well as the lead element of some prepared models. It has been proven to contain adequate quantities of these three important elements of germination and soil as well as other minor elements agriculture sector.

Key words: Agricultural sector, fertilizers, NPK, liquid, hydrogen index, phosphoric

INTRODUCTION

Agriculture is one of the main basics that the national economy of most countries depends on. So, working on developing this sector and exerting efforts to maintain it and enhancing it by developed techniques notably agricultural researches and using fertilizers are of the top priorities of most of those who are interested in agriculture. Generally speaking, fertilizers are organic and non-organic materials used to feed plants and improving the chemical, physical and vital features of the soil (Mataraiev, 2002). Using these fertilizers, especially, the organic ones, affects positively on the product of plants. So, it can be concluded that the organic fertilizing process is the corner stone which should be depended on and used to increase the productivity of the agricultural lands which in turn, participates very actively in decreasing environmental pollution whose main cause is the over-use in chemical mineral fertilizers. Organic fertilizers whether liquid or solid, play a vital role in the growing of the agricultural crops and they affect on the features of the soil via. improving the soil structure and organizing its fertility regarding the acidity of the soil and increasing the ability to exchange positive ions which are called (Katyons). Besides, the organic fertilizers supply the plant with the nutrition elements which are released from organic compounds during their dissolving and participate in increasing the biological activity inside the area of root spread. Fertilizers, in general can be classified into various types, organic fertilizers, chemical fertilizers, mineral fertilizers and others. All kinds of fertilizers contain one of the important and necessary nutritional elements needed for the growing of plants which are nitrogen, phosphorus, potassium, etc. It has been scientifically and practically proved that nitrogen for instance is present in the composition of cells in plants

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and also in the composition of the chlorophyll whereby its shortage makes the leaves yellow and leads to low productivity besides the considerable role of both the phosphorus and the potassium in the growing of plants and the roots as well as reinforcing the soil. Most farmers resort to using chemical fertilizers or solid fertilizers and solid sewage waste as well as municipal compost on a large scale. They are not devoid of defects and negative aspects all contain heavy elements which may accumulate in the soil and harm soil, plants and animals. The use of such compost must be based on certain considerations related to the compost, soil and crops (Abou Seeda and Verloo, 1986). For example, the plant (Aleqhawan) which is sensitive to chemical fertilizers (Macz *et al*., 2001) and which is used for medical, decoration and cooking purposes and which is cultivated on vast areas all over the world the over-use of chemical fertilizers has affected considerably on the productive power to a great extent of this plant besides the effect on the quality of the soil and causing dangerous environmental problems (Han *et al*., 2014; Min *et al*., 2016). Most studies focus on the replacement of the used chemical fertilizers by organic ones which differ from the first in that they are characterized by activity in environmental sustainability and plant growth. At first, the used fertilizers depend on the traditional solid organic fertilizers such as hay and manure (Sun *et al*., 2014; Atiyeh *et al*., 2001). However, after the emergence of liquid organic fertilizers from natural sources which are rich with organic substances and which have proved to be active in increasing product and preserving and sustaining the soil and plant health, the demand for them became more than that on the other fertilizers (Pichyangkura and Chadchawan, 2015; Hou *et al*., 2017; Dordas *et al*., 2008). Many studies have proved that the liquid organic fertilizers have actively strengthened the growth of the roots of the tomato plant (Zhu *et al*., 2013; Canfora *et al*., 2015). The liquid organic fertilizer is considered more affective than the normal organic fertilizer. That is so due to the matter's properties the liquids penetrate though the soil more quickly to be absorbed by the roots of the plants more efficiently compared with the normal fertilizer which needs more time to be absorbed by the roots.

MATERIALS AND METHODS

The practical part: The practical part depends on the use of fish compost (all the guts of the stomach of the fish) these guts are taken and subjected to many operations which are (mechanical digestion, chemical digestion, standardization and (NPK) measure).

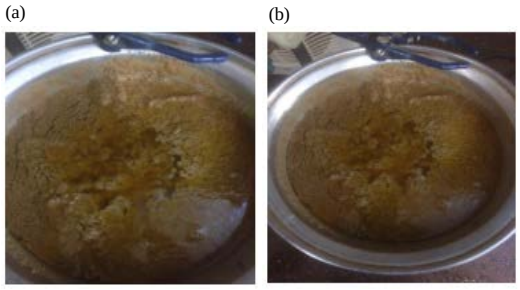

Fig. 1a, b: The result of the mechanical digestion of the fish guts after heating

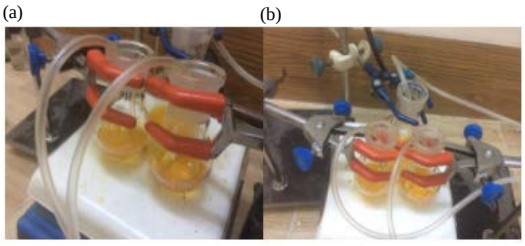

Fig. 2a, b: Samples before heating

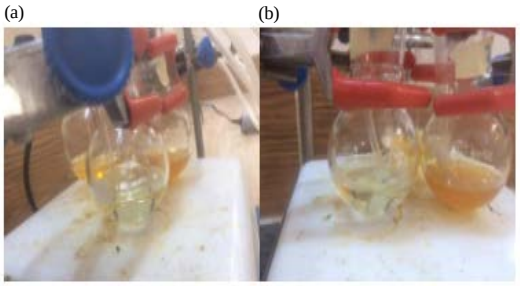

Fig. 3a, b: Samples after heating

The first step: This step included the process of mechanical digestion by grinding where by the guts of the fish are cut and carefully grinded in the mixer for an hour after that what has been mixed is heated to the boiling degree for three hours with movement to distribute the heat. The result of all that is obtained which is illustrated in Fig. 1-3.

The second step: This step includes chemical digestion by using concentrated phosphoric acid whereby the outcome of the first step is divided to many parts to prepare several samples with different (pH). The outcome of the first step is divided into three parts with the addition of the phosphoric acid with continuous moving and keeping the (pH) controlled for each sample then the hydrogen index is gauged. The first sample at 2-1 pH the second at 3 and 4 pH and the third one at 5 and 6 pH.

pH (1-2, 3-4 and 5-6)			
Without ear at 65-80°C	With ear at 65-80°C	Without ear at 45-60°C	With ear at 65-80°C

Fig. 4: Filtering all the samples

Fig. 5a, g): Estimating the content of the fertilizer

The third step: In this step, two variables are covered which are temperature and the existence of air (oxygen) whereby each part of the second step is divided into many parts.

Experiments were conducted under various temperatures, the first was done at (45-60°) the second at 65-80°C. Each sample under these varying degrees is divided into two parts one with air (oxygen) via. pumping air bubbles inside the vessel and the other without air. The mixture is moved for 24 h for all samples.

The fourth step: In this step, the acid was neutralized in some samples using the ammonia gas while other samples were left for 5 days in order to get a self neutralization for the acid. Filtering all the samples and taking the liquid part which constitutes the liquid organic fertilizer and measuring the (NPK) to determine the rates of the elements: nitrogen, phosphorus, potassium, manganese, iron and sulphur (Fig. 4).

Estimating the content of the fertilizer from the nutrition elements: The rate of nitrogen was estimated in the prepared samples using (Kjeldahles method) which is available in the Central Laboratory of the Higher Studies, College of Agriculture, Baghdad University and the Industrial Fertilizers Company in Baghdad also the rates of both the phosphorus potassium and sulphur were estimated in the same laboratory. In addition to estimating the proportions of some micro nutrients such as manganese, iron and lead in the University of Mosul College of basic education using a device (SensAA, GBC scientific equipment) (Fig. 5).

RESULTS AND DISCUSSION

Recently, fertilizers have become indispensable for the agricultural crop specially after the emergence of desertification in lands and the agricultural areas the shortage in lands and other problems which disturb the world. Farmers use nowadays large quantities of fertilizers yearly all over the world. The increase in product, thanks to the addition of fertilizers is about quarter of the global product. Without fertilizing more lands should have been cultivated and more workers should have been employed to produce the same quantity. The project of producing liquid organic fertilizers is considered of the vital and environmental pioneering projects which aims at ensuring the most excellent organic fertilizers for the those working in the sphere of agriculture as well as protecting the environment for it prevents the accumulation and the spreading of animal and plant compost or burning the compost and consequently polluting the environment considerably. There are various sources for extracting and manufacturing the liquid organic fertilizers that depended on the algae, the remains of fruits and plants in some ways.

This research works on the production of liquid organic fertilizers from natural raw materials which are not chemical and are not harmful to the environment these materials are namely guts of fish. As is known, Iraq is rich with many kinds fishes, so, large quantities of these fertilizers can be produced and made use of with low cost. The practical part included a number of variables which are: mechanical digestion which includes cutting and grinding the compost with the use of mixers.

Chemical digestion by way of controlling the concentration of the acid whereby we relied on using the concentrated phosphoric acid with due regard to the preparation of many samples with various (pH) for the purposes of comparison the (pH) included (1-4) and finally (5 and 6).

As for the other variable which is temperature these already prepared samples were heated to high temperatures (45-60, 65-80). The last variable was oxygen (i.e., the existence or absence of air) whereby the variables (Temperature and the hydrogen index) were fixed and air bubbles were pumped inside some of these samples and its absence in other samples (at the same temperature and the hydrogen index) also for comparison purposes.

The period of heating and moving is the same period (24 h) after these steps was the process of filtering the outcome and taking the liquid part (because the objective of the work is to prepare liquid fertilizers). Finally, the acid was neutralized by pumping the a gas bubbles at last some results were selected with varying conditions and specifying them by using the (NPK) measures (measuring the rates of nitrogen, phosphorus and potassium) which are the three important and nutrition elements for both plants and soil. The results were good as is shown in Table 1.

Table 1 shows the rate of the nutrition elements (N, P, K and S) in the prepared samples which were measured in the Central Lab of the Higher Studies, College of Agriculture, Baghdad University and the Industrial Fertilizers Company in Baghdad. While the micro nutrients (Mn, Fe and Pb) was measured at Mosul of University. Results showed that the highest degree of hydrogen was in sample No. 7 which was done at pH 5 and 6 without neutralizing the acid with ammonia gas (it was self-equated after being left for five days) and the reaction was done in the presence of oxygen and the heating temperature ranged from 65-80°C.

As for the element of lead which is harmful to soil and plants because it is a toxic factor the measurements have proved that the percentage was zero and this gives more importance to liquid organic fertilizers prepared in this research. In comparison with what has been previously referred to by some sources (Abou Seeda *et al*., 1992). About the content of the organic fertilizers or the remains of the nutrition elements illustrated in Table 2-4. It is clear that the rate of the three important elements for soil

Table 1: The rate of the nutirtion elements (N, P, K and S)

Number of sample test	Macro elements			Micro elements		
	Nitrogen (N) (ppm)	Phosphorus (p) (ppm)	Potassium (k) (ppm)	Manganese (Mn) (ppm)	Iron (Fe) (ppm)	Sulfur (S) (ppm)
1	3.26	0.727	0.624	1.38	2.960	2.960
2	3.07	0.917	0.778	1.97	1.340	1.340
3	1.70	1.361	0.601	1.94	3.220	3.220
4	2.99	0.885	0.595	1.46	3.120	3.120
5	2.96	1.263	0.741	2.20	1.720	1.720
6	1.34	1.188	0.630	2.12	3.170	3. 17
7	3.43	1.650	0.559	2.40	5.430	3.430
8	3.12	1.240	0.718	2.48	1.500	1.500
9	1.72	1.535	0.611	2.32	3.260	3.260
10	3.22	1.258	0.657	1.54	3.030	3.030

Table 2: Measurements of manganese ratio

Variables	Conc. (µg/mL)	RSD (%)	Mean abs.	Replicates		
Cal blank	------	4.60	0.0283	0.0278	0.0273	0.0298
Standard 1	1.000	High	0.0027	0.0035	0.0015	0.0032
Standard 2	2.000	High	0.0055	0.0029	0.0078	0.0056
Standard 3	3.000	3.510	0.0114	0.0115	0.0117	0.0109
Standard 4	4.000	17.23	0.0135	0.0109	0.0151	0.0146
Sample label						
Sample 1	2.361	High	0.0078	0.0067	0.0047	0.0120
Sample 2	3.341	High	0.0111	0.0085	0.0106	0.0140
Sample 3	2.761	High	0.0091	0.0133	0.0083	0.0058
Sample 4	3.367	High	0.0111	0.0088	0.0162	0.0084
Sample 5	4.339	High	0.0144	0.0123	0.0182	0.0126
Sample 6	4.060	High	0.0134	0.0096	0.0220	0.0086
Sample 7	2.787	High	0.0092	0.0081	0.0119	0.0077
Sample 8	4.157	High	0.0138	0.0118	0.0096	0.0199
Sample 9	3.447	High	0.0114	0.0161	0.0097	0.0083
Sample 10	High	12.58	0.0176	0.0187	0.0191	0.0151

Table 3: Measurements of iron ratio

Variables	Conc. (µg/mL)	RSD (%)	Mean abs.	Replicates		
Cal blank	-----	1.53	0.0452	0.0459	0.0452	0.0445
Standard 1	4.000	High	0.0059	0.0068	0.0042	0.0066
Standard 2	6.000	0.65	0.0074	0.0074	0.0074	0.0075
Standard 3	8.000	High	0.0103	0.0079	0.0102	0.0128
Sample label						
Sample 1	1.213	High	0.0016	0.0032	-0.0004	0.0019
Sample 2	2.316	High	0.0030	0.0061	0.0026	0.0005
Sample 3	2.114	High	0.0028	0.0045	0.0023	0.0015
Sample 4	1.765	High	0.0023	0.0028	0.0035	0.0007
Sample 5	3.268	High	0.0043	0.0011	0.0059	0.0059
Sample 6	0.474	High	0.0006	0.0003	-0.0008	0.0024
Sample 7	4.283	High	0.0056	0.0071	0.0041	0.0056
Sample 8	5.685	High	0.0075	0.0075	0.0091	0.0058
Sample 9	5.939	High	0.0078	0.0110	0.0066	0.0058
Sample 10	2.572	14.14	0.0034	0.0039	0.0029	0.0034

Table 4: Content of the organic fertilizers

Organic fertilizer	N (%)	P (%)	K (%)
Wood ashes	-	1.0	5.0
Cow manure	0.6	0.3	0.5
Sheep manure	0.9	0.3	0.9
Horse manure	0.7	0.2	0.6
Poultry manure	1.0-4.0	0.8-1.6	0.5-1.5
Peat	1.2-1.5	0.1	0.2
Garden compost	2.7	2.9	0.9
Municipal compost	1.0-2.0	0.1-0.2	0.3-1.0

and plants which are obtained from our work are very good and can be used effectively in the agriculture sector compared with some of the published references concerning the qualifications of the artificial organic fertilizer which conditioned that the rate of the nitrogen should not be <0.5% (Abou Seeda *et al*., 1992). Also the rates which are obtained if compared with the rates existing in some of the commercial fertilizers which are sold in markets such as the fruit colour fertilizer which is of the fertilizers specialized in the speed of colouring the fruits naturally without any intrusion of any chemical compounds the rate of nitrogen in it is 1.7%. Whereas the rates of the three nutrients nitrogen, phosphorus and potassium in stimplex fertilizer are 0.6-0.1%. The activity of the organic fertilizer which is prepared easily and the possibility of using it in the agricultural sector has become clear (Fig. 6 and 7).

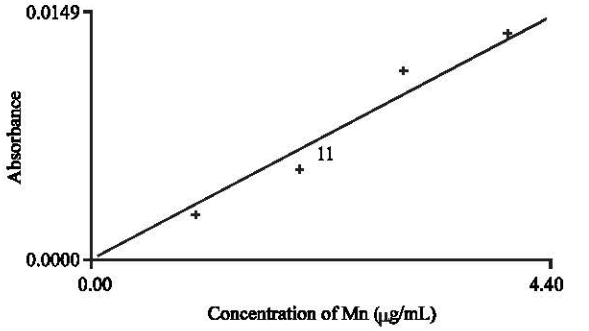

Fig. 6: Concentration of Mn (µg/mL)

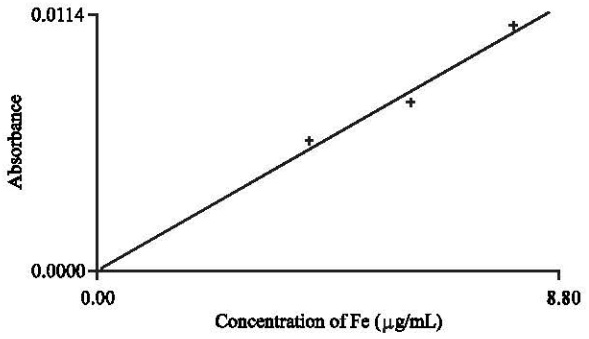

Fig. 7: Concentration of Fe (µg/mL)

CONCLUSION

The high prices of the chemical fertilizers and their negative impact on soil, humans and environment due to the recurrent use have driven farmers and growers to look for good alternative fertilizers. These are the organic fertilizers, especially, the liquid fertilizers which meet the need by organic materials which in turn threatens most of the agricultural lands. Using liquid organic fertilizers is considered one of the fastest ways that brings life to both soil and plants. They research rapidly and promptly on supporting, spreading and growing of plants besides that fact that they are rather less expensive and their little side effects compared with using chemical fertilizers.

RECOMMENDATIONS

On the basis of the results obtained from our study which is characterized by easy preparation, low cost as well as the availability the raw material in our country-Iraq and most Arab countries we recommend the preparation of such fertilizers and using them, so as to increase productivity and maintain the fertility of the soil.

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