



**Studying The Effect Of Time Variation On Some Properties Of Vermiwash
Extracted From Earthworms Incubators**

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Abstract

The aim of this study was to determine the effect of time on the physical and chemical properties of earthworm fluid extracted from earthworm incubators. Earthworms, classified within the phylum Annelida ,class Clitellata, order Oligochaeta, were reared in 30 cm diameter plastic incubators. Twenty worms were placed in each incubator, and grated potato was added daily as their feed. Earthworm fluid was collected from the incubators every two weeks. The results indicated a variation in the nutrient content of the earthworm fluid during the incubation period. It was also shown that the pH value decreased slightly, becoming acidic, decreasing from 6.5 to 5.5. Electrical conductivity levels also fluctuated. The percentage in the worm fluid was 3.16 after two weeks of the experiment, 3.51 in the fourth week, and reached its highest point at 4.27 in the sixth week, before decreasing to 2.67 in the eighth week. The results showed a slight increase in phosphorus concentration, rising from 0.022 to 0.62 during the collection process. The sodium content increased from 1.98 to 2.65. The results also showed a significant increase in nitrogen concentration from 5.8 to 15.8. Similarly, potassium concentration gradually increased in the worm fluid over the weeks of collection, from 1.20 to 5.75. However, the organic matter content in the incubators decreased significantly from 40.01 to 5.41. Furthermore, using grated potatoes as earthworm feed improves the nutritional composition and quality of the worm fluid, making it a valuable source of essential nutrients for plant growth.

Keywords : earthworm, vermiwash, physico-chemical properties.



Introduction

Earthworms are creatures classified within the phylum Annelida. The body of the worm is segmented. The first section is referred to as the prostomium, while the terminal segment is designated as the pygidium, which houses the anus. The clitellum is situated toward the anterior of the worm. (Ghena, 2022)

elongated, slender, tubular, and bilaterally symmetrical (Qassem, 2018).

All body segments, excluding the first and final, possess minute setae that the worm use for excavation and locomotion. (Mohamed, 2023).

The earthworm's body is abundant in proteins, minerals, and enzymes, which are released into the soil upon its death (Qassem, 2018).

Earthworms alter the physical, biological, and chemical properties of the soil. Through actions including as burrowing, casting, feeding, and breeding, they can lower soil salinity and neutralize pH, stimulate soil aeration, and enhance microbial activity and nutrient content (Ahmed et al., 2021).

While cultivating worms in incubators under optimal conditions, the worms' activity and the infiltration of organic materials produce a liquid referred to as vermiwash. (Singh, 2024).

It is an odorless, brown liquid organic fertilizer derived from worm culture. It is seen as a possible reservoir of bacteria and nutrients, growth hormones, enzymes, amino acids, and vitamins, hence serving as superior supplies for crop production in sustainable organic agriculture. (Meena et al., 2021)

In addition to its use as a fertilizer to improve agricultural yield, it can also be utilized for disease suppression and pest management owing to the presence of vital antibacterial and pest-repellent compounds (Thakur and Sood, 2019; Nadana et al., 2020).

resulting in produce that are safe for consumption and commercially lucrative. (Singh et al., 2024)



Material and methods

Earth worms collection

Worm samples were collected from the Army Canal Baghdad Governorate / Al-Rusafa side during September 2025 by spade in depth of 0.5 m . The adult worms are collected using tweezers then quantity of soil from the same collection area is added to them after they are placed in clean glass jar , and then they are transferred to the invertebrate laboratory at Al_Mustansiriya university (Chachain,2006)

Morphological Identification of earthworm

The morphological identification of earthworm species relies on exterior characteristics. For this aim, identifications were verified by Prof. Dr. Nebrass Faleh Chachain from the Biology Department at the College of Science, Mustansiriya University. Keys utilized include those by **Bouché (1972)**, **Perel (1976)**, **Gates (1982)**, **Sims and Gerard (1985)**, **James (2004)**, **Csuzdi and Zicsi (2003)**, and **Blakemore (2009)**.

The worms were rinsed with water to eliminate mud, then anesthetized with 10% diluted ethanol followed by 30% for 10 minutes, and thereafter inspected under a dissecting microscope with a 40X objective lens.

The exterior characteristics for the identification of earthworms comprised the following:

- color of the body
- Arrangement of setae
- Configuration of the prostomium
- Length of the body and number of segments
- Morphology and cross-section of the clitellum.
- Location and structure of tubercula pubertatis (Tp).
- Presence and location of male pores- Glandular hypertrophy (Gt)
- Openings of the spermatheca.

Following microscopic analysis, earthworms were euthanized in 70% ethanol for subsequent fixation and placed in glass tubes containing 4% formaldehyde. (Mohamed,2023).



Photography

An adult earthworm specimen was selected and dried on 11 cm diameter filter paper and the image was taken using a Sony camera

Vermiwash preparation

-Five plastic incubators, 63 cm high and 30 cm in diameter, were prepared.randomly perforated from the base

-A layer of coarse And fine gravel 15 cm high, a layer of sand 15cm high, and a layer of soil 20 cm high mixed with organic matter (peat moss) and potato grates were placed in each incubator

-100 worms were collected and 20 worms were placed in each incubator with one liter of dechlorination water added to each incubator.

- The incubators were monitored daily and the soil was aerated to prevent soil rot. Within 90 days, vermiwash was collected from the incubators every 15 days

- Some parameters of vermiwash were analyzed, such as (pH, EC, N, Na ,P, organic matter, K)at the College Science, University of Baghdad (**Qassem,2018**).

Physical and chemical analysis of vermiwash

- Total nitrogen was determined by **Bremmer and Mulvaney (1982)** procedure.

-Total available phosphorus(TAP) was determined by colorimetric method (**Bansal and Kapoor 2000**).

-Total Potassium, Sodium and Calcium was determined by flame photometer (**Bansal and Kapoor 2000**).

- The pH and electrical conductivity (EC) were determined by the method of **Garg et al, (2006)**

Statistical Analysis:

The Statistical Packages of Social Sciences -SPSS (2019) program was used to detect the effect of difference factors (Incubation periods) in study parameters. Least significant difference-LSD (ANOVA one way and two way)was used to significant compare between means in this study.

Results and discussions

-Morphological identification of earthworm

Aporrectodea Trapezoides

Diagnosis: The coloration is predominantly brown, occasionally greenish, with an unpigmented pale pink anteriorly transitioning to grey posteriorly; some individuals exhibit a dark reddish-brown hue. The body length ranges from 8 to 12 cm, with a segment count of 100 to 137. Weight 0.8-1.3g; prostomium epilobous. Dorsal pore located in the furrow between segments 5/6-9/10, while spermathecal pores are situated in the furrow between segments 9/10/11, between setal lines cd. Male pore located on segment XV (15). The clitellum, in a saddle shape, spans six segments, specifically XXII-XXXII (27-32), with the tubercula pubertatis located on segments XXXI-XXXIII (31-33) as a ribbon-shaped organ. Setae are closely coupled. GT 9, 10, 11. (Mohamed,2023).

Scientific classification

Kingdom: *Animalia*

Phylum: *Annelida*

Class: *Clitellata*

Subclass: *Oligochaeta*

Order: *Crassiclitellata*

Family: *Lumbricidae*

Genus: *Aporrectodea*

Species: *trapezoides*



4cm

Figure (1) : External appearance of Aporrectodea Trapezoides

1-prostomium, 2-Clitellum , 3-pygidium .

-Physical and chemical analysis of vermiwash

The soil temperature in the incubators ranged from 22-25°C during September and October. Due to the ambient heat, the incubators were watered daily with the addition of one liter of , dechloried water. In mid-November and December, the soil temperature reached 18-20°C, reducing the frequency of watering to every three days with the addition of one liter of water. This was due to the lower temperature and the presence of peat moss, which slows down heat loss from the soil. (Ghena,2022) The vermiwash collected from the incubators ranged in color from milky to dark brown, reflecting the increased nitrogen concentration resulting from the metabolic activities of the worms and microorganisms within the incubators.

Table (1): Physico-chemical properties of vermiwash samples collected at different incubation periods

Parameters	Incubation periods				L.S.D.
	10/16	11/10	12/6	1/1	
PH	6.6 ±0.38 a	6.5 ±0.31 a	6.2 ±0.26 a	5.5 ±0.27 b	0.619 *
EC (Ms/ds)	2.67 ±0.09 b	3.16 ±0.16 ab	3.51 ±0.12 ab	4.27±0.22 a	1.308 *
P	0.022 ±0.001 c	0.028 ±0.003 c	0.35 ±0.02 b	0.62 ±0.05 a	0.215 *
Na %	1.22 ±0.07 c	19.8 ±0.29 b	2.65 ±0.09 a	2.78±0.13 a	0.667 *
K %	1.20 ±0.04 c	1.2 ±0.02 c	3.7 ±0.17 b	5.75 ±0.26 a	1.074 *
N %	5.35 ±0.19 c	5.8 ±0.21 bc	7.8±0.34 b	9.8 ±0.62 a	2.175 *
Organic matter	40.01 ±207 a	32.34 ±1.63 b	20.7 ±0.87 c	5.41 ±0.25 d	6.096 *

Means having with the different letters in same row differed significantly.
* (P≤0.05).



The results in **Table- 1-** show that the lowest value for the exponent was in the third period, reaching 5.5, which differed significantly from the other periods. In contrast, the highest value was recorded in the first period, reaching 6.6, representing a decrease of 16.67% compared to the first period's value and showing a significant difference compared to the L.S.D value of 0.619.

Figure (2) demonstrate that the pH value reduced from 6.5 to 5.5. May arise from increased concentrations of CO₂ and organic acids. Produced by the activities of microorganisms and earthworms. The biotic transformation of organic matter into diverse intermediate compounds, together the enhanced acidic mineralization of organic nitrogen to nitrate and nitrite, as well as phosphorus to ortho-phosphates, may be considered supplementary mechanisms leading to the reduction of pH. Records (**Garg, 2004; Gunadi et al., 2002**) yield analogous results. The pH transitioned from alkaline to acidic or neutral. Through the progressive mineralization of organic substances .

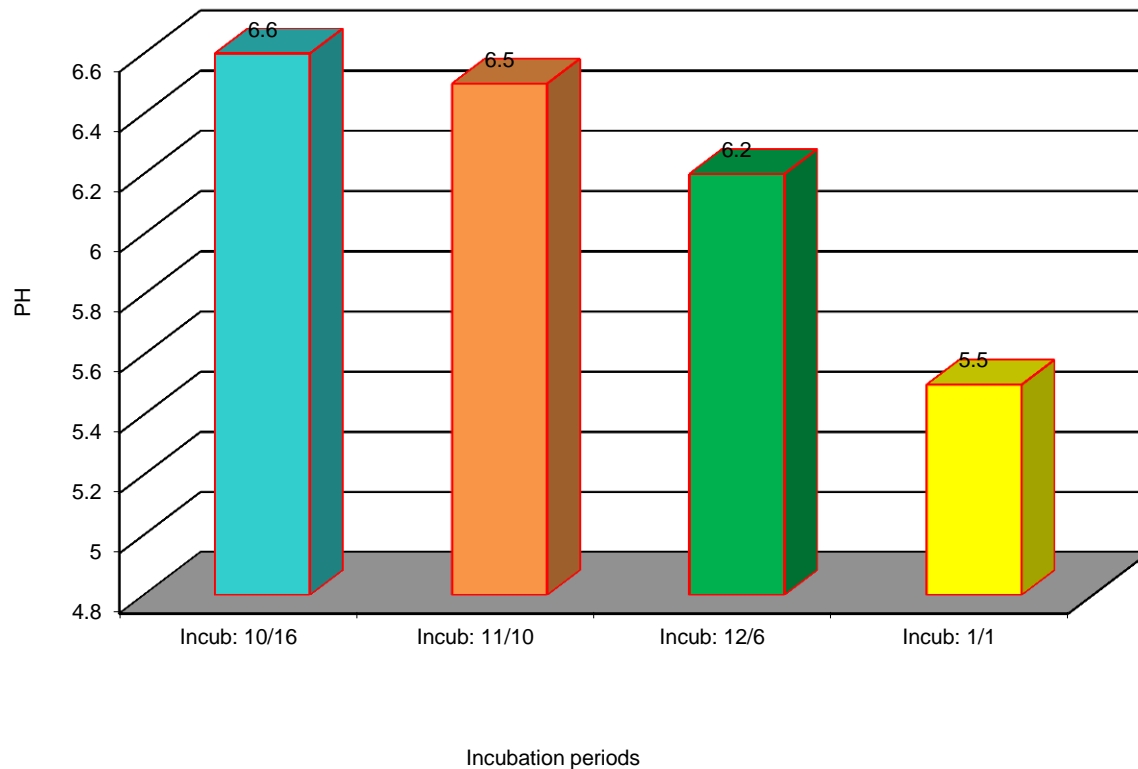


Figure 1: PH of vermiwash samples collected at different incubation periods

Electrical conductivity serves as an indicator of the total ion concentration in the soil solution (**Elbanna et al, 2021**). **Tab-1-** show that the highest value for electrical conductivity was 4.27 in the last period, which differed significantly from the first group, which reached 2.67. The percentage decrease was 37.47 compared to the first group, and significant differences were shown compared to the L.S.D value, which reached 1.308. On January 1st, This rise is ascribed to a reduction in temperature, allowing the incubator to maintain moisture for an extended duration, resulting in less frequent irrigation (every 3 days). Decreased irrigation and drainage, coupled with the buildup of concentrated castings produced by earthworms, led to heightened salinity and salt



concentration.also The increased electrical conductivity is due to the decomposition of organic matter by earthworms and microorganisms, releasing mineral salts such as potassium, phosphorus, and sodium. This is consistent with what (**Makkar et al. 2017**) indicated

The phosphorus ratios in (**Table 1**) indicated no significant differences between the first and second periods, but the third and fourth periods recorded significant differences compared to the lowest period, with the fourth period recording the highest percentage, reaching 0.62% compared to the first group's 0.022%, and the percentage increase was 3% compared to the first group.

The phosphorus concentration in the vermiwash generated in this study increased from 0.022% to 0.62%. As shown in **Figure(3)**The augmentation of phosphatase activity and the mechanical disintegration of substances lead to increased mineralization. Soil microorganisms degrade supplementary potatoes utilized as food for earthworms, transforming phosphorus into water-soluble phosphorus, which influences its content in Vermiwash. Salinity influences phosphorus levels; elevated salinity causes increased salt precipitation, leading to diminished phosphorus concentration. Phosphorus combines with sodium and calcium ions, generating insoluble compounds that diminish its concentration in Vermiwash.This is consistent with what he found (**Krishnamurthy, 1990**).

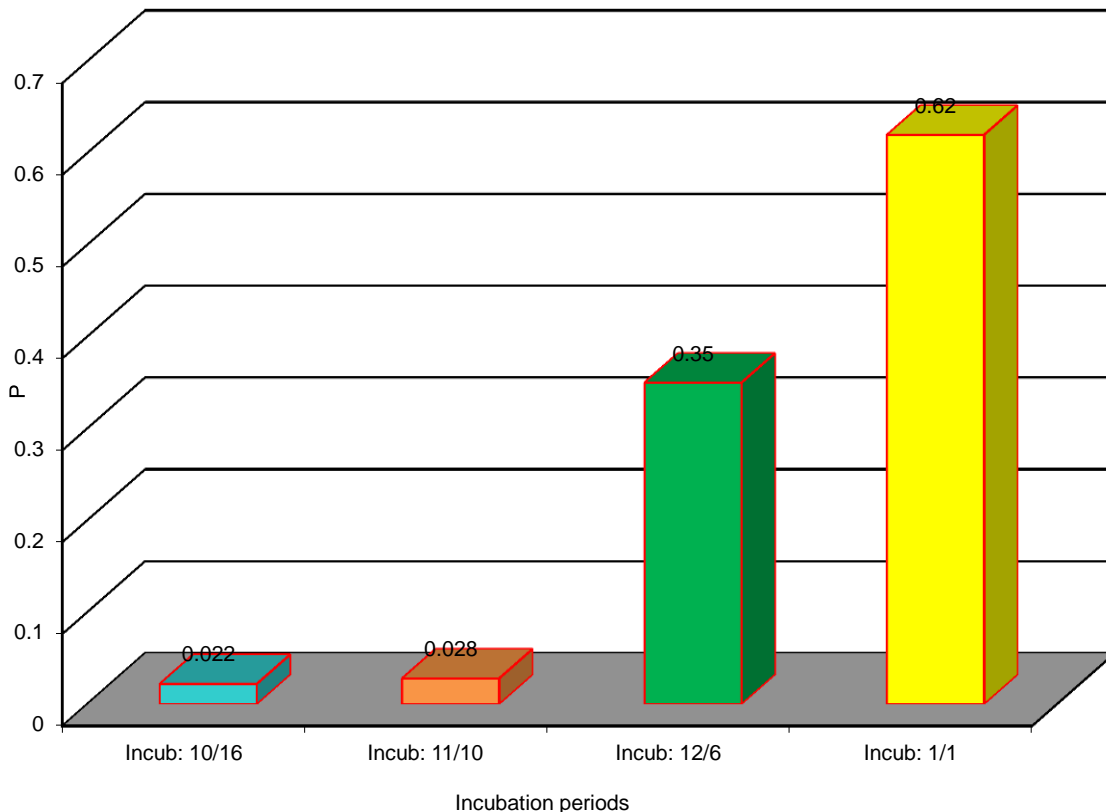


Figure 2: P of vermiwash samples collected at different incubation periods

The results in- **tab 1**- indicate that the highest sodium percentage was 2.78 in the last time period, with no significant differences between it and the third period. However, it differed from the second and first periods, reaching 1.22 in the last period, representing a decrease of 56.11% compared to the control group. Increased sodium concentration resulting from potato decomposition and evaporation of some of the incubator water leads to salt accumulation in the vermiwash This increase corresponds with the findings of both. (**Sugapriya and Mahalingam, 2010**).

The percentage values of potassium in (**Table 1**) showed that there were no significant differences between the first and second periods, while significant differences were found between the third and fourth periods, and between them and the first and second periods. The third period recorded the highest percentage, reaching 5.75, while the lowest percentage recorded by both the first and second periods was 1.20, giving an increase of 379 compared to the control group. Concentrations of potassium increased (1.20-5.75). associated with organic mineralization and heightened activity of earthworms and microorganisms (**Devi and Khwairakpam, 2020; Singh and Kumar, 2017**).

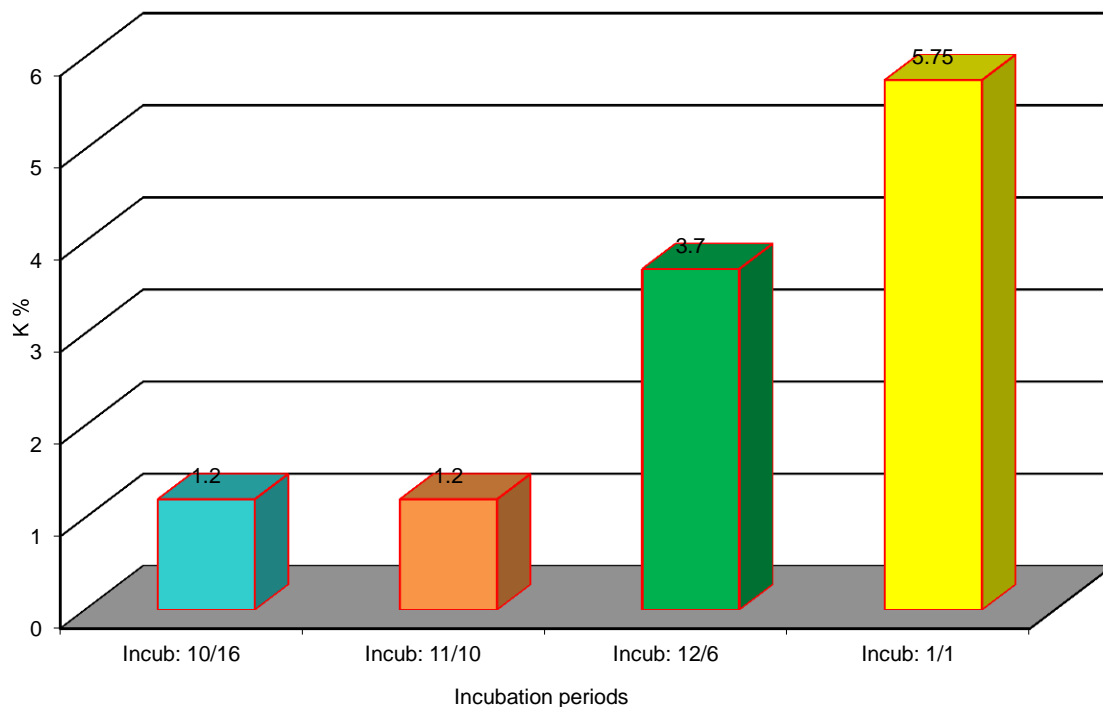


Figure 3: K of vermivash samples collected at different incubation periods



The percentage of nitrogen, as shown in (Table1) reached 9.8% in the third period, which differed significantly from all periods and gave an increase of 84% compared to the control group.

The increased nitrogen concentrations in the final sample were associated with the breakdown of organic materials by annelids and microbes This result is consistent with what was indicated (Madan and Yadav, 2012 ; Hand et al, 1988). as an increase in nitrogen concentration was recorded as a result of the mucous secretions and nitrogenous waste produced by earthworms.and the decomposition of organic matter.

The results indicated that organic matter recorded its highest percentage during the first period, reaching 40.01%. As shown in (Table 1), significant differences were observed between all periods, with the lowest percentage occurring during the last period, reaching 5.4%, compared to the first period, and giving a percentage of 86.47% compared to the first period.

The percentage of organic matter in vermiwash has dropped, ranging from 40.01 to 5.41, due to breakdown by earthworms and soil bacteria. As food availability diminishes, particularly in November and December due to declining temperatures, the worms migrate to the deeper soil layers and limit their food consumption.(Ahmed et al., 2022).

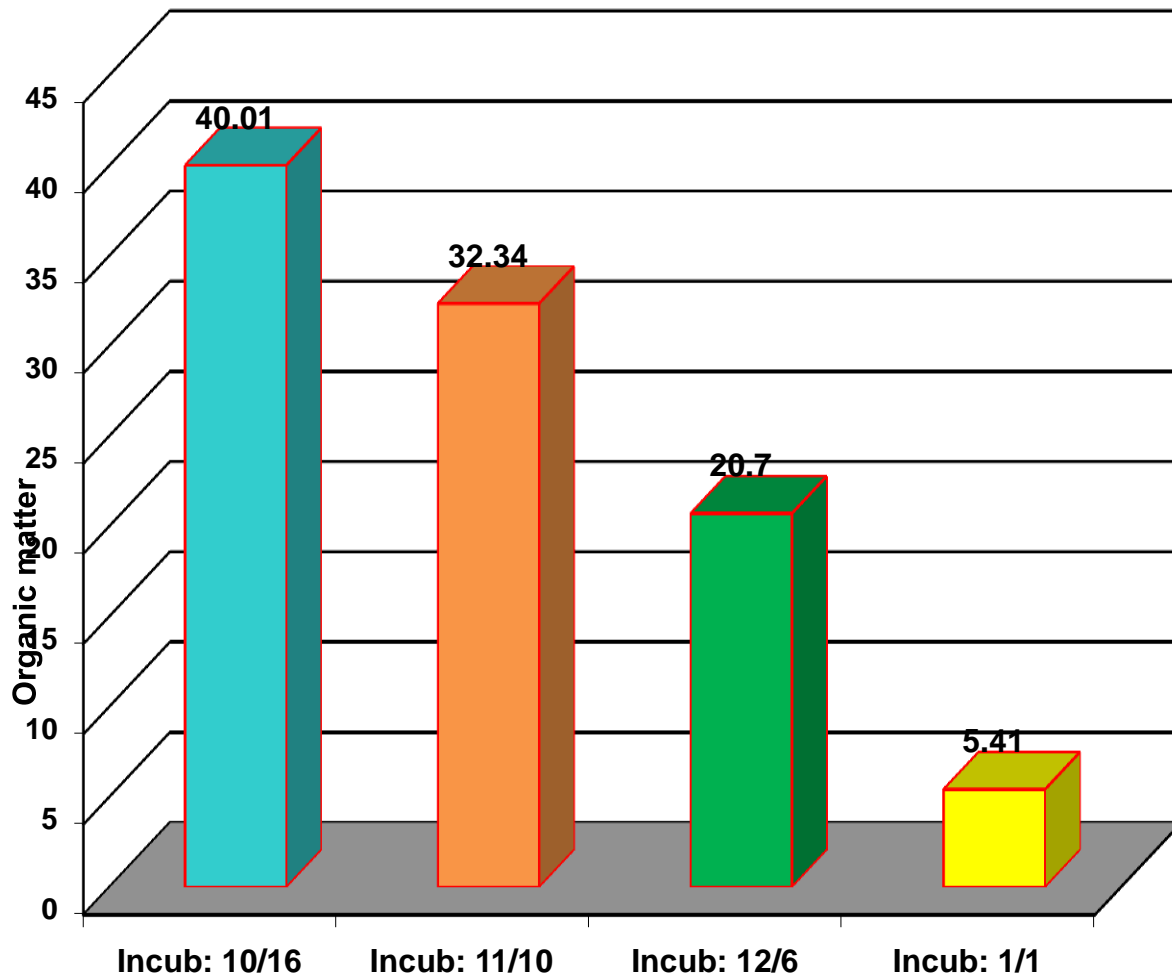


Figure 4: Organic matter of vermiwash samples collected at different incubation periods



Conclusions

- Time affects the physical and chemical properties of vermiwash.
- pH changes over time, trending towards an acidity of 5.5–6.6.
- Electrical conductivity and salt concentrations showed significant changes, with some samples exhibiting increased salinity.
- The concentrations of essential nutrients (nitrogen, phosphorus, potassium, and sodium) vary.
- Using potatoes as earthworm feed during the rearing period improved the quality of the vermiwash.
- Vermiwash is considered a good source of nutrients necessary for plant growth.

Recommendation

Perform additional research to investigate the impact of various organic food kinds on the quality of Vermiwash and assess the resultant Vermiwash's influence on the growth and production of different crops across varying agricultural situations

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دراسة تأثير تغير الزمن على بعض خصائص سائل الديدان المستخلص من حاضنات ديدان الارض

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مستخلص البحث:

الهدف من هذه الدراسة هو تحديد تأثير الزمن على الخصائص الفيزيائية والكيميائية لسائل الديدان المستخلص من حاضنات ديدان الارض . تم تربية ديدان الارض التي تصنف ضمن شعبة الحلقيات ، صنف حاملات السرج ، رتبة قليلة الاهلاب في حاضنات بلاستيكية قطرها 30 سم، حيث وُضِعَ 20 دودة في كل حاضنة، تم اضافة البطاطا المبشورة يوميا كغذاء لها ثم جُمِعَ سائل الديدان كل أسبوعين من الحاضنات .

أشارت النتائج إلى تباين في نسبة العناصر الغذائية في سائل الديدان خلال فترة الحضانة. كذلك اوضحت ان قيمة الأس الهيدروجيني تناقص بشكل طفيف ، ليصبح ضمن النطاق الحمضي حيث تناقصت قيمته من 6.5 الى 5.5 ايضاً تذبذبت مستويات التوصيل الكهربائي كانت نسبتها في السائل الدودي بعد أسبوعين من بدء التجربة 3.16 وكانت في الاسبوع الرابع 3.51 بينما بلغت اعلى نسبة في الاسبوع السادس 4.27 ثم انخفضت في الاسبوع الثامن لتبلغ 2.67 اظهرت النتائج زيادة طفيفة في تركيز الفسفور حيث زادت من 0.022 الى 0.62 خلال عملية الجمع. ازدادت نسبة الصوديوم من 1.98 الى 2.65. اظهرت النتائج زيادة تركيز النتروجين بشكل ملحوظ من 5.8 الى 15.8 كذلك البوتاسيوم زادت نسبة تركيز البوتاسيوم بشكل تدريجي في السائل الدودي خلال اسابيع الجمع من 1.20 الى 5.75 لكن

بالنسبة المادة العضوية في الحاضنات فقد أشارت النتائج إلى انخفاضها بشكل كبير من 40.01 الى 5.41 بالاضافة الى ذلك فإن استخدام البطاطا المبشورة كغذاء لديدان الأرض يحسن التركيب الغذائي ويرفع من جودة السائل الدودي مما يجعله مصدراً فيما العناصر الغذائية الضرورية لنمو النبات .

الكلمات المفتاحية: دودة الأرض، سائل الديدان، الخصائص الفيزيائية والكيميائية.