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Prof. Dr. Harith Salman Hasaani

Editor-in-chief of the Scholar Journal for Sciences & Technology

In the Name of Allah the Merciful

Praise be to Allah, Lord of the Worlds, and prayers and peace be upon the Seal of Messengers Muhammad Bin Abdullah and on his family and companions.

After here we meet with you in the first number of the Scholar Journal for Sciences & Technology, which we hope to be a lamp illuminating, For students of science everywhere, They receive the science and knowledge they need. We are optimistic that we are on track to achieve the objectives of the Nordic Academy And its scientific journal, the dissemination of knowledge and the real information and provide it to anyone looking for it, and since it is difficult for any Journal to draw its features and determine its destination since the first issue, but we are trying to provide the basic indicators of ambition and direction in the way of culture long and difficult by careful to complete the requirements of scientific research sound in the published research and studies.

It is no exaggeration to say that the publication of a new scientific journal insisting and insisting on the availability of safety conditions and accuracy in its production of the first issue is to enter into a risk-free adventure at a time of explosion and decline in many of the concepts, visions and ethical values of scientific research, But the concern and emphasis on scientific values sound and correct despite the difficulty was and will remain the hope and goal of scientists and noble values at all times and places, And so it has been confirmed to achieve the conditions of publication specified in everything that is published, regardless of the reactions to maintain our balance of original researchers and students of science from the correct sources, it is not wise to collect a large number of writers and publishers, But the wisdom to attract diligent and diligent researchers, no matter how few they are, only a few who owe them credit in the antithesis of science and few owe them thanks to the enlightenment of humanity and guidance.

FULL PAPER**Physico-Chemical Properties of Yemeni Crude Oil of Alif –Mareb,
Masilla and Jordan – Shabwa Fields****ABSTRACT:**

Given the immense importance of crude oil to contemporary civilization as a raw material for several chemical and petrochemical businesses as well as a source of energy, in this study we assess the properties of specific Yemeni crude, and fuel oils, in particular, Masila crude oil and Mareb crude oil.

These crudes' and fuel oils' general requirements are established.

And contrasted utilizing the available data in the specialist literature with a few other regional and global kinds, such as Brent and West Texas benchmark crudes. It is discovered that the lightest and sweetest crude oil is Mareb crude oil blend. The aforementioned samples contained eleven metals and heavy metals, of which the most prominent ones were identified by atomic absorption spectroscopy and the ICP technique as (Na, K, Mg) and (V, Co, Ni). Figures depict the sequence in which the metal concentrations in Yemeni crude oils were found:

Due to the high significance of crude oil to modern society as a source of energy and as raw material for a wide chemical and petrochemical industries; in this study, we evaluate the characteristics of certain Yemeni crude, and fuel oils specifically Mareb crude oil blend, Masila crude oil . The general specifications of these crudes and fuel oils are determined and compared with some other regional and international types including Brent and West Texas benchmark crudes using the published data in the specialized literature. It is revealed that Mareb crude oil blend is the lightest and sweetest crude oil followed. the levels of heavy metals present in the crude oil For heavy metals, the range of values were Ag (0.003- 0.0614), Ca (3.24-1876), Cd (<0.001-0.0195), Co (<0.0018-0.1615), Cr (<0.0018-1.776), Fe (1.684 -94.3), K (0.0320-12.59), Na (0.04 -31.94), Ni (0.1894-1.60), Pb (0.0534-1.31), V (0.0667- 0.45) . In many nations, the quantities of metals in the investigated sample were generally lower than those in crude oil and fuel oil. This indicates that Yemeni fuel oil and petroleum are of the highest caliber. In general, the analyzed sample's metal contents were lower than those of crude oil and fuel oil in many different nations. This indicates that Yemeni fuel oil and petroleum are of the highest caliber.

Keywords: Yemeni crude oil, Alif, Masilah, Eyad-Jordan, TBP, Physico-chemical

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1. Introduction

The demand for petroleum, a non-renewable energy source, is high worldwide. petroleum industry depletion; heating systems; transportation industries; and domains Petroleum is an intricate blend of many organic materials.

Hydrocarbons are the main component of petroleum and are typically combined with other minor components including oxygen, nitrogen, and sulfur. Petroleum is typically found in land solids. Hydrocarbons are the main component of petroleum and are typically combined with other minor components including oxygen, nitrogen, and sulfur. Petroleum is typically found in land solids.

Measuring the physical-chemical parameters of crude oil and finished petroleum products is required to identify and predict their behavior under specific conditions [17]. additionally to contrast the measured values with global norms.

Crude oil typically has a varied or nearly identical character depending on its source. Crude oils are mostly aromatic, paraffinic, and naphthenic, however they can be complex. [22]. From C1 to C120, all common alkenes are present in crude oils[12].

A small error in the prediction of any property can make big changes in design and operation specifications of units, which in turn effects on the plant cost, production cost, plant life, desire product specifications, and finally on the profit.

Therefore, a significant amount of the additional cost can be avoided by using an adequate characterization approach to accurately forecast the attributes of petroleum fractions. The data indicates that West Texas Intermediate crude oil (WTI), one of the world's market crudes used as a benchmark for pricing other US crudes, is produced in Texas and southern Oklahoma in the United States.

The hydrocarbon combination is extremely intricate. The different ratios of the components that make up crude oils cause noticeable changes in their properties. For refiners handling crudes from various sources, a straightforward standard may be devised to classify crudes with comparable attributes.

Relative to the hydrocarbon classes that predominate in the mixture, crude oils can be arbitrarily divided into three or four groupings.

The main distinctions between crude oil from various sources can be attributed to the hydrogen and heteroatom concentrations, although the carbon component of crude oil remains largely unchanged.

Certain crude oils are mostly composed of hydrocarbons since they contain only trace amounts of nitrogen, oxygen, and sulfur. However, if the constituents have at least one atom of nitrogen, oxygen, or sulfur in their molecular structures, then a crude oil with 9.5% (w/w) heteroatoms may not actually have any true hydrocarbon ingredients.

Three categories of crudes are described as follows: 1. Paraffinic: Compared to aromatic and naphthenic hydrocarbons, the ratio of paraffinic hydrocarbons is higher. 2. Naphthenic: Compared to paraffinic

crudes, the percentages of naphthenic and aromatic hydrocarbons are comparatively higher. 3. Asphaltic: have a higher asphaltic content, a greater proportion of polynuclear aromatics, and a lower paraffin percentage than paraffinic crudes.

olefins Unsaturated hydrocarbons, such as ethylene and propylene, that have a double carbon bond, with the molecular formula C_nH_{2n} .

paraffins Saturated aliphatic hydrocarbons with the molecular formula C_nH_{2n+2} . Reforming A process for the transformation of naphthenic to products with higher octane number. Reforming Comprises isomerization, cracking, polymerization, and dehydrogenation.

visbreaking A low-temperature cracking process used to reduce the viscosity or pour point of straight-run residues.

2. Site Description

One of Yemen's onshore basins, the Masila Basin is situated in the country's east (Fig. 1). A few significant hydrocarbon oilfields may be found in the Masila Basin, which is one of Yemen's largest hydrocarbon basins (Fig. 1A). However, the Shabwa oilfield's Masila, Mareb Alif-field, and Jordan Eyda are the study's areas of interest (Fig. 1A, 1B, 1C).

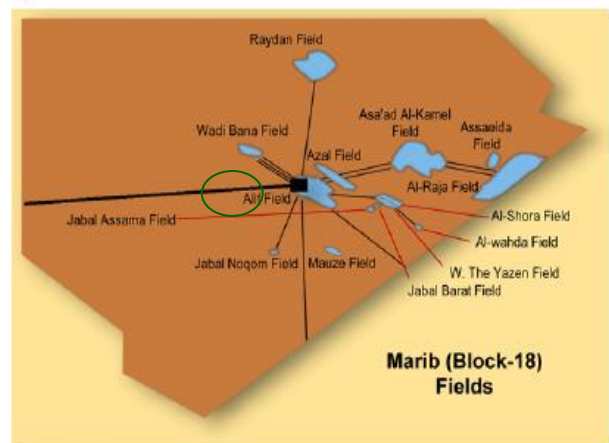
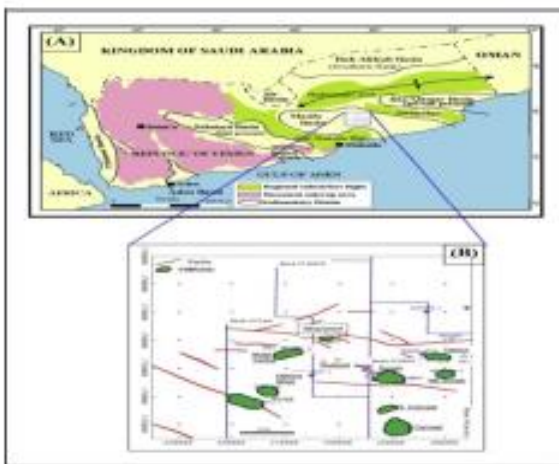


Figure (1A) location map of some Masila. Basin's. **Figure (1B)** Mareb field (block 18)

Blocks including Sharyoof oilfield (Block 53), Hadramout region of the Republic of Yemen [4]

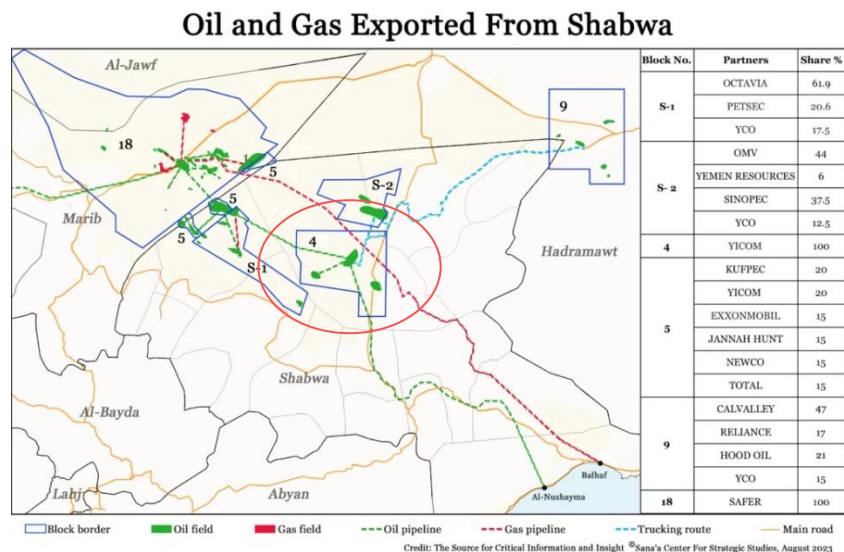


Figure (1C) Block 4 of the Eyad area in Jordan district

Horst, tilted fault blocks that originated in the Late Jurassic–Early Cretaceous and developed in the Oligocene–Middle Miocene period as a result of the Red Sea and the Gulf of Aden opening during the Tertiary rifting tectonic event characterize the main structures in these oilfields [4, 5, 8, 9, 18].

The least productive block in Shabwa, Block 4, is entirely owned and run by YICOM. Block 4 contains three oil fields. It is located in the Jordan district's Eyad sector, north of Ataq, the capital of the governorate.[45] Although it has not been thoroughly investigated, seasoned specialists in the area speculate that it may have sizable unexplored deposits that, if properly utilized, may surpass other blocks in the governorate Figure (1C).

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3. Objectives

examining the characteristics of the crude oils from the Shabwa Jordan-Eyad field, Masila, Mareb-Alif field, and comparison with other crude oils in Yemen and worldwide.

4. Material and Method

From each field, crude oils from Masila, Mareb-Shabwa were gathered and removed. and ready for examination, like the crude oil characterization.

Characterization of crude oils.

1) Density and Specific Gravity: utilizing a hydrometer cylinder, hydrometer, and glass stirring in accordance with the (ASTM D-1298) method.

- 2) According to the (ASTM D-445) technique, kinetic viscosity was measured at 40° C using an electric furnace at 100 ° C and a viscometer measuring (5/4685, 5/61315, 5/4686, 5/4688), Kv-55, and kinetic bath developed by Tanaka Scientific Limited Company.
- 3) Using the Conductivity Method, determine the total salt content of crude oil (IP 265)
- 4) Utilizing a conductivity cell, meter, thermometer, and cylinder.
- 5) We used an auto vapor pressure tester model AVP-30 D, a manometer, and a vapor pressure bomb to determine the vapor pressure of crude oil in accordance with the Reid method (ASTM D-323).
- 6) Using toluene, an Oil Test Centrifuge Model Set A made in Germany, centrifuge tubes, an Interdit Pour TouteMettler PE 600 Transaction, and a heating bath, the Centrifuge Method is used to extract water and sediment from crude oil in accordance with (ASTM D-4007).
- 7) Sulfur in oil as determined by IP 336, with the Horiba Company model SLFA-2800 Sulfur in Oil Analyzer.
- 8) ICP: The Optical Emission Spectroscopy Principle. One technique for optical emission spectrometry is called inductively coupled plasma, or ICP. The component constituents (atoms) of the sample under analysis are energized when external plasma energy is directed towards it. Emission radiation, or spectrum rays, are emitted as the excited atoms settle back to a low energy state. The emission radiation wavelength of the photon is determined by measuring this emission radiation. The location of the photon rays determines the type of element, and the intensity of the rays determines the content of each element. Argon gas is fed into the torch coil first, followed by the feeding of high-frequency electric current into the working coil at the end of the torch tube to produce plasma. Plasma is produced by ionizing argon gas using the electromagnetic field produced by the high-frequency current burner inside the tube.
- 9) **Differential Scanning Calorimetry for Determining Wax Appearance Temperature.**

As a function of temperature, the difference in heat flow between the sample and a reference at the same temperature is measured. DSC is frequently used in wax system investigations to calculate the amount of crystallized wax under quiescent conditions and the temperature at which wax crystallization begins.

- The sample and reference temperatures in this system are managed by the same furnace.
- The system keeps track of the sample and reference temperatures.
- A temperature differential between the sample and the reference arises from variations in the sample's enthalpy or heat capacity.
- Using calibration, the temperature difference is noted and connected to the sample's enthalpy change.
- A little metal pan is filled with a 1–10 mg sample that is sealed.
- Usually, an empty pan and cover serve as the reference.
- A nitrogen gas flow is maintained above the samples in order to establish a dry and repeatable environment.
- A typical heat flow plot showing the temperature at which wax crystallizes. Wax begins to crystallize at the onset temperature (T1) and produces two peaks; the end point occurs at T2. This process occurs when a sample cools. A baseline, often known as a dot line, connects the onset and finish points

Infrared Spectroscopy (IR / FTIR)

FTIR and Infrared Spectroscopy

Chemical substances can be identified and examined using infrared spectroscopy. A sample is exposed to an infrared beam, and the sorts of molecules present in the sample can be determined by measuring the amount of radiation absorbed by the sample at various frequencies.

The most popular kind of infrared spectrometer is the Fourier transform infrared (FTIR) spectrometer. It logs the information gathered and converts it into a spectrum. The spectrum is shown with a graph that indicates the frequency and amount of absorption that took place. The spectrum can be used to identify the sample at the molecular level because various molecules absorb the radiation at different frequencies in known proportions.

(TBP) distillation is a popular batch distillation method that is often utilized primarily for marketing and refining purposes when characterizing crude oils. Plotting the cumulative mass or volume distillation fraction with rising temperature yields the TBP curve. The True Boiling Point (TBP) distillation analysis is used to determine the qualities of natural petroleum and petroleum products. It has been shown to be highly helpful in the design and operation of refinery units as well as the characterization of petroleum.

5. Results

The physicochemical properties of the crude oils are shown in Table (1), which also compares the sulfur content and API gravity of Yemeni crude oil to the API (2005) standard. The physicochemical characteristics obtained for the oil samples ranged in value as follows, according to the results: specific gravity (0.8010-0.916), API gravity (25.72-44.99), and sulfur content (0.1270 –0.859), water content (0.00-4.9), TAN (0.00-0.54); pour point (-33-18), density at 150C (0.8010-0.8598), wax content (30.95-45.25), R.V.P (12.5-45), Asphalten content (0.00-0.8), Kinematic viscosity at 50°C (1.632-106.67), density at 150C (0.8010-0.8598), wax content (30.95-45.25), R.V.P (12.5-45), asphalten content (0.00-0.8), water content (0.00-4.9), TAN (0.00-0.54), pour point (-33-18), and kinematic viscosity at 50oC (1.632-106.67) are among the values to consider.

The amounts of heavy metals found in crude oil are displayed in Table 2. Ag (0.003-0.0614), Ca (3.24-1876), Cd (<0.001-0.0195), Co (<0.0018-0.1615), Cr (<0.0018-1.776), Fe (1.684 -94.3), K (0.0320-12.59), Na (0.04 -31.94), Ni (0.1894-1.60), Pb (0.0534-1.31), and V (0.0667-0.45) were the range of values for heavy metals.

The physico-chemical parameters of Yemeni crude oils are presented in Table 1.

| | | | |
|-----------------|--------|--------|-------|
| Density at150°C | 0.8010 | 0.8296 | 0.899 |
| API | 44.99 | 38.90 | 25.72 |
| S.G | 0.8010 | 0.8304 | 0.916 |
| TAN | 0.02 | 0.00 | 0.54 |
| Pour point | -33 | -24 | -18 |
| Water content | 0.00 | 4.9 | 0.00 |
| Wax content | 39.67 | 45.25 | 30.95 |

| | | | |
|--|--------|--------|--------|
| Sulfur content | 0.1270 | 0.1371 | 0.8598 |
| R.V.P | 45 | 27.7 | 12.5 |
| Asphalten cont. | 0.00 | 0.11 | 0.80 |
| Kinematic viscosity at50 ⁰ C | 1.632 | 2.724 | 106.67 |

Table 2: The concentrations of heavy metals found in the Yemeni crude oils under study

| | Alif field | Almasillah field | Jardan Eyad field |
|----|------------|------------------|-------------------|
| Ag | 0.003 | <0.003 | 0.0614 |
| Ca | 6.900 | 83.41 | 18.6+76 |
| Cd | 0.001 | <0.001 | 0.0195 |
| Co | 0.067 | <0.002 | 0.1615 |
| Cr | 0.008 | 0.0018 | 1.776 |
| Fe | 1.684 | 18.50 | 94.3 |
| K | 0.320 | 12.59 | 4.169 |
| Na | 0.04 | 31.94 | 19.67 |
| Ni | 1.60 | 0.1894 | 0.3915 |
| Pb | 1.31 | 0.0534 | 0.3915 |
| V | 0.45 | 0.0667 | 0.2073 |

Table 3: Temperature of Wax Appearance of Yemeni Crude Oils

| | WAT °C | Wt-mg |
|-----------------------|--------|-------|
| Alif (Mareb) | 12.32 | 6.4 |
| Almasillah | 39.50 | 8.4 |
| Jardan (Eyad field) | -8.90 | 10.8 |

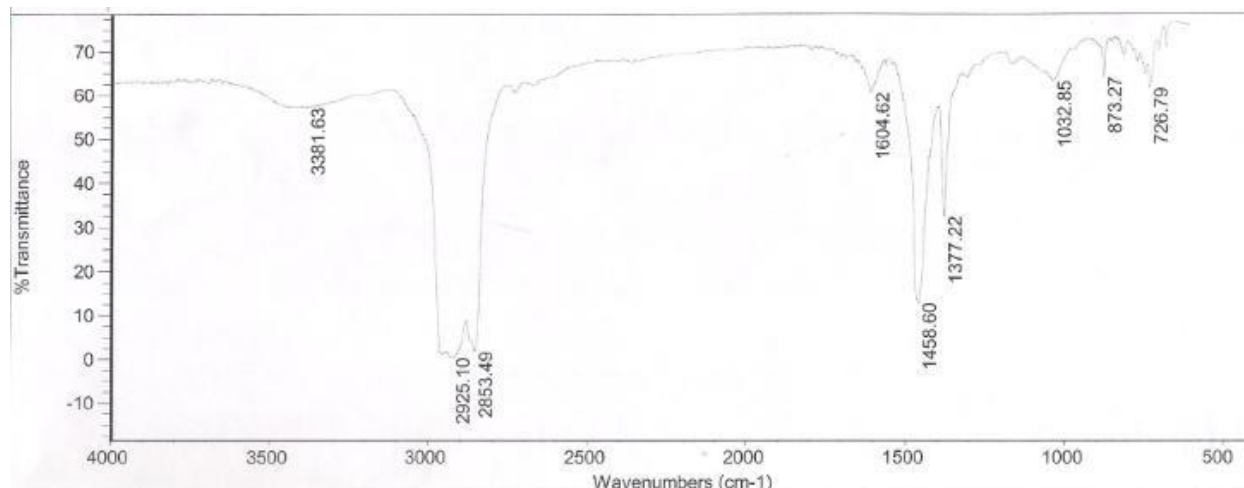


Figure (2): Almasilah crude oil's infrared spectrum

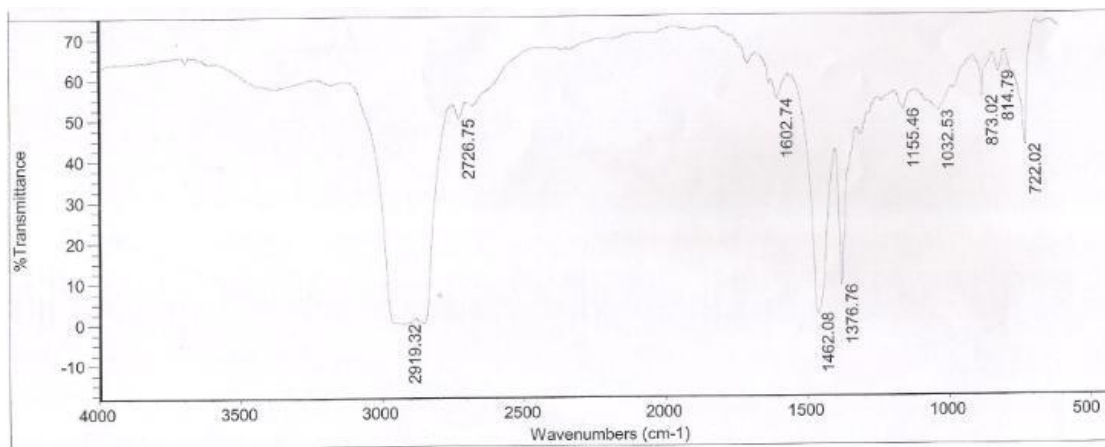


Figure 3 shows the Eyad (Jardan) Shabwa crude oil's infrared spectrum.

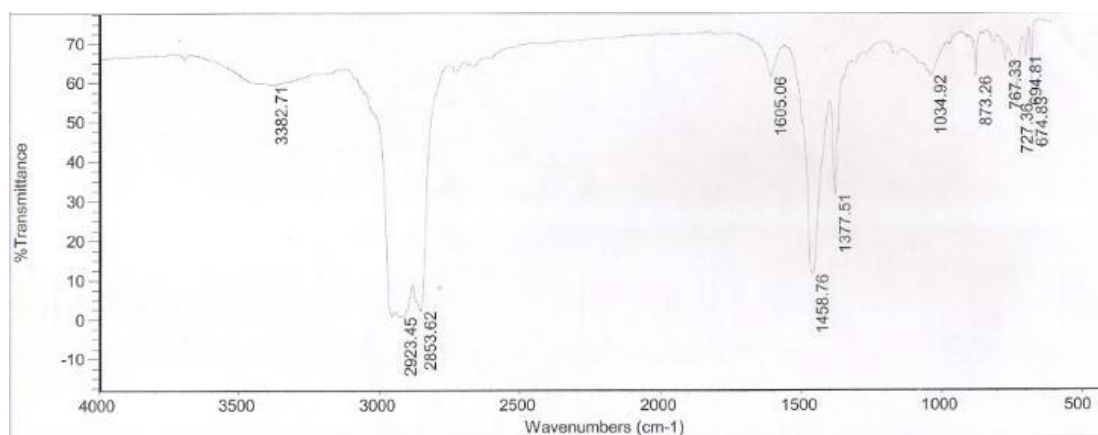


Figure 4: Alif (Mareb) crude oil's infrared spectrum.

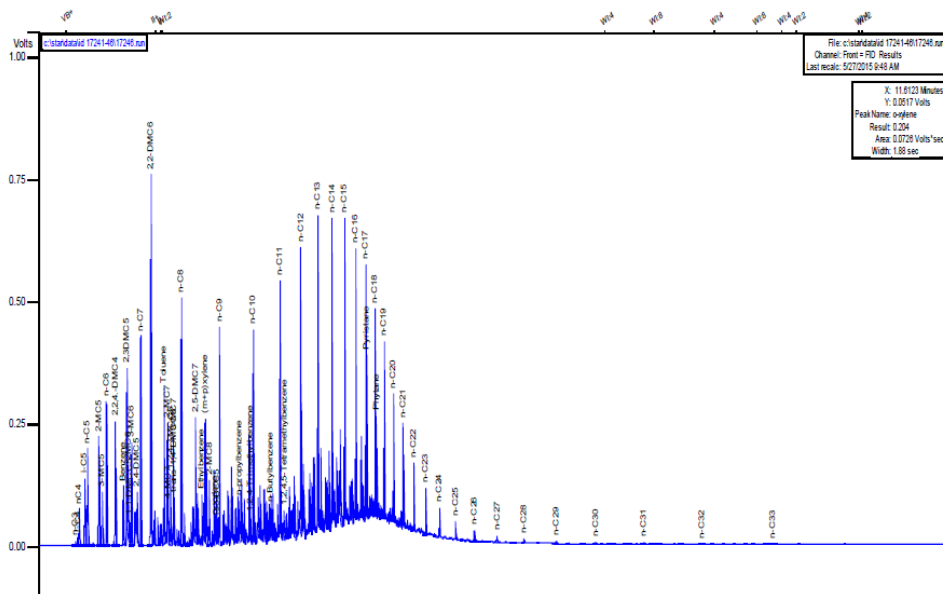


Figure 5: A representative entire oil sample for Eyad (Jordan) Shabwa crude oil utilizing GC-FID fingerprint.

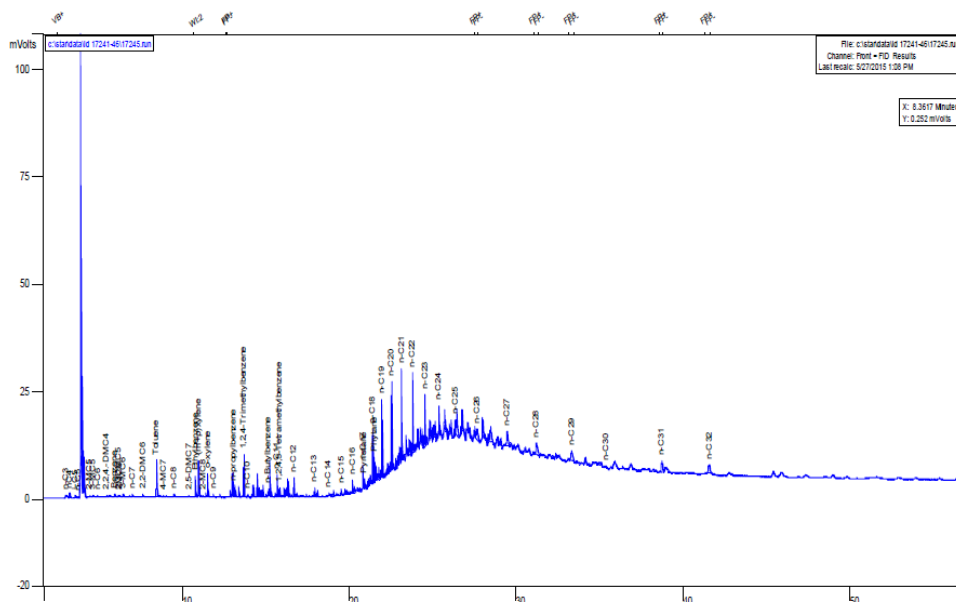


Figure (6): GC-FID fingerprint of a representative whole oil sample from AL-Masilah crude oil sample.

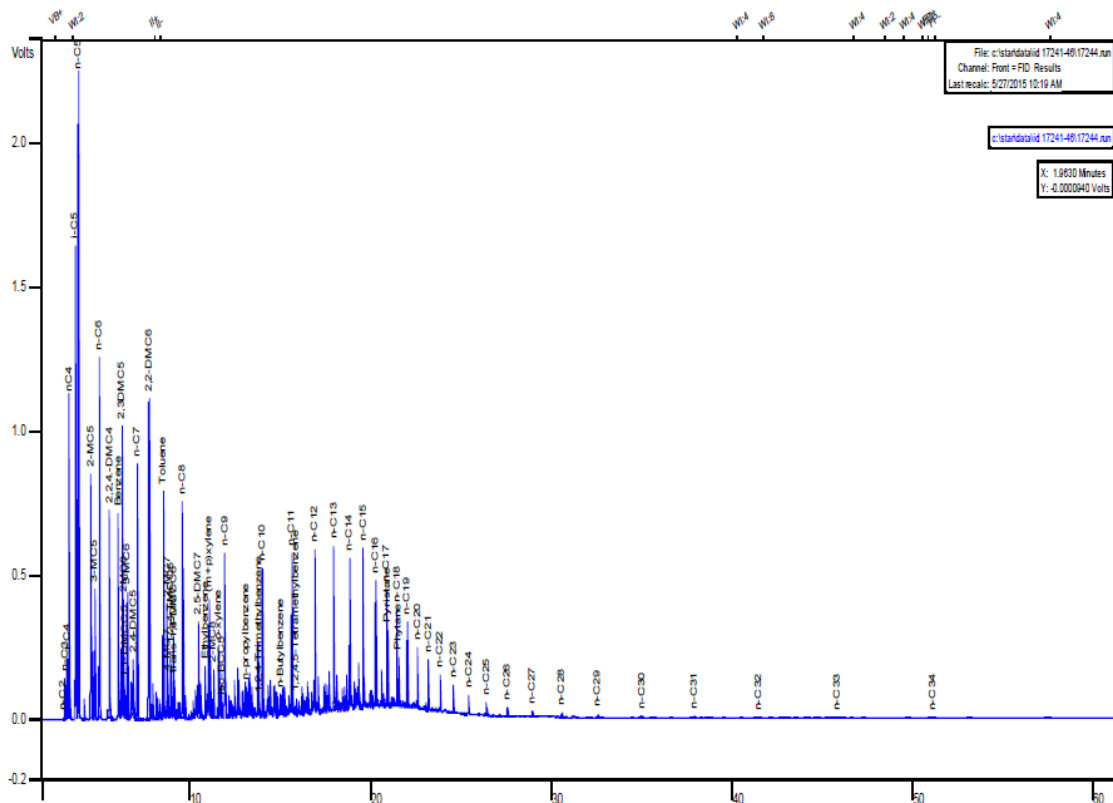


Figure (7): Alif crude oil sample representative whole oil utilizing GC-FID fingerprint.

Table 4: Yemeni crude oil's properties: mean and standard deviation

| Field Parameter | Alif field (Mean ± SD*) | Almasillah field (Mean ± SD*) | JardanEyad field (Mean ± SD*) |
|----------------------------|------------------------------|--------------------------------|-------------------------------|
| Density at150° C | 0.846 ^a ± 0.0925 | 0.830 ^a ± 0.0711 | 0.931 ^a ±0.0278 |
| API | 44.66 ^a ± 0.592 | 38.27 ^b ± 1.020 | 25.48 ^c ± 0.496 |
| S.G | 0.8126 ^a ± 0.0105 | 0.8684 ^{a,b} ± 0.0493 | 0.8938 ^b ± 0.0201 |
| TAN | 0.013 ^a ± 0.0058 | 0.007 ^a ± 0.0058 | 0.537 ^b ± 0.0152 |
| Pour point | -33 ^a ± 1 | -24 ^b ± 1 | -18 ^c ± 1 |
| Water content | 0.030 ^a ± 0.058 | 4.901 ^b ± 0.200 | 0.003 ^a ± 0.006 |
| Wax content | 39.49 ^a ± 0.439 | 44.95 ^b ± 0.327 | 31.22 ^c ± 0.584 |
| Sulfur content | 0.1483 ^a ± 0.0449 | 0.1485 ^a ± 0.0471 | 0.8735 ^b ± 0.0369 |
| R.V.P | 44.67 ^a ± 1.528 | 28.03 ^b ± 0.757 | 12.80 ^c ± 0.265 |
| Asphalten content | 0.003 ^a ± 0.006 | 0.120 ^b ± 0.010 | 0.860 ^c ± 0.053 |
| Kinamatic viscosity at500C | 1.658 ^a ± 0.075 | 2.776 ^a ± 1.002 | 106.737 ^b ± 1.002 |

SD* : Standard deviation (N = 3), at the 0.05 level.

Table 5: Yemeni crude oil's heavy metal mean and standard deviation

| Field Parameter | Alif field (Mean ± SD*) | Almasillah field (Mean ± SD*) | Jardan Eyad field (Mean ± SD*) |
|-----------------|-------------------------------|-------------------------------|--------------------------------|
| Ag | 0.003 ^a ± 0.001 | 0.003 ^a ± 0.001 | 0.061 ^b ± 1E-4 |
| Ca | 6.90 ^a ± 1E-3 | 83.42 ^b ± 0.015 | 18.67 ^c ± 0.025 |
| Cd | 0.0013 ^a ± 5.77E-4 | 0.0013 ^a ± 6.08E-4 | 0.0192 ^b ± 3.79E-4 |
| Co | 0.066 ^a ± 0.0061 | 0.002 ^b ± 0.0011 | 0.162 ^c ± 1.528E-4 |
| Cr | 0.008 ^a ± 0.001 | 0.002 ^a ± 1E-4 | 1.774 ^b ± 0.004 |
| Fe | 1.686 ^a ± 0.0032 | 18.467 ^b ± 0.1528 | 94.200 ^c ± 0.2646 |
| K | 0.32 ^a ± 0.002 | 12.59 ^b ± 0.035 | 4.17 ^c ± 0.003 |
| Na | 0.04 ^a ± 0.01 | 31.94 ^b ± 0.02 | 19.67 ^c ± 0.02 |
| Ni | 1.61 ^a ± 0.01 | 0.19 ^b ± 5.03E-4 | 0.39 ^c ± 0.01 |
| Pb | 1.310 ^a ± 0.020 | 0.057 ^b ± 0.006 | 0.386 ^c ± 0.005 |
| V | 0.453 ^a ± 0.0153 | 0.067 ^b ± 0.0012 | 0.205 ^c ± 0.0055 |

SD* : Standard deviation (N = 3), at the 0.05 level.

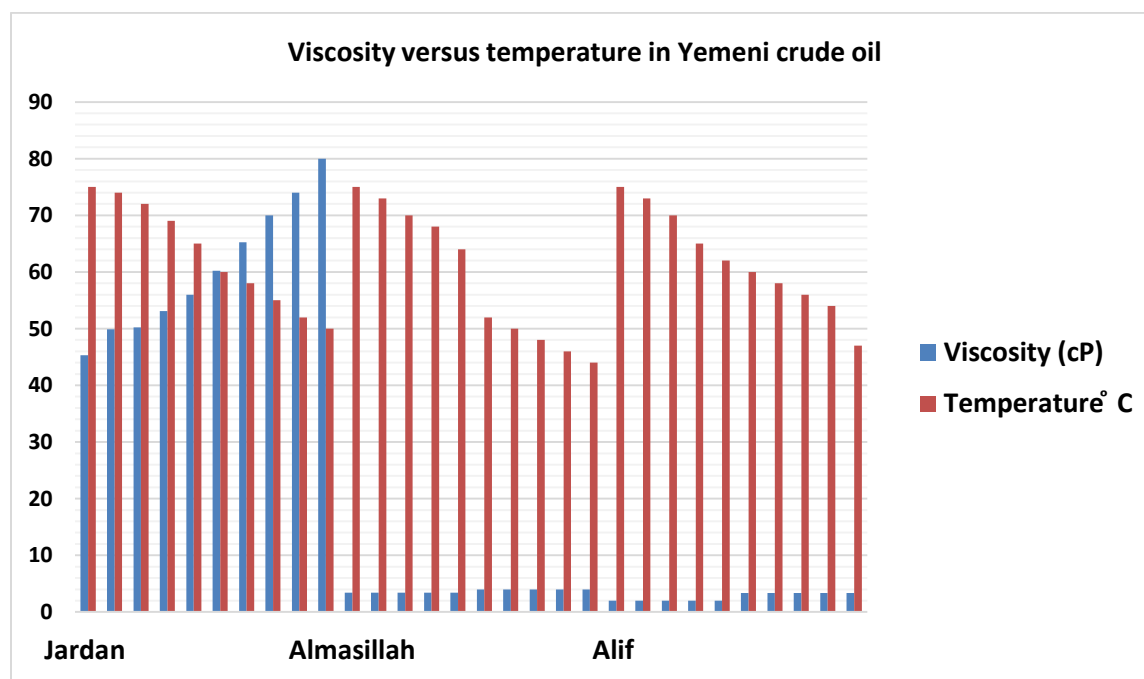


Figure 8: Viscosity of Yemeni crude oil as a function of temperature

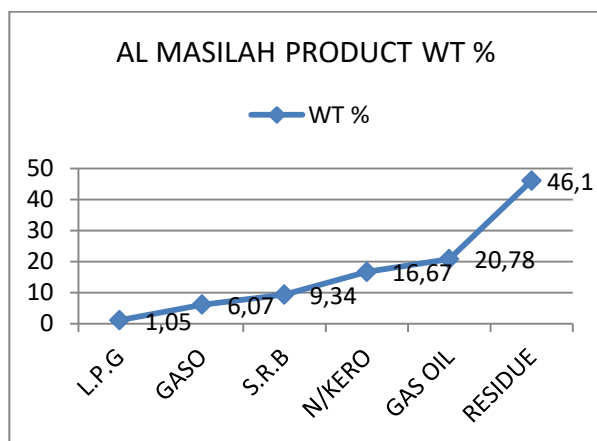
TBP was investigated for the Mareb-Alif and Almasillah fields. During the distillation process, the temperature corresponding to the volumetric percentage distilled was recorded. The results

were recorded in Table (6), and based on it, the correct distillation curve was drawn by representing the temperature versus the volumetric percentages distilled as in the figures (10a,b).

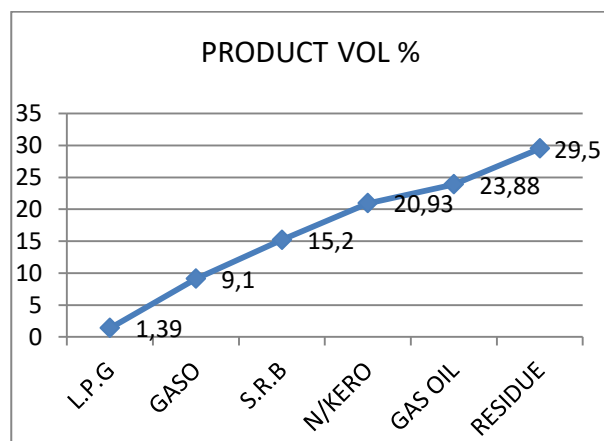
Table (6) Temperature corresponding to the volumetric percentage

| | | | | | | | | | | | |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Vol.% | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| Temp. °C | 29 | 74 | 94 | 109 | 127 | 145 | 171 | 188 | 212 | 238 | 259 |
| Vol.% | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 89 | | | |
| Temp. °C | 289 | 314 | 340 | 367 | 388 | 409 | 434 | 496 | | | |

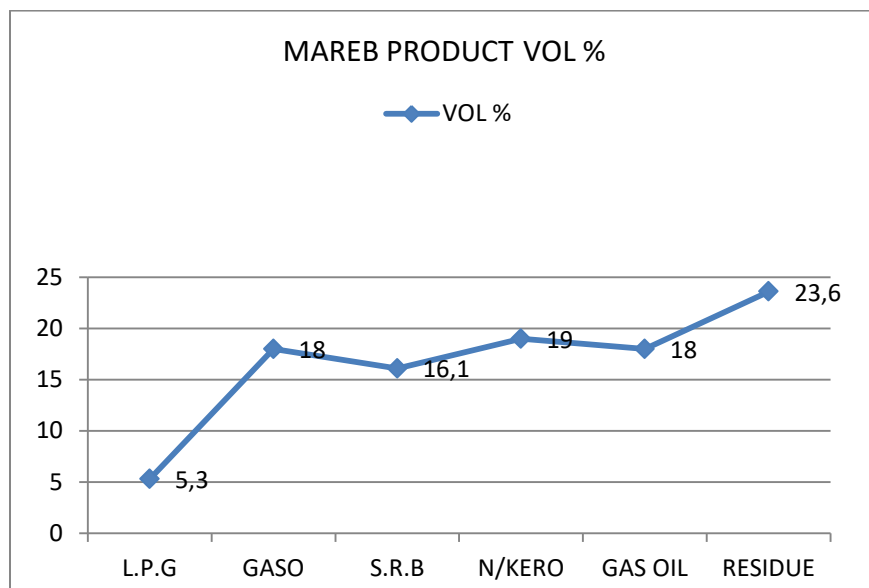
Figures (9) Different fractions of studied Yemeni crude oils



Different fractions distillation of Al-Masillah crude oil (9-a)



Different fractions distillation of Jordan crude oil (9-b)



Different fractions distillation of Mareb Alif crude oil (9-c)

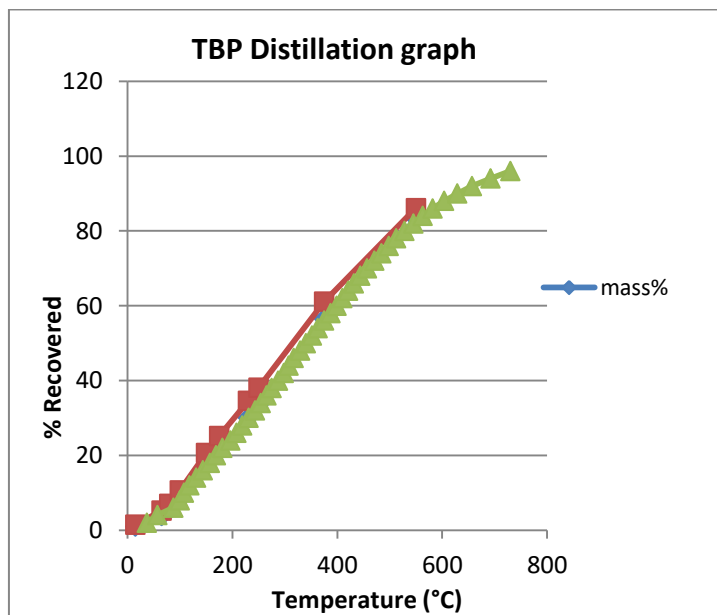


Figure (10-a) TBP for Almasillah crude oil

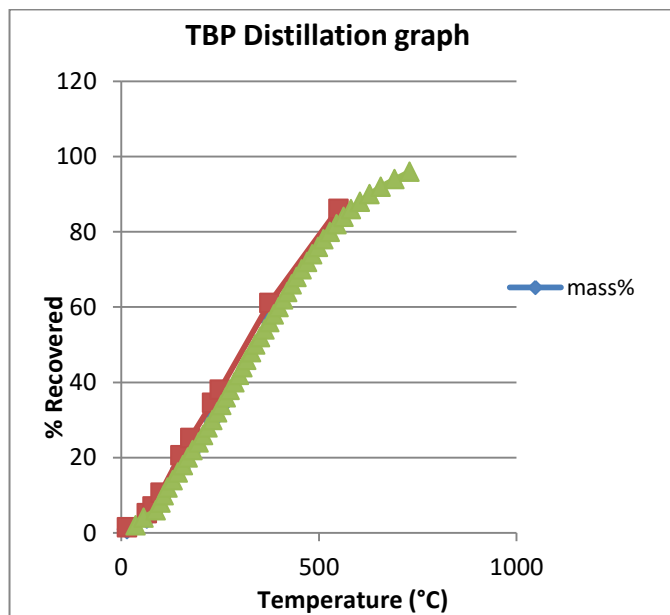


Figure 10-b) TBP for Mareb- Alif crude oil

6. Discussion

Properties and characteristics of Yemeni crude oils.

According to Tables (1), the crude oils are classified as light crude type, with an API weight of around 44.99 (sp.gr. 0.8010) Alif 41.15 (sp.gr. 08188). in comparison to 34,38.90 (sp. gr. 0.8296) AL Masilah and 25,72 (sp. gr. 0,8992) Jordan (Eyad field).

All of the samples' low pour point results are compatible with GC-FID analysis rather than a high wax content. The samples' high wax and low asphaltenes content readings suggest that the crude oils from Yemen are paraffinic in nature. With the exception of Jordan (Eyad field), where the sulfur percentage is (0.8598), most oil samples have low sulfur content (>0.5), indicating sweet type and light oil.

All samples have low TAN values (0.00-0.54), indicating that Yemeni crude oil does not have a tendency to corrode.

With the exception of AL Masilah (4.9) and water content (0.00-0.90), Ca, K, and Na increased in this sample. Since crude oil has a very low kinematic viscosity at 500 °C, the low viscosity obtained for crude oil suggests that it can go through pipes with ease. This has the unintended consequence of making it easy for oil to flow to extremely low temperatures during transit, features that guarantee Yemeni crude oil's purity.

Heavy metals of Yemeni crude oils

Oil samples frequently include heavy metals. Potential origins of trace metals in petroleum include the following: adding biological materials from the source rocks, or clay minerals or interstitial aqueous solution through the aqueous phase during primary and secondary migration;

diagnosing the presence of metal complexes from the original biological materials; and obtaining trace metals from formation waters or reservoir rock minerals.[21].

Table (2) makes clear that the majority of the trace elements found in this investigation were found at usually low levels. This was in line with studies indicating, in comparison to heavy oils, light oil samples typically have lower quantities of trace metals. [17]

The findings of Ni, V, and Fe are predicted as these elements are frequently found in oil samples. Sulfur content, specific gravity, and API gravity are significant factors

It is well known that when the specific gravity of crude oil lowers, the API weight of the oil increases [20]. Additionally, it has been noted that the % sulfur concentration in petroleum blends and API gravity have an inverse connection [6]. The majority of light oil samples are discovered in regions with less sulfur rock concentrations.

Moreover, sulfur raises the specific gravity of oil samples because it is a relatively heavy ingredient. Additionally, this explains why samples of low sulfur oil have low specific gravities and vice versa. Research like [15] and (Joel et al., 2009) have already demonstrated the inverse relationship between API gravity and specific gravity, as well as percentage sulfur concentration. API should ascertain the crude oil's grade or quality in this investigation.

Oil samples are commonly categorized as light oils if their API gravity is greater than 31; medium crude oils are defined as having an API weight between 22 and 31; and heavy crude oils are defined as having an API weight of 20 or less (API, 2011). This API study demonstrates that light oil makes up the majority of the oil extracted from certain Yemeni fields. The medium-sized Jordan (Eyad field) sample is the exception.

Because heavy oil is more expensive to convert into more valuable oil, more difficult to process, and too thick to be easily piped through pipelines without being diluted, light oil samples are highly sought for and have a high market value. petroleum products, including fuel oil, diesel, and gasoline. It is well recognized that the heavier the oil, the more challenging the refining process is, as beneficial products in the oil refining process [2]. A crude oil's sulfur content influences whether it is sweet or sour.

All crude oils used in this study were found to be low sulfur based on their sulfur content based on API standards. Yemeni oil samples can therefore be classified as sweet (0.0846-0.488). Petroleum samples are classified as sweet if their sulfur content is less than 0.5%. Anything over 0.5% is called acidic.

A fluid's internal friction, or its reluctance to flowing, is measured by its viscosity. As a result, it illustrates oil's capacity to move across locations [11]. According to the study's findings, Yemeni crude oils can swiftly drain following spills because of their comparatively low viscosity.

Viscosity is a measure of a fluid's internal friction, or resistance to flowing. It therefore demonstrates the ability of oil to travel across regions [11]. The study's conclusions indicate that Yemeni crude oils' relatively low viscosity allows them to drain quickly after spills.

In the investigation of energy loss during production, oil viscosity plays a crucial role. To maximize transportation, oil viscosity is a necessary understanding for all engineering processes,

including pipeline building. Additionally, reservoir simulations and fluid structure identification depend heavily on viscosity [1].

Because crude oil has a low viscosity, it may flow through pipes more easily during transportation, simplifying the process. But it also implies that, in the case of oil theft leading to contamination, oil samples from some Yemeni fields might readily find their way into the environment. Figure (8) illustrates the observed inverse relationship between viscosity and temperature.

Crude oil's low pour point ratings suggest that it is suitable for use at low temperatures. Acidity and salinity are crucial processing operating indicators.

Elevated levels of these characteristics suggest that crude oil has a strong propensity to corrode [7].

These parameters' values were found in a few Yemeni oil fields. With the exception of AL-masilah oil (4.9), which has a very low potential for corrosion, the table (3.4) demonstrates how very low the water content (0.00-0.90) is. With the exception of Jordan (Eyad field), where TAN is not present in any sample (0.54), Yemeni crude oil's low pour point readings suggest that it can be used at low temperatures and is not prone to corrosion.

Compositional analysis using GC-FID.

The gas chromatograms of three Yemeni oil samples, as shown in figures (5-7), demonstrated a high degree of similarity between the rich hydrocarbons in the Alif and Jordan (Eyad field oil samples) and the lighter hydrocarbons in the Alif oil sample and the poorer hydrocarbons in the Al-Masilah oil sample. It can also be used to determine the source, as the CPI values for petroleum contaminants are typically close to one (Bray, 1961). Source differences can be determined by comparing the relative concentrations of steranes and C27-C29 (Hunt, 1996).

Oils with slightly lower contents of C28 and C29 and relatively higher concentrations of C27 steranes indicate greater input from an organic source in the sea, whereas oils with a predominance of C28, C29, and C30 steranes indicate the origin of oils derived primarily from mixed terrestrial and marine organic sources. The analysis indicates that there may be an increase in the marine organic source due to the slightly lower abundance of C28 and C29 and the significantly larger concentration of C27 steranes.

analysis difference (Co, Cr, Fe, Ni, Pb, V). Table (5) shows that the P-value of t-test (0.006) is less than the significant level (0.05), which means that there is a statistical difference between Yemeni crude oils.

Wax Characteristics.

The generated wax is controlled to be somewhat greasy under working conditions with a solvent composition of 75% MEK, a solvent to oil ratio of 20:1, a mixing temperature of 50°C, and a 20-minute residence time at a filtration temperature of -22°C. to come into contact Moreover, it has been discovered to be soluble in carbon tetrachloride, petroleum, toluene, xylene, kerosene, benzene, ethyl alcohol, and hot acetone.

Figures (5-7) illustrate the GC result. About 37.8405% of light hydrocarbons (n-C10-n-C16) and 6.6057% of C36+ are present. Oil that remains in the wax can produce light paraffins. This study is more in accordance with (Amel A. Nimer et al., 2010). The results revealed that at a maximum temperature of 50 °C, with a residence period of 20 minutes and a solvent to oil ratio of 20:1, 92% of the raw product wax could be extracted using a 75% volume MEK combination at a filtration.

The resultant wax feels a little oily to the touch and dissolves in acetone, petroleum, toluene, xylene, kerosene, benzene, ethyl alcohol, and carbon tetrachloride. According to gas chromatographic research, light products (C10–C16) make up 6% of the wax produced, whereas C45+ makes up 10%. Furthermore, As'ad et al. (2015) found that this study effectively used pure methyl ethyl ketone solvent to demonstrate the impact of parametric adjustments on the wax treatment of Australian heavy crude oil.

It was discovered that the wax yield rose when the cooling temperature dropped, the solvent-to-oil ratio increased, and the mixing temperature increased. Based on the experimental findings, it was determined that a solvent to oil ratio of 15:1, a mixing temperature of 50°C, and a cooling temperature of -20°C produced the best wax yield of 27.9% by weight.

Table(8) Reported value of physical parameters of some crude oil [23].

| Characteristic | Texas Gulf | Nigerian (Bonney) | Canada | Venzuela (Lagemar) | Syrian | Alif Mareb | Al-Masillah | Eyad-Jardan |
|-------------------------|------------|-------------------|--------|--------------------|--------|------------|-------------|-------------|
| API Gravity | 36.5 | 38.1 | 34.9 | 30.7 | 0.9094 | 44.99 | 38.90 | 25.72 |
| Viscosity | 41.0 | 38.4 | 47.8 | 107.0 | 31.6 | 1.632 | 2.724 | 106.67 |
| Sulphur wt% | 0.16 | 0.14. | 0.56 | 1.48 | 4.08 | 0.1270 | 0.1371 | 0.8598 |
| Water & sediments vol % | 0.1 | Trace | Trace | Trace | 4.08 | 0.00 | 4.9 | 0.00 |
| Reid vapor pressure | 32 | 6.9 | 8.4 | 2.5 | 5.8 | 45 | 27.7 | 12.5 |

Table (9) lists the metal and heavy metal contents in Yemeni and some foreign crude oil as reported by [21]

| Crude oil Metal ppm | Alif field | Jardan (Eyad field) | Hijah [] | Sounah [] | Syria | Kuwait | Morocco | West Texas |
|---------------------|------------|-----------------------|-----------|------------|-------|--------|---------|------------|
| Na | 0.04 | 19.67 | 7.23 | 5.20 | 5.67 | - | - | - |
| Mg | - | - | 3.398 | 4.387 | | - | - | - |
| Al | - | - | 0.082 | 0.095 | 0.285 | - | - | - |
| K | 0.320 | 4.169 | 5.55 | 2.83 | 0.51 | - | - | - |
| Ca | 6.900 | 18.76 | 1.72 | | 0.97 | | | |
| V | 0.45 | 0.2073 | 4.127 | 0.398 | 15.04 | 22.5 | 0.6 | 7.9 |
| Cr | 0.008 | 1.776 | 0.24 | 0.26 | 48.43 | - | - | - |
| Mn | - | - | 0.22 | 0.20 | 38.46 | - | - | - |
| Fe | 1.684 | 94.3 | 0.43 | 0.54 | 0.79 | 0.7 | - | 5.1 |
| Co | 0.067 | 0.1615 | 6.82 | 7.79 | 0.36 | - | - | - |
| Ni | 1.60 | 0.3915 | 2.54 | 3.20 | 6.67 | 6.00 | 0.8 | 4.8 |
| Cu | - | - | 0.21 | 0.19 | 26.90 | 0.1 | 0.1 | 0.4 |
| Cd | 0.001 | 0.0195 | 0.717 | 0.69 | 29.49 | - | - | - |
| Zn | - | - | - | - | - | - | - | - |
| Pb | 1.31 | 0.3915 | 0.23 | 0.27 | 1.53 | - | - | - |

Alif – Mareb crude oil had the lowest concentration of magnesium, while Sounah crude oil had the highest concentration. Crude oil from Kuwait has the highest content of (V), whereas Alif field had the lowest. Alif field has the lowest concentration of (Cd) and Syrian crude oil had the highest. While Kuwaiti crude oil had the lowest quantity of iron (Fe) and Jordan crude oil had the greatest concentration.

Table (10) comparison between three studied crude oils

| CRUDE OIL YIELD % vol | | | | | | |
|-------------------------|------|-------|--------|---------|---------|-------|
| | LPG | GASO | SRB. | N/KERO | LGO | AR |
| TBP CUT POINT 0C | 0-20 | 20-95 | 95-149 | 149-250 | 250-369 | 369 |
| Alif- Mareb | 5.3 | 18.0 | 16.1 | 19.0 | 18.4 | 23.6 |
| Jardan-Eyad | 1.39 | 9.10 | 15.20 | 20.93 | 23.88 | 29.50 |
| Almasillah | 1.57 | 7.48 | 10.70 | 17.86 | 20.85 | 41.64 |

Derive the equilibrium evaporation curve from the integer distillation curve:

We assume that the part between the two volume percentage is 20, 75% on the correct distillation curve is straight line, then slope of correct distillation will be :

$$\text{Slop} = \frac{730.4 - 260.6}{75 - 20} = 8.54^{\circ}\text{F} / \%$$

Where :

$$T_{75\%} = 388^{\circ}\text{C} = 730.4^{\circ}\text{F}, T_{20\%} = 127^{\circ}\text{C} = 260.6^{\circ}\text{F}$$

So we will have slop of equilibrium evaporation = 5.73 °F / %

The degree of distillation is halved mathematically :

$$730.4 - 25 \times 8.54 = 517^{\circ}\text{F} = 269^{\circ}\text{C}$$

The half degree over actual distillation slop 498 °F = 259 °C

Hence : degree of distillation 50% volume average :

$$T_{50\%} = \frac{517 + 498}{2} = 508^{\circ}\text{F}$$

We calculate the degree of equilibrium evaporation 50 %

$$\text{TBP } 50\% - \text{EFV}50 = 68^{\circ}\text{F}$$

$$\text{EFV } 50\% = 440^{\circ}\text{F}$$

Then degree of evaporation 0 % over equilibrium evaporation is:

$$\text{EFV } 0\% = \text{EFV } 50\% - 5.73 \times 50 = 154^{\circ}\text{F}$$

In order not to neglect the curvature that actually exists in the correct distillation curve and thus The curvature in the balanced evaporation curve between several points based on the following equation:

The slope of the equilibrium evaporation curve is from 20 to 75%.

_____ =

The slope of the equilibrium distillation curve is from 20 to 75%.

The slope of the equilibrium evaporation curve of studied part

_____ =

Slop of distillation at the same part

Then the slop evaporation at the studied part =

$$\frac{5.73}{\text{_____}} \times \text{slop distillation at the studied part}$$

$$\begin{aligned} &8.54 \\ &\text{Slop equilibrium evaporation between 50 , 60 \%} \\ &\frac{597 - 498}{10} = 9.9^\circ\text{F/\%} \end{aligned}$$

$$\text{Slop} = \frac{597 - 498}{10} = 9.9^\circ\text{F/\%}$$

Slop of equilibrium evaporation between 50 , 60

$$\text{Slop} = \frac{5.73}{3.54} \times 9.9 = 6.64^\circ\text{F/\%}$$

Hence degree of evaporation on equilibrium is

$$\text{EFV } 60 \% = \text{EFV } 50\% + 6.64 \times 10 = 440 + 6.64 \times 10 = 506^\circ\text{F}$$

The temperature corresponding to the volume percentages was calculated and the results were recorded in the table ()

| Two points calculated °C | | Two points calculated °F | | Slope of the equilibrium evaporation curve | Slope of the equilibrium distillation curve | Percentage % |
|--------------------------|-----|--------------------------|-----|--|---|--------------|
| | | | | | | |
| 72 | 116 | 162 | 241 | 7.86 | 11.72 | 0 – 10 |
| 116 | 138 | 241 | 281 | 3.99 | 5.94 | 10 – 20 |
| 138 | 168 | 281 | 334 | 5.31 | 7.92 | 20 – 30 |
| 168 | 195 | 334 | 383 | 4.95 | 7.38 | 30 – 40 |
| 195 | 227 | 383 | 440 | 5.66 | 8.44 | 40 – 50 |
| 227 | 263 | 440 | 506 | 6.64 | 9.90 | 50 – 60 |
| 263 | 299 | 506 | 570 | 6.40 | 9.54 | 60 – 70 |
| 299 | 227 | 570 | 621 | 5.07 | 7.56 | 70 – 80 |
| 327 | 392 | 621 | 738 | 11.67 | 17.4 | 80 – 89 |

7. Conclusion:

Crude oil extraction activity brings serious heavy metal contamination of soil. The heavy metals accumulation in the soil is due to various factors such as: the nature of soils, the relief, and the litology, the hydrology, the climate, the dominant winds, the soil reaction, the cathionic exchange capacity, the use of the land, and not least the source of contamination, which is various depending by oil extraction, The risk associated with the presence of metals in soil depends by their ability to transfer in water or plants

Yemeni crude oils are the best according to their properties, this study allow us to implement the new study for Syrian crude oil and it’s derivatives as heavy Naphtha and Kerosene. In cooperation with Homs Refinery Company.

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FULL PAPER**Breeding and Cultivating some Types of Wild Bees that Pollinate a Wide Range of Plants*****Prepared by***

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Abstract

Our research science is focused on studying the physical and chemical properties of *ozmia cornuta* and *osmia Rufa*) and where these two people were living with a wide, beautiful crop of crop crops in 6 cities from the Crimea in Russia, the nearby black and sea in the mountainous heights. The places are Simferopol (capital of the Red Costuulous Republic of the Crima), the Red Forest, the Nearc.Stapo, the Saina and SiveaTop Farms are located in the farms of the Black Sea, the streets and the beach Al-Washta in the Crusader of the Clari Island. The tension of the severity and all the tools and requirements of the research were prepared by two years of study in the year (11/2021).

Key words: Wild bees, *osmia cornuta* *osmia rufa* , nesting methods.

Introduction:

Wild bees are insects that can have some of their species domesticated. These two types of bees live in the wild and are known for their ability to be tamed. The wild bees *Osmia cornuta* and *Osmia rufa* belong to the family Megachilidae and are considered beneficial insects for agriculture, as they pollinate various plants. Approximately 90% of the world's plants are pollinated by bees. This significant percentage of pollination performed by bees provides a nutritional value estimated at billions of dollars. Pollination by bees increases agricultural yields, ornamental trees, and maintains ecological balance. In the past few decades, the bee population has declined globally due to the reduction of cultivated areas, the expansion of pastures, deforestation, lack of plant pollination, and environmental pollution.

Wild bees are vital to agricultural ecosystems, playing a crucial role in flower pollination, which helps increase crop production and improve quality. It is estimated that there are around 4,000 native bee species in North America alone, and more than 4,500 in the Russian Federation and European Union countries. Research shows that these wild insects provide more than 1.5 billion US dollars annually through crop pollination.

Importance of the Study

Wild bees are incredibly effective pollinators, contributing significantly to the pollination of various crops such as blueberries, apples, cherries, almonds, watermelons, and pumpkins. Studies have shown that wild bees transfer pollen to these crops at a rate 1.5 to 2 times higher than that of honeybees, particularly in the case of sour cherries and apples.

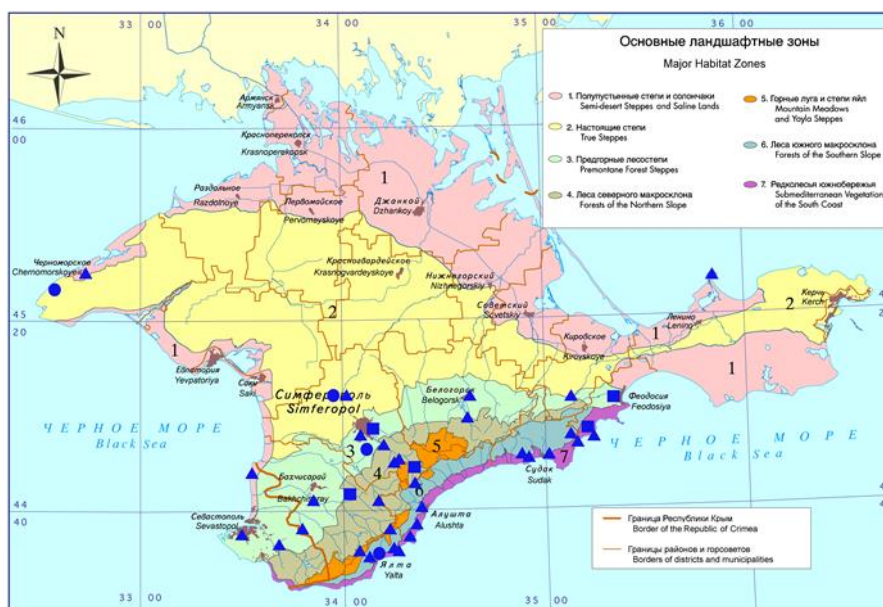
This remarkable creature, bestowed by God with unique attributes and features, possesses qualities not found in many other living organisms. There are approximately 20,000 species of bees living on Earth, divided into seven families, including the Megachilidae family to which these two species belong. This family is notably beneficial to humans, animals, and agriculture.

The massive die-off of both honeybees (*Apis mellifera*) and wild bees due to environmental pollution and the use of pesticides and agricultural chemicals is a critical issue that requires the attention of governments worldwide. Many wild bee species are currently threatened with extinction, and unfortunately, numerous species have already become extinct.

The global losses of wild bee colonies have sparked genuine public concern as the declines in both social and solitary bees continue globally. The deterioration of insect-mediated pollination can critically affect agricultural and natural ecosystems (Fontaine et al.). This raises important questions about colony losses and underscores the necessity of developing effective and practical approaches to assess the risks faced by honeybees. Advances are needed in developing field, semi-field, and laboratory testing methods.¹

(Hendriksma, H. P., Härtel, S., Steffan-Dewenter, (2018). 2 (5), 509-517.)

The figure below shows the locations of the cities of wild bees in the Crimean Peninsula *Osmia cornuta* and *Osmia rufa* (Yalta. Simferopol. Sevastopol. Al-Washta. Bakhshi Saraya)



An image showing the spread of wild bees that pollinate many plants in the Crimean Peninsula (Black Sea). Figure (1) (Ivanov S. P.2019)

Problem Statement

The study of these two species of wild bees, which pollinate a wide range of agricultural crops, has primarily focused on their distribution and presence in the Crimean Peninsula along the shores of the Black Sea. This includes their spread in the interior forests, jungles, hills, and green meadows throughout the entire agricultural area of the peninsula.

In previous studies of these two species, the research was somewhat superficial and lacked detail compared to the current study, which has thoroughly examined the lives of these two species. The current study has not only provided a detailed account of these bees but also innovated modern colonies to domesticate a wide variety of wild pollinating bees, including the family to which these two species belong. Additionally, traps have been developed to capture anything that harms the bees in their living and breeding environments. We have also identified the plants most frequently visited or preferred by these two species.

This highlights the difference between previous studies and the current study. The current research has documented some important details concerning ***Osmia cornuta*** and ***Osmia rufa*** from the **Megachilidae** family.

Study Objectives:

1. To determine the extent of the distribution and presence of the two species, ***Osmia cornuta*** and ***Osmia rufa***, in the Crimean Peninsula.

2. To outline their daily activities during the day.
3. To evaluate the various factors involved in nest building.
4. To develop better living conditions for these two species

Theoretical Framework

The flight times of the two species, *Osmia cornuta* and *Osmia rufa*, were determined at the beginning of spring. We prepared and set up the Ulya Fabra colony and the new colony we developed about four years ago, creating suitable conditions for them. Tubes and all necessary equipment were prepared to determine the flight times from the nests. We identified the emergence times of males and females from the nests during spring, specifically from the end of March (between March 21 and May 15) each year. This period represents the development and life span of these two species, with only minor differences. *Osmia rufa* emerges from its nests about a week before *Osmia cornuta* and both species complete their life cycle before May 15 each year. Notes and corrections were made on some scientific studies and misconceptions related to the development of these species.

The study involved evaluating various factors related to nest building and constant monitoring to determine when females leave their nests in the colony to collect pollen, when they return, and the types of pollen they collect, including which trees they prefer to visit. It also involved understanding the condition of the initial fertilized eggs, which produce females, while unfertilized eggs produce males. The female lays the fertilized egg (female) at the bottom of the tube, before collecting pollen. She then adds a large quantity of pollen next to the first fertilized egg. After that, she adds a small amount of moistened soil as a barrier after the egg and pollen, followed by the second egg, which is also a fertilized female, placed after the barrier. This process continues as the tube is built.

The average winter temperature of the bees was measured, and the time of emergence after incubation at 20°C was recorded, along with the lifespan after emergence in pollinating male bees. *Osmia* was subjected to 25 artificial winter treatments with varying durations (30, 90, 150, 210, and 270 days) and temperatures (0, 4, 7, 10, and 13°C). For all temperatures, survival was highest with 90 days of winter exposure and at 10°C temperatures.

1(Spear, D. M., Silverman, S., Forrest, J. R. K., 2016, 187 (6), 797-803).

Female bees start their activity early in the morning, just before sunrise, at temperatures of +3°C and above. During their daily flight from the colony, they begin collecting pollen from nearby trees and flowers. The proximity of trees and the presence of water provide the females with an opportunity to collect a large amount of pollen. It was found that a short heat wave (1 hour at 45°C) can delay the emergence of adult males but not females. The bee colony was somewhat resilient to a range of high-temperature exposures from which larvae did not survive .

1 (Houston T. F., Ecology and behavior of the bee, 2008, Vol. 15, pp. 591–609).

The females can visit 10-15 flowers during each flight period, with each visit lasting between one and seven minutes. Upon emerging from their nests (tubes), the females are met by males who are ready to mate. Remarkably, males fertilize females from different tubes rather than from the same tube, as the females perceive males from the same tube as their siblings. After mating, the females circle around the colony, and if they circle multiple times, they pick up cues to locate their colony. Once identified, they start collecting pollen from various nearby plants and begin nesting in one of the colony tubes. They deposit the pollen, initiating the life cycle of the next generation of these

Breeding and Cultivating some Types

species. This process begins four days after the first egg is laid at the neck of the tube (female). The egg hatches into a larva, which then remains a pupa for about one to two weeks, feeding on the pollen provided by the original mother. After more than two weeks, from early June each year, the pupa gradually matures into an adult bee and remains in its nest until the beginning of spring. This is how the life cycle of both mentioned species is completed.

1)Gaul A.M. University Vernadsky (Russia. Simferopol) 2019.170.(

Development of Living Conditions for the Reproduction of *Osmia cornuta* and *Osmia rufa* from the Megachilidae Family

To enhance the living conditions and reproductive success of *Osmia cornuta* and *Osmia rufa*, which pollinate various fruit trees, ornamental trees, and different seed-bearing plants, several strategies have been developed. Among these strategies, we designed our own colonies, which have been patented. The construction of these colonies has facilitated the domestication of these species, thereby increasing their numbers.

We also selected the most suitable locations for placing these bee colonies, choosing sites close to agricultural biodiversity and away from noise. It is crucial to have a nearby water source, even if minimal. Continuous monitoring and strategic placement are essential, considering the nesting preferences of these species. One colony is not sufficient; multiple colonies should be placed in various directions, taking into account sunlight, humidity, ventilation, wind, and rain.

Many beekeepers feel closely connected to nature, spending a lot of time outdoors, with a shared interest in purchasing insects and a fair understanding of ecological processes. These skills are often praised in citizen science projects focusing on bees. However, amateur experts sometimes struggle to identify target species, such as European honey bees, whereas beekeepers can easily distinguish between these two species of bees (1).

(Bosch J. –2018. – Vol. 32, N 4. – P. 711–716)



a



How to Build the Nest from the Inside: A Diagram 2

(Ivanov S. P.2019)

In the image above, we can observe how the female bees lay their eggs. The first egg is placed in the inner cavity of the tube (the hollow stem). The female then collects pollen and places it next to the egg. She creates a barrier using wet clay and then deposits the second egg (female) in a row towards the beginning of the tube. Finally, she lays a smaller egg and a small amount of pollen to produce males at the front of the tube.

Traits of Wild Bees:

The body of the female *Osmia cornuta* is covered in dense hair, measuring 32-36 mm in length and 16-20 mm in width. In contrast, the female *Osmia rufa* is 22-26 mm in length and 11-14 mm in width. Both species collect pollen all over their bodies, allowing them to gather a larger quantity of pollen with each visit to flowers compared to honeybees, which collect pollen in pouches on their hind legs. To pollinate 1 hectare of plants, such as fruit trees, 1500-1600 females of *Osmia cornuta* and *Osmia rufa* are required, compared to about 20,000 honeybees.

Fertilized eggs produce females, while unfertilized eggs produce males. A colony consists of both males and females. The proboscis of *Osmia cornuta* is 3-5 mm long, while that of *Osmia rufa* is 2-3 mm long. Bees generally have five eyes—two main eyes for outside work and three smaller eyes in a triangle above the main eyes for working inside the hive in the dark. They also have six legs and four wings. The weight of an *Osmia cornuta* bee can reach up to 180 grams, while the weight of an *Osmia rufa* does not exceed 130 grams. Both species are larger than their males.

Breeding and Cultivating some Types

When preparing tubes of specific lengths (4-25 cm), it should be noted that if the tubes are insufficient, the female may resort to any hole, even as small as 4 cm, to lay her eggs in that small cavity.

Megachile Sculpturalis Smith, 1853, was detected nesting in a trap nest and "bee hotel" in Simferopol. The nests were constructed from resin with the addition of mud and sawdust. The females visited flowers of Eryngium Campestre L., Inula Helenium L., and Carduus Acanthoides L., while pollen samples from one female contained pollen only from Ballota Nigra L. This invasive species in the Crimean Peninsula marks the easternmost point in its European range and possibly the most prominent event in its distribution (1130 km from the nearest previously known point in Hungary). This is the first known invasive bee species in Russia. The giant bee, Russia, distribution, nesting biology, Megachile (Callomegachile) Sculpturalis Smith, 1853 (Hymenoptera: Megachilidae).

Cavity-nesting species in the Megachilidae family are the main part of invasive bees worldwide due to the ease of accidental transport of their nests. Monitoring invasive bee species is crucial to better understand their potential impacts on native bees (Portman et al., 2019). Number of papers on giant bee fauna in Russia (Ivanov S. P., Fateryga A. V. - 2019. - N 395. - P. 7-13).

Our scientific research on two types of solitary wild bees involves a comprehensive study of these species from all scientific aspects. We have highlighted the chemical and physical properties they possess and developed special colonies for solitary bees. Previous studies used very old colonies, whereas our innovation in building more attractive colonies has shown a significant increase in the number of bees. After increasing the number of females in the new colony, we observed a substantial increase in pollen collection from flower plants.



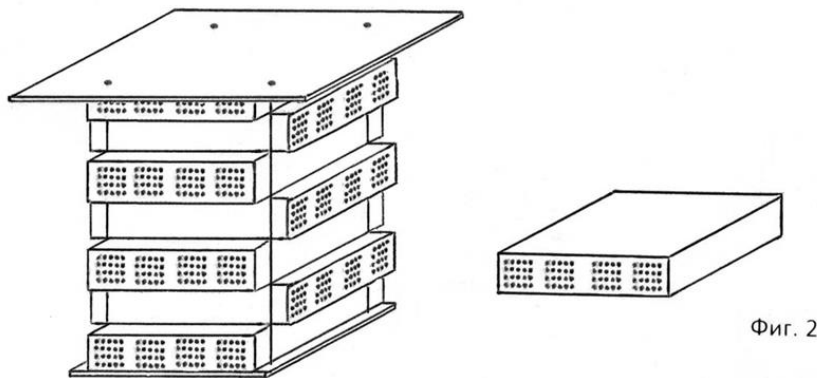
4- Ulya Fabra colony Figure .

(Ja'ul. 2019)

Breeding and Cultivating some Types

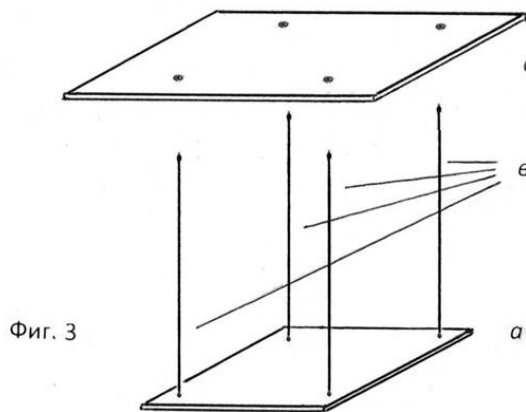
We would like to point out that we have obtained several patents named "Utility Model for Wild Bee Hive" with number 186446 from the Russian Federation. These patents cover the nesting of certain types of wild bees and the preparation of artificial bee colonies. The bees naturally accept these artificial nests, making it possible for them to be housed in these pre-prepared nests made from hollow cane stems. The females lay their eggs in these nests, where their offspring can be raised comfortably. Each colony contains over 1200 hollow tubes, although some smaller colonies may have around 50 nests or tubes.

The wild bees were attracted to the new colony with ease, and the females identified their nests with great precision, preferring it over the Ulya Fabra colony. This well-executed work and planning enabled these two species to multiply successfully in the peninsula.



Фиг. 1

Фиг. 2



Фиг. 3

Patent for a useful model of a beehive, Figure (5)

(Ja'ul. 2019)

To know the number of trees that the female visits, the following equation must be applied:

$$n = \frac{k}{tv} \times kQA \times 2 \text{ Hectare}$$

N = number of females to visit one hectare of plants

K = number of flowers in one hectare

T=continuation of female work during a day

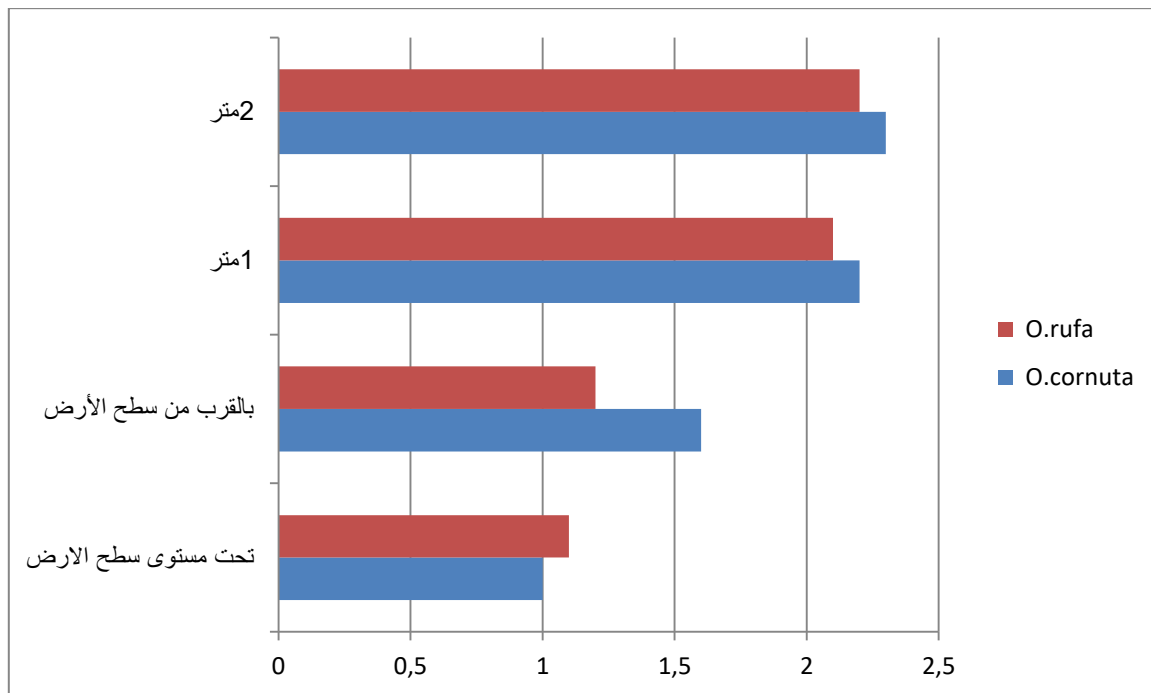
V = the number of flowers that the female visits during an hour of work

KQA=General Activity Coefficient

| Indicator effect mm | | | | the description |
|---------------------|---------------------|--------------|---------------------|---|
| O.rufa | | O.CORNUTA | | |
| X ± Sx | Minimum and maximum | X ± Sx | Minimum and maximum | |
| 295,1 ± 50,9 | 186-391 | 307, ±44,4 | 222-373 | Length of nesting tube |
| 243,6 ± 57,1 | 69-372 | 258,2 ± 50,5 | 160-373 | The length of the first egg without a gap |
| 56,7 ± 39 | 12-153 | 62,8 ± 34,8 | 16-125 | The length of the distance between the first barrier at the node to the other node with the space ((females)) |
| 78,1 ± 66,8 | 83-293 | 131,8 ± 58,2 | 38-293 | The length of the last nest from egg to egg ((males)) |
| 167,4 ± 71,7 | 14-295 | 126,4 ± 63 | 13-298 | The ring of the row of the cell |

Comparison table between *Osmia rufa* and *Osmia cornuta* Figure (6)

(Ja’ul. 2019)



Nesting in tubes and laying eggs, Figure (7).

(Ja’ul. 2019)

Study Procedures and Methods:

Several tools were prepared to assist in the study of wild bees, including hollow reeds, scalpels, saws, various tracking and monitoring devices, wooden boxes, temperature and humidity measuring devices, various scales, mirrors, tweezers, adhesives, cardboard, wooden poles, strings, and surveillance cameras. Despite this, the range of materials used to form trap nests is relatively narrow. The aforementioned studies were conducted using bamboo sticks, pre-drilled wooden blocks, and cardboard tubes .

Nesting Methods:

The nesting tubes were prepared with different lengths, approximately 4-25 cm, to create colonies of about 1200 tubes per colony. In early spring, as the tree flowers bloom, the females begin laying eggs in the tubes. They visit the flowers to pollinate and collect pollen to bring back to the nesting site (pre-prepared colony tubes). The females make several trips between the colony and the plants until the tubes are filled with eggs and pollen, with intervals of pollen between each egg. This process of laying eggs and pollinating flowers continues until the tubes are fully stocked by the female bees of both species.

For **Osmia cornuta**, the operating temperature range is from +4°C up to +48°C.

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For **Osmia rufa**, the operating temperature range is from +7°C up to +45°C. If the temperature drops below 4°C, the females refrain from leaving the tubes due to the cold. Conversely, if the temperature exceeds 48°C, the females are affected by the hot summer weather. Humidity depends on the water vapor in the air; if it exceeds 60%, it negatively impacts bee nesting, and if it falls below 2%, it also has a negative effect. Therefore, the optimal humidity for nesting these two species ranges between 2% and 60% water vapor in the air. Regarding soil moisture, the colonies for these two species should be built at a height of 50 cm or more.



While making artificial nests for wild bees, Figure (8)

(Ja'ul. 2019)

Physical and chemical characteristics of wild bees *Osmia cornuta* and *Osmia rufa*

| Chemical properties | Physical properties | Type |
|---|--|-----------------------------|
| <ul style="list-style-type: none"> • Measuring the total temperature of the female life of about $270 \pm ^\circ C$ • The vacuum pills are collected in its bottom body and the replacement of honey bees that bear the pipes in small bags in their background and can visit more than 15 flowers per month period. • The reward of the female by a group of males immediately after the home and retained by the material in the period of her life as the female eggs in the tuna (cell) and males in the front of the front tube during the vaccination of plants must be examined soil, especially soil from the seaside and make sure the salts like reputations and clerosals (NACL, MGCL, CACL), sulfate and sulfate (SO3, SO4), and acquisitions (HCO3). • Fathar flies at the beginning of the spring when the ice and the first plant flows and ending at the beginning of the ice in the quarantine of the Crimea Island. • In the Symphor Farm Foundation, the White Closta Flip was found by <i>Osmia Cornuta</i> has produced a crop of 7,6 kg / ha. | <ul style="list-style-type: none"> • It is built to yellow and covers its body from under heavy hair from black color. • Fetal fell of 120-180 grams. • The male weight does not exceed 130 grams. • The 5 of them are two of two large eyes to work in the day and 3-triangle shape to work in the dark in the cell. • Horn a large sensor of 8 - 16 mm. • It is length of 32-66 mm and its display from 16-20. | <p><i>Osmia cornuta</i></p> |
| <ul style="list-style-type: none"> • Measuring the total temperature of the female life of about $260 ^\circ C$. • The vacuum pills are collected in its lower body and can visit more than ten flowers per period of airline • The fertility of the 1-3 male is imposed on the excuse from the tube. • Fly flies at the beginning of the spring after Fath Athash <i>Osmia Cornuta</i> a week to two weeks. • When the white clover is vaccinated produced a wrath of 4,6 kg / ha. | <ul style="list-style-type: none"> • The color of the brown to Yellow covers her body light hair. • The female weight of 60-85 gm while male weight does not exceed 75 grams • The 5 eyes have two large two working days in the day and 3 triangle shape to work in the dark. • Length of Khartoum and Qenseur Running 4-8 mm. • It is length of 22-6 mm and 11-14. | <p><i>Osmia rufa</i></p> |

Results:

The study showed that the wild bees **Osmia cornuta** and **Osmia rufa**, which were cultivated in the farms of Simferopol, have demonstrated the following:

1. **Osmia cornuta** outperformed **Osmia rufa** in the number of plants it pollinates, especially fruit crops such as apples, pears, and pomegranates, among many other plants.
2. Farms in Sevastopol, Yalta, and Al-Washta, which are among the six locations where these two species were introduced, did not show noticeable increases in agricultural yields. This is believed to be due to the proximity of these farms to the salty waters of the Black Sea, which contain a high percentage of sulfur oxides like SO, SO₂, SO₃, SO₄, S₂O₂, iron (Fe, FeO₂), and other salts like NaCl and organic compounds that affected the nearby farms, thus hindering the bees' adaptation in those areas.
3. There is a significant level of environmental pollution near the coastal cities due to the presence of many industrial and tourist facilities in the cities along the Black Sea.
4. The farms in Bakhchisaray recorded a very high presence of these two species of wild bees.
5. Regarding the weather conditions that affect these two species, the difference is slight: **Osmia cornuta** flies from its nests approximately 5-10 minutes before **Osmia rufa**.
6. The temperature throughout the life cycle of both species was recorded, averaging around 270°C (the average temperature during the life of each female).
7. In early spring, the first trees begin to bloom, and the females awaken from their dormancy to lay eggs and start visiting the first blossoming trees.

Recommendations:

Our study recommends the cultivation of wild bee species alongside honeybees in our Arab environments, particularly in Yemen. Despite the crucial role that wild bees play, they face numerous challenges such as climate change, habitat loss, and pesticides. The disappearance of half the local species in the American Midwest over the past century highlights the urgent need to protect these species and enhance their role in pollination.

Previous studies have summarized that it is possible to domesticate and establish these species in hollow wooden hives. However, earlier research did not fully explore the methods for domesticating them in modern colonies, including how to create and treat tubes to attract bees comfortably, the types of pollen they prefer, and the optimal placement and orientation of hives.

Our study builds upon where previous research left off, introducing modern models of attractive colonies. We have developed traps to catch parasites affecting bee colonies and measured the pollen brought to the hive, identifying the types of trees and flowers frequented by the bees. These findings and innovations have led to multiple patents (for colony construction, parasite traps, and preferred trees for these bee species).

Conclusion:

Studies show that wild bees can significantly contribute to the food economy, with their role in pollinating crops being comparable to or even greater than that of honeybees. Therefore, it is crucial to acknowledge the importance of wild bees and take necessary actions to protect and support them.

Breeding and Cultivating some Types

Obtaining crucial results for our scientific research, based on the volume of previous information, studies, and predictions regarding the development and presence of these two species in the peninsula, has enabled us to develop appropriate plans and programs to better understand their lives and correct some misconceptions about their development. With the help of our supervisors, we have conducted meticulous work in this field, resulting in accurate knowledge of how these two species respond to natural and artificial conditions.

Our scientific research, following our planned methodologies, is worthy of attention for the successful reproduction of these species, thereby aiding in tree pollination to increase fruit yield, agricultural development, and environmental balance, especially in our working area in the Crimean Peninsula. Our work in this field continues, thanks to the blessings and guidance of God. We have also managed to transfer some species of pollinating bees to Yemen, where they have adapted well to the natural conditions of climate, temperature, plant diversity, and soil. However, we faced some challenges with transportation, monitoring, and preparing the tubes due to the current conditions in the country. Some species of wild pollinating bees have been planted in various areas of Yemen, such as Tehama, Al-Mahwit, Sana'a, Dhamar, and southern regions like Sabir in Lahij and Shabwa.

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FULL PAPER**Assessment of Tumor Necrosis Factor Alpha (TNF- α) and the Effects of Irisin Hormone on it in Diabetic Foot Ulcer Patients in Thi-Qar Province.****Abstract**

Diabetic foot ulcers (DFUs) are a vital complications of diabetes that outcomes in great morbidity and mortality. Mortality costs connected by the progress of a DFU are expected to 5% with in the first 12 months, and 5-year morality prices have been expected as. DFU are a famous issue of account for important morbidity and DM, healthcare expenses, and mortality. The have a look at aimed to have a look at a probable affiliation of TNF- α serum stage in DFU initiation the use of enzyme related immunosorbent assay (ELISA) and the consequences of irisin hormone at the TNF- α in DFU and T2DM sufferers. In this have a look at, forty sufferers with DFU and kind 2 DM, so an age variety among 30 and 50 years have been included; further to 40 healthy volunteers whose intercourse and age were matched with the DFU patient's organisation to act as a manipulate, serum samples were accumulated to evaluation degrees of TNF- α with the useful resource of the usage of Enzyme-Linked Immunosorbent Assay (ELISA). The TNF- α discovered a DFU statistically appreciably better serum stage with inside the newly recognized DFU sufferers in comparison with the wholesome manipulate organization. The better stage of TNF- α in DFU sufferers in comparison to the manipulate organization can also additionally have a position with inside the improvement and pathogenesis of DFU. The present day have a look at confirmed an affiliation among the serum TNF- α stage and DFU and this studied marker may assist with inside the prediction of T2DM. We concluded that the position of TNF- α in those illnesses has now no longer been absolutely understood; however, it's far usually acknowledged to make contributions to the development of ailment while excessively produced via way of means of activating and amassing fibroblasts, fibrosis., stricture formation, and inflicting erosion of joint

Keywords: DFUs, TNF α ., Irisin, Diabetes, T2DM.

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Introduction

Diabetes mellitus is a heterogeneous metabolic sickness characterized via way of means of the presence of hyperglycemia as a result of either defective insulin action or impaired insulin secretion. Diabetes is associated with chronic hyperglycemia, with particularly particular long-time period complications of the microvascular system that affect the nerves, kidneys, and eyes, further to an extended threat for cardiovascular sickness (CVD). The diagnostic requirements for diabetes are based totally on glycemic thresholds, which can be associated with microvascular sickness, mainly retinopathy (Roomi *et al.*, 2019; Zubin Punthakee *et al.*, 2018).

A deadly consequence of diabetes that can lead to infection, amputation, and even death, diabetic foot ulceration is striking an increasing number of people with diabetes mellitus. Foot ulcers have a complicated etiology, with several variables being important at different stages. Because there is a high likelihood of recurrence and amputation even after healing, foot ulcers are refractory, necessitating careful consideration of nursing and management strategies. It has been underlined how crucial it is to put policies in place for DFU control and prevention (Xuan Wang *et al.*, 2022). So, (DFUs), which are caused by the triopathy that links peripheral neuropathy, ischemia, and arteriopathy. The population under study, along with additional elements including comorbidities, diabetes control, and healthcare access, all affect the morbidity and mortality of DFUs (Zhihong, and Jean-Philippe, 2023)

Diabetes may be categorized into essential sorts kind 1 diabetes (because of the destruction of B cells, typically main to absolute insulin deficiency). Type 2 diabetes (resulting from a modern lack of insulin secretion withinside the context of insulin resistance). Gestational diabetes (GDM) is diabetes identified with inside the 2nd or 1/3 trimester of being pregnant that isn't overt (Roomi *et al.*, 2019).

In January 2012, Bostrom and Making diagnosed a brand new muscular tissues veil peptide known as irisin to emphasis its function as a means of communication between different parts of the body and skeletal muscle. Irisin is a cleaved and secreted fragment of the fibronectin kind III domain-containing protein 5FNDC5 (additionally called FRCP2 and PeP), a member of the gene own circle of relatives that carries fibronectin kind III replication. People are very interested by this protein due to the fact it can be used to deal with diabetes and perhaps even obesity. Irisin is a myokine launched after workout and has the cappotential to stimulate tanning of white adipose tissue (WAT), that is consequently related to expanded power expenditure (Bostrom *et al.*, 2012). Irisin become found as a myokine shaped with the aid of using photolytic cleavage of the membrane protein “fibronectin kind III domain-containing protein 5 (FNDC5)” (Bostrom *et al.*, 2012).

On the other hand, By enhancing the sensitization of the insulin receptor in the heart and skeletal muscle, improving hepatic glucose and lipid metabolism, boosting pancreatic β cell activities, and converting white adipose tissue to brown adipose tissue, isisin has been reported to ameliorate type 2 diabetes and insulin resistance (Mamo Gizaw *et al.*, 2020). So irisin's anti-

inflammatory actions are mediated by a number of mechanisms, such as suppression of pro-inflammatory cytokine production while elevation of anti-inflammatory cytokine production, inhibition of pathways leading to increased vascular permeability, induction of polarization in M2-type macrophages, and inhibition of macrophage proliferation. The majority of research reported lower levels of irisin in people with type II diabetes mellitus (T2DM) and mets, despite some contradicting findings. When cells exposed to inflammatory stimuli are treated with irisin, the inflammatory response is reduced and cellular viability is increased. A wide range of techniques, including pharmacological, behavioral, and nutritional ones, have been researched to raise plasma irisin levels. Through the process known as "adipocyte browning," irisin is proposed to mediate some of the beneficial benefits of exercise by increasing white adipocytes' post-exercise energy expenditure and triggering separation protein 1. Brown fat has been linked to thinness in humans and has been demonstrated to have anti-obesity and antidiabetic benefits in mouse models (Qian *et al.*, 2013; Cypess *et al.*, 2009; van Marken Lichtenbelt *et al.*, 2009).

Irisin is a potential regulator of glucose metabolism and is involved in energy balance, according to Polyzos *et al.*'s 2018 research. Irisin affects muscle, liver, and adipose tissue, which results in normoglycemia (Polyzos *et al.*, 2018)

TNF- (tumor necrosis factor- α) is a important agent that causes inflammation. It is produced primarily from adipocytes and/or peripheral tissues and causes specific tissues to become infected by triggering numerous intermediate transcriptional pathways and producing reactive oxygen species. TNF- degrees when upward thrust, It causes insulin resistance in all adipocytes and peripheral tissues. with the aid of using interfering with insulin signaling through serine phosphorylation, ensuing withinside the upward thrust of T2DM. A cytokine secreted with the aid of using continual inflammatory cells. The immune device produces it. Type 2 diabetes is concept to be related to moderate continual irritation of the pancreas (Alzamil H. *et al.* 2020).

TNF- binds to two wonderful receptors, triggering signaling pathways that bring about a whole lot of mobile responses along with mobile survival, differentiation, and proliferation. TNF-signaling activation this is irrelevant or immoderate is related to continual infection and can in the end cause the improvement of pathological headaches along with autoimmune disease (Jang *et al.*, 2021). The motive of this have a look at became to research the viable dating of TNF-serum level with DFU initiation, the usage of enzyme-associated immunosorbent assay (ELISA), and the results of irisin hormone on TNF- in DFU and T2DM patients.

Patients and methods

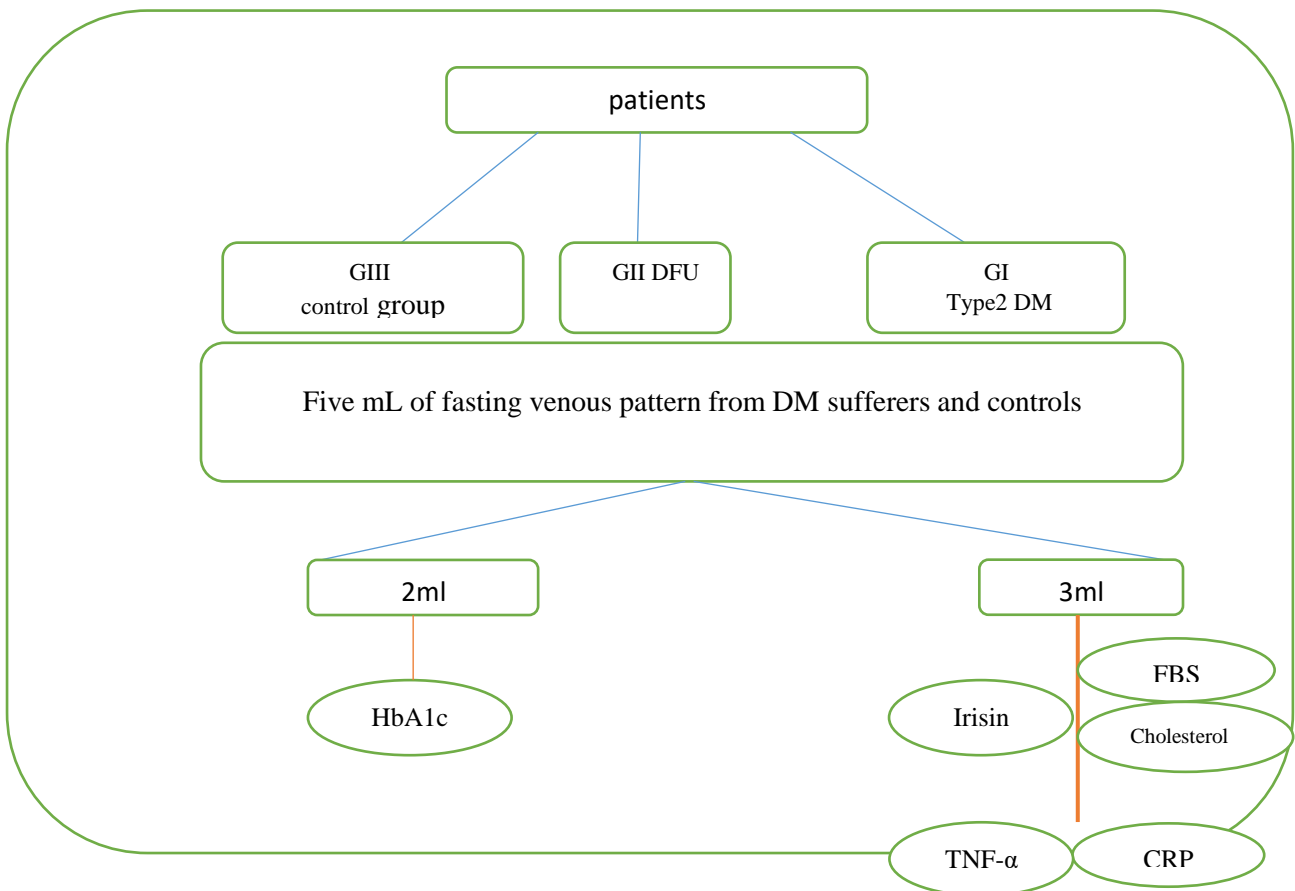
This case control examine became performed on 120 Iraqi adults, divided into three groups. Group I consists of 40 sufferers newly identified with kind 2 diabetes. Group II: As a case group, 40 sufferers recognized with DFU had been included. Group III consists of 40 wholesome topics as a manage group. So five mL of fasting venous pattern from DM sufferers and controls had been divided into parts: the primary concerned placing 2 mL in an anticoagulation (EDTA tube) tube, which became used to investigate the HbA1c, and the second one concerned

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permitting three mL to clot to get serum through placing it in empty disposable tubes and centrifuging it at 3000 rpm for 10 minutes. In this examine, the serum became remoted and applied to evaluate glucose, cholesterol, and triglycerides. The residual serum became saved at - 20 °C till the TNF- and irisin hormone ranges in serum had been decided the usage of a sandwich ELISA kit.

"Body mass index" is a dedication of someone's weight is related to their height, with the aid of using equation: $BMI = \text{Weight (kg)} / \text{Height (m)}^2$ (Nuttall, 2015). On the alternative hand glucose turned into after enzymatic oxidation while glucose oxidase is present. The hydrogen peroxide shaped re-joins beneath Neath the formation of a red-violet quinoneimine dye as an indicator by the catalysis of peroxidase using phenol and 4aminophenazone (Trinder, 1969). HbA1C take a look at System reagents on Beckman Coulter AU analyzers for the quantitative dedication of HbA1c (Hemoglobin A1c) in human blood (Jeppsson *et al.*, 2002). So the cholesterol with the aid of using precept of Enzymetic approach defined with the aid of using Allain *et al.*, (1974).

The irisin hormone awareness become calculated to suit up with the ELISA., primarily based totally at the sandwich principle (Miyazawa *et al.*, 1999). However, for the in vivo qualitative and quantitative dedication of TNF-, we used the technique ELISA Kit, a solid-section sandwich ELISA, while CHROMATM CRP and MAU use a sandwich immune-detection technique (Pepys and Hirschfield 2003).



Statistical analysis

The Shapiro-Wilk check become used to explain the information normality, and the assessment become accomplished the use of SPSS software program software version 22.0 (SPSS Inc., Chicago, IL, USA). Data expressions turn out to be the mean \pm preferred deviation. The one-manner ANOVA takes a have a take a observe and compares the groups' quantitative variables.

Results

The present examine confirmed a massive growth ($P \leq 0.05$) in BMI stage in DFU sufferers as compared with Type 2 sufferers and the manage group. So there has been a massive growth ($P \leq 0.05$) in FBS and (HbA1C) degrees in sufferers with DFU as comparing to Type 2 patients and the manage group. So this have a look at defined a massive growth ($P \leq 0.05$) in HbA1C and FBS degrees in a affected person with kind 2 diabetes as compared with the manage group. On the opposite hand, the suggest stage of cholesterol confirmed a massive growth ($p \leq 0.05$) in sufferers with DFU as compared with the T2DM and manage groups. Also, there wasn't a massive growth in T2DM as compared with the manage group.

This examine confirmed a massive growth ($P \leq 0.05$) in irisin degrees in kind 2 sufferers as compared with DFU sufferers and the manage group. While this examine defined a massive decrease ($P \leq 0.05$) in irisin stage in sufferers with DFU as compared with kind 2 sufferers and the manage group, As a result, the have a look at determined a massive growth ($P 0.05$) in TNF- and CRP degrees in DFU sufferers as compared to T2DM sufferers and the manage group (Table 1).

Discussion

Irisin is a peptide that has been broadly investigated in latest years. Increasing irisin tiers has been proven in severa research to be useful and shielding in obesity, insulin resistance, and metabolic disorders (Shi, X *et al.*, 2016). Irisin in keeping with se can also additionally exert an impact at the discount of concentrations of glucose, insulin, and triglycerides after prescribing an eight-week diet to overweight subjects (Lopez-Legarrea *et al.*, 2014). It changed into observed on this take a look at that with the boom withinside the stage of irisin, we discover a lower withinside the stage of sugar withinside the blood, and the effects of this take a look at coincided with (Arhire *et al.*, 2019), which said that the irisin molecule acts as an insulin sensitizer because it will increase glucose uptake into skeletal muscle and improves hepatic glucose and lipid metabolism, and Korta *et al.*, 2019, which stated that irisin is taken into consideration to be an critical choice for the remedy of diabetes, because it will increase insulin sensitivity, will increase glycogenesis, and reduces gluconeogenesis. In different hand, numerous most important new findings arose from every other take a look at observed that each the plasma and intramuscular tiers of irisin lower following cerebral ischemia (Dong-Jie *et al.*, 2016).

The results confirmed a giant growth withinside the degree of HbA1c. That can be what maximum correctly displays the preceding 2-3 months of glycemic manipulate, thus the

affected person with an extended period of DM and terrible manipulate of the disorder and remedy caused an expanded degree of HbA1c withinside the blood (Harris, 1998). The excessive degree of HbA1C on this look at become matched with any other look at through Kamran, (2010) who mentioned that terrible manipulate and an extended period of the DM disorder caused better HbA1c ranges and diabetic headaches which include nephropathy).

The results confirmed a giant growth in blood sugar in DFU and T2DM as compared with the manipulate group. The sickness of beta cells in pancreas organ ends in reduced secretion of insulin. If beta cells don't produce sufficient insulin, or the frame doesn't reply to the insulin this is present, glucose builds up withinside the blood as opposed to being absorbed through cells withinside the frame, main to prediabetes or diabetes. In diabetes, the frame's cells are starved of strength in spite of excessive blood glucose ranges (Arthur and John, 2006).

The reasons for the excessive dyslipidemia occurrence in those sufferers may be defined in numerous ways; the healthcare system in addition to suitable affected person schooling play an crucial position in disorder control. According to the Thai document in 2003, medicinal drugs have been now no longer taken through 30% of diabetic sufferers who fulfilled the standards for receiving lipid-decreasing medicines, and best 40.1% of folks who took their medicinal drugs completed the goal LDL ranges of one hundred mg/dL. This clarification matched with the examine through (Stone *et al.*, 2014).

The effect of transferring towards a cutting-edge life-style ought to now no longer be underestimated, with growing nations an increasing number of adopting Western-fashion diets that encompass excessive-calorie ingredients with multiplied carbohydrate, fat, and beef content material and occasional fiber content material. These nutritional modifications correlate with a fast increase in the superiority of obesity, metabolic syndrome, and T2DM. TNF- ranges have been determined to be substantially improved on this examine, which can be related to macrophage activation, as improved serum TNF- ranges have been determined in levels of insulin resistance and the development of diabetes mellitus (Foss-Freitas *et al.*, 2008). TNF- α ranges may also play a sizable position in diabetes, and plenty of variables can be related to serum TNF- ranges. TNF-, the maximum crucial pathophysiological and physiological supervisor of vascular adhesion molecules, is a key pro-inflammatory cytokine with vast metabolic outcomes that without delay regulates the manufacturing of several cardiovascular chance factors (Mohamed-Ali *et al.*, 1998).

The present study confirmed a large growth withinside the degree of C-reactive protein (CRP) in DM patients as compared with manage groups. Type 2 diabetes mellitus, additionally referred to as non-insulin-based diabetes mellitus, is because of insulin resistance, and now numerous research have proven a clean affiliation among type 2 diabetes and irritation (Urooj *et al.*, 2011). In 1998, a speculation became proposed suggesting that long-time period innate immune machine activation ensuing in continual irritation elicited ailment in preference to repair, main to type 2 diabetes (Pickup and Crook, 1998). Our effects assist preceding research that recommended the association of CRP with an extended danger of diabetes and metabolic syndrome (Tang, 2021).

Conclusions

We discussed the position of TNF- signaling in a few autoimmune illnesses, in addition to the modern-day TNF- inhibitors used as healing tablets for those conditions. TNF-, additionally referred to as a proinflammatory cytokine, has been proven to have pleiotropic outcomes on diverse mobileular fashions and has been implicated withinside the pathogenesis of autoimmune illnesses. TNF-'s position in those illnesses isn't always absolutely understood; however, it's miles broadly widely wide-spread that it contributes to ailment development while overproduced via way of means of activating and amassing fibroblasts, inflicting joint erosion, fibrosis, and stricture formation. TNF-inhibitors are presently being utilized in scientific trials to deal with a number of inflammatory illnesses. High ranges of irisin, on the alternative hand, act as anti inflammatory dealers in opposition to in addition to in overweight sufferers on this look at and numerous different apparent studies.

Data Accessibility

Upon request, the corresponding author can provide the data used to support the findings of this study.

Conflicts of Interest

The authors declare that they do not have any financial ties to any specific businesses.

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Table 1: Parameters of the studied groups. (95% Confidence Interval)

| Dependent Variable | (I) Nature | (J) Nature | Mean Difference (I-J) | Std. Error | Sig. |
|--------------------|------------|------------|-----------------------|------------|------|
| TNF- α | DFU | T2 | 74.47983* | .60847 | .000 |
| | | Control | 98.91383* | .68030 | .000 |
| | T2 | DFU | -74.47983* | .60847 | .000 |
| | | Control | 24.43400* | .68030 | .000 |
| | Control | DFU | -98.91383* | .68030 | .000 |
| | | T2 | -24.43400* | .68030 | .000 |
| Irisin | DFU | T2 | -13.21863* | 1.04220 | .000 |
| | | Control | 6.05608* | 1.16521 | .000 |
| | T2 | DFU | 13.21863* | 1.04220 | .000 |
| | | Control | -7.16255* | 1.16521 | .000 |
| | Control | DFU | -6.05608* | 1.16521 | .000 |
| | | T2 | 7.16255* | 1.16521 | .000 |
| CRP | DFU | T2 | 12.53653* | .58515 | .000 |
| | | Control | 5.57042* | .65422 | .000 |
| | T2 | DFU | -12.53653* | .58515 | .000 |
| | | Control | 18.10695* | .65422 | .000 |
| | Control | DFU | -5.57042* | .65422 | .000 |
| | | T2 | -18.10695* | .65422 | .000 |
| FBS | DFU | T2 | -.35233 | .32645 | .282 |
| | | Control | 3.02917* | .36499 | .000 |
| | T2 | DFU | .35233 | .32645 | .282 |
| | | Control | 3.38150* | .36499 | .000 |
| | Control | DFU | -3.02917* | .36499 | .000 |
| | | T2 | | | |

Assessment of Tumor Necrosis Factor.....

| | | | | | |
|-------------|---------|---------|------------|--------|------|
| | | T2 | -3.38150* | .36499 | .000 |
| HbA1C | DFU | T2 | .92867* | .26262 | .001 |
| | | Control | -2.63268* | .29362 | .000 |
| | T2 | DFU | .92867* | .26262 | .001 |
| | | Control | 3.56135* | .29362 | .000 |
| | Control | DFU | -2.63268* | .29362 | .000 |
| | | T2 | -3.56135* | .29362 | .000 |
| Cholesterol | DFU | T2 | -2.00967* | .16156 | .000 |
| | | Control | .44150* | .18063 | .016 |
| | T2 | DFU | 2.00967* | .16156 | .000 |
| | | Control | 2.45117* | .18063 | .000 |
| | Control | DFU | -.44150* | .18063 | .016 |
| | | T2 | -2.45117* | .18063 | .000 |
| BMI | DFU | T2 | 21.43600* | .39522 | .000 |
| | | Control | 5.24700* | .44187 | .000 |
| | T2 | DFU | -21.43600* | .39522 | .000 |
| | | Control | -16.18900* | .44187 | .000 |
| | Control | DFU | -5.24700* | .44187 | .000 |
| | | T2 | 16.18900* | .44187 | .000 |

DFUs:Diabetic foot ulcers, T2: Type 2 diabetic mellitus, BMI: Body mass index, TNF- α Tumer necrosis factor alpha, CRP:C-reactive protein, FBS:Fasting blood suger)

FULL PAPER**Two Results to Clarify the Relationship Between P_{ijk}^h and R_{ijk}^h with Two Connections of Third Order in Finsler Spaces****Prepared by**

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Abstract

The relations between various curvature tensors discussed by Finslerian geometrics. In this paper, two theorems that clarify the relationship between P_{ijk}^h and R_{ijk}^h in generalized tri-recurrent space are discussed. Moreover, the behavior of some tensors are tri-recurrent if R_{ijk}^h satisfies the generalized tri-recurrence property.

Keywords: Holomorphic ally projective curvature tensor P_{ijk}^h , \mathcal{B} –covariant derivative, h –and covariant derivative.

1. Introduction and Preliminaries

Finsler geometry is a kind of differential geometry. It usually consider as a generalization of Riemannian geometry. In this research, we use a methodology based on previous theories and spaces in Finsler geometry. Here we focus on the relationship between the Holomorphically projective curvature tensor P_{ijk}^h and curvature tensor P_{ijk}^h .

The importance of the research lies in studying this relationship and developing it in more general spaces with two connections.

The relationship between the curvature tensors R_{ijk}^h , W_{ijk}^h and P_{ijk}^h in generalized recurrent and birecurrent Finsler space in sense of Berwald discussed by [1, 5]. Srivastava [17] defined special R -generalized recurrent Finsler spaces of the order two.

Further, the generalized BP –tri-recurrent space and generalized P^h –tri-recurrent space introduced by [2, 3]. The generalized P^h –tri-recurrent space discussed by Qasem et al. [13].

An n –dimensional Finsler space F_n equipped with the metric function $F(x, y)$ satisfying the three conditions [6, 18]. The vector y_i , g_{ij} and g^{ij} are defined by

$$(1.1) \quad y_i = g_{ij}(x, y) y^j.$$

$$(1.2) \quad g_{ij} g^{ik} = \delta_j^k = \begin{cases} 1 & \text{if } j = k, \\ 0 & \text{if } j \neq k. \end{cases}$$

In view of Eqs. (1.1) and (1.2), we have

$$(1.3) \quad \delta_k^i y^k = y^i, \quad \delta_j^i g_{ir} = g_{jr} \quad \text{and} \quad \delta_k^i y_i = y_k.$$

The tensor C_{ijk} is defined by [8]

$$C_{ijk} = \frac{1}{2} \partial_i g_{jk} = \frac{1}{4} \partial_i \partial_j \partial_k F^2 .$$

The above tensor satisfies the following [8, 10, 16]

$$(1.4) \quad C_{ijk} y^i = C_{kij} y^i = C_{jki} y^i = 0 \quad \text{and} \quad \delta_k^i C_{jil} = C_{jkl} .$$

Berwald introduced a covariant derivative, this derivative denoted by \mathcal{B}_k . This derivative with tensor T_j^i is defined by

$$\mathcal{B}_k T_j^i = \partial_k T_j^i - (\partial_r T_j^i) G_k^r + T_j^r G_{rk}^i - T_r^i G_{jk}^r .$$

The covariant differentiation in Berwald sense of the vector y^i and metric tensor g_{ij} satisfy

$$(1.5) \quad \mathcal{B}_k y^i = 0 \quad \text{and} \quad \mathcal{B}_k g_{ij} = -2 y^h \mathcal{B}_h C_{ijk} = -2 C_{ijk|h} y^h .$$

Cartan h –covariant derivative with x^k is given by [7, 15]

$$X_{(k)}^i = \partial_k X^i - (\partial_r X^i) G_k^r + X^r \Gamma_{rk}^{*i} ,$$

where Γ_{rk}^{*i} is a function called it Cartan’s connection parameter. Therefore, the covariant differentiation in Cartan sense of y^i and g_{ij} are vanish identically i.e.

$$(1.6) \quad y_{(k)}^i = 0 \quad \text{and} \quad g_{ij(k)} = 0 .$$

The curvature tensor R_{jkh}^i is defined by [15]

$$R_{jkh}^i = \partial_h \Gamma_{jk}^{*i} + (\partial_l \Gamma_{jk}^{*i}) G_k^l + C_{jm}^i (\partial_h G_k^m - G_{hl}^m G_k^l) + \Gamma_{mk}^{*i} \Gamma_{jh}^{*m} - h/k ,$$

which satisfies

$$(1.7) \quad R_{jki}^i = R_{jk} .$$

The tensor R_{jkh}^i , its associative R_{rjkh} , R –Ricci tensor R_{jk} and curvature vector R_k satisfy [11, 12]

$$(1.8) \quad R_{rjkh} = g_{ri} R_{jkh}^i, \quad R_{jk} y^j = R_k \quad \text{and} \quad R_{jkh}^i y^j = H_{kh}^i = K_{jkh}^i y^j .$$

The tensor P_{jkh}^i called hv –curvature tensor is defined by [4, 9, 15]

$$P_{jkh}^i = \partial_h \Gamma_{jk}^{*i} + C_{jr}^i P_{kh}^r - C_{jhl}^i .$$

Two Results to Clarify the Relationship Between

The associate tensor P_{ijkh} , torsion tensor P_{kh}^i and P –Ricci tensor P_{jk} of hv –curvature tensor P_{jkh}^i satisfies the relations

$$(1.9) \quad P_{ijkh} = g_{ir} P_{jkh}^r, \quad P_{jkh}^i y^j = P_{kh}^i = C_{khir}^i y^r, \quad P_{jki}^i = P_{jk} \quad \text{and} \quad P_{jki}^i y^i = 0.$$

The generalized tri-recurrent space in Berwald and Cartan senses which are characterized by the conditions [2, 3]

$$(1.10) \quad \begin{aligned} \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n P_{jkh}^i &= a_{lmn} P_{jkh}^i + b_{lmn} (\delta_j^i g_{kh} - \delta_k^i g_{jh}) \\ &\quad - 2y^t c_{mn} \mathcal{B}_t (\delta_j^i C_{khl} - \delta_k^i C_{jhl}) - 2y^t d_{ln} \mathcal{B}_t (\delta_j^i C_{khm} - \delta_k^i C_{jhm}) \\ &\quad - 2y^t \mu_n \mathcal{B}_l \mathcal{B}_t (\delta_j^i C_{khm} - \delta_k^i C_{jhm}), \end{aligned}$$

$$(1.11) \quad P_{jkh(l)(m)(n)}^i = c_{lmn} P_{jkh}^i + d_{lmn} (\delta_j^i g_{kh} - \delta_k^i g_{jh}),$$

respectively, where $a_{lmn} = \mathcal{B}_l u_{mn} + u_{mn} \lambda_l$ and $b_{lmn} = \mathcal{B}_l v_{mn} + u_{mn} \mu_l$ are non – zero covariant tensors field of third order, $c_{mn} = v_{mn}$ and $d_{ln} = \mathcal{B}_l \mu_n$ are non – zero covariant tensor field of second order. $\mathcal{B}_l \mathcal{B}_m \mathcal{B}_n$ is the differential operator in Berwald sense with x^n , x^m and x^l , successively. Also, $c_{lmn} = a_{lm(n)} + a_{lm} \lambda_n$ and $d_{lmn} = a_{lm} \mu_n + b_{lm(n)}$ are non – zero covariant tensors field of third order. $(l)(m)(n)$ is the differential operator in sense of Cartan with x^l , x^m and x^n , successively. The mentioned spaces are denoted them by $G(BP) - TRF_n$ and $G(P^h) - TRF_n$. Also, the tensors which satisfy the conditions (1.10) and (1.11) are called generalized \mathcal{B} –tri-recurrent tensor and generalized h –tri-recurrent tensor.

Transvecting the condition (1.10) by y^j , applying Eqs. (1.3), (1.4), (1.5) and (1.9), we get

$$(1.12) \quad \begin{aligned} \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n P_{kh}^i &= a_{lmn} P_{kh}^i + b_{lmn} (y^i g_{kh} - \delta_k^i y_h) - 2y^t c_{mn} \mathcal{B}_t (y^i C_{khl}) \\ &\quad - 2y^t d_{ln} \mathcal{B}_t (y^i C_{khm}) - 2y^t \mu_n \mathcal{B}_l \mathcal{B}_t (y^i C_{khm}). \end{aligned}$$

Contracting i and h in the condition (1.10), applying Eqs. (1.3), (1.4) and (1.9), we get

$$(1.13) \quad \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n P_{jk} = a_{lmn} P_{jk}.$$

Transvecting (1.11) by g_{ir} , using Eqs. (1.3), (1.6) and (1.9), we get

$$(1.14) \quad P_{rjkh(l)(m)(n)} = c_{lmn} P_{rjkh} + d_{lmn} (g_{jr} g_{kh} - g_{kr} g_{jh}).$$

Transvecting (1.11) by y^j , using Eqs. (1.1), (1.3), (1.6) and (1.9), we have

$$(1.15) \quad P_{kh(l)(m)(n)}^i = c_{lmn} P_{kh}^i + d_{lmn} (y^i g_{kh} - \delta_k^i y_h).$$

Contracting i and h in the condition (1.10), using Eqs. (1.3) and (1.9), we have

$$(1.16) \quad P_{jk(l)(m)(n)} = c_{lmn} P_{jk}.$$

2. Main Results

In this section, we focus on the conditions for R_{jkh}^i that be generalized tri-recurrent in two senses. The holomorphically projective curvature tensor P_{ijk}^h is defined by [14]

$$(2.1) \quad P_{ijk}^h = R_{ijk}^h + \frac{1}{n+2} (R_{ik}\delta_j^h - R_{jk}\delta_i^h + S_{ik}F_j^h - S_{jk}\delta_i^h + 2S_{ij}F_k^h),$$

where $S_{ij} = F_i^a R_{aj}$. Transvecting Eq. (2.1) by g_{hr} , using Eqs. (1.3), (1.8), (1.9) and put $(g_{hl}F_j^h = g_{jl})$, we get

$$(2.2) \quad P_{rijk} = R_{rijk} + \frac{1}{n+2} (R_{ik} g_{jr} - R_{jk} g_{ir} + S_{ik} g_{jr} - S_{jk} g_{ir} + 2 S_{ij} g_{kr}).$$

Transvecting Eq. (2.1) by y^i , using Eqs. (1.3), (1.8) and (1.9), we get

$$(2.3) \quad P_{jk}^h = H_{jk}^h + \frac{1}{n+2} (R_k\delta_j^h - R_{jk} y^h + S_k F_j^h - S_{jk} y^h + 2 S_j F_k^h).$$

Contracting i and h in Eq. (2.1), using Eqs. (1.2), (1.7), (1.9) and put $(S_{ik}F_j^i = S_{jk})$, we get

$$(2.4) \quad P_{jk} = R_{jk} + \frac{1}{n+2} [(1 - n)R_{jk} + (3 - n) S_{jk}].$$

Theorem 2.1. *In $G(BP) - TRF_n$, the tensor $(R_{ik}\delta_j^h - R_{jk}\delta_i^h + S_{ik}F_j^h - S_{jk}\delta_i^h + 2 S_{ij}F_k^h)$ behaves as tri-recurrent if R_{ijk}^h is a generalized \mathcal{B} -tri-recurrent tensor.*

Proof. Assume that a $G(BP) - TRF_n$, i.e. characterized by the condition (1.10). Taking \mathcal{B} -covariant derivative for Eq. (2.1) thrice with respect to x^n, x^m and x^l , then applying the condition (1.10), we get

$$\begin{aligned} \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n R_{ijk}^h &= a_{lmn} P_{ijk}^h + b_{lmn} (\delta_i^h g_{jk} - \delta_j^h g_{ik}) - 2y^t c_{mn} \mathcal{B}_t (\delta_i^h C_{jkl} - \delta_j^h C_{ikl}) \\ &\quad - 2y^t d_{ln} \mathcal{B}_t (\delta_i^h C_{jkm} - \delta_j^h C_{ikm}) - 2y^t \mu_n \mathcal{B}_l \mathcal{B}_t (\delta_i^h C_{jkm} - \delta_j^h C_{ikm}) \\ &\quad - \frac{1}{n+2} \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n (R_{ik}\delta_j^h - R_{jk}\delta_i^h + S_{ik}F_j^h - S_{jk}\delta_i^h + 2 S_{ij}F_k^h). \end{aligned}$$

Using Eq. (2.1) in above equation, we get

$$\begin{aligned} \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n R_{ijk}^h &= a_{lmn} R_{ijk}^h + b_{lmn} (\delta_i^h g_{jk} - \delta_j^h g_{ik}) - 2y^t c_{mn} \mathcal{B}_t (\delta_i^h C_{jkl} - \delta_j^h C_{ikl}) \\ &\quad - 2y^t d_{ln} \mathcal{B}_t (\delta_i^h C_{jkm} - \delta_j^h C_{ikm}) - 2y^t \mu_n \mathcal{B}_l \mathcal{B}_t (\delta_i^h C_{jkm} - \delta_j^h C_{ikm}) \end{aligned}$$

if and only if

$$\begin{aligned} \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n (R_{ik}\delta_j^h - R_{jk}\delta_i^h + S_{ik}F_j^h - S_{jk}\delta_i^h + 2 S_{ij}F_k^h) \\ = a_{lmn} (R_{ik}\delta_j^h - R_{jk}\delta_i^h + S_{ik}F_j^h - S_{jk}\delta_i^h + 2 S_{ij}F_k^h). \end{aligned}$$

The above equation refers to required.

Now, we have two corollaries related to the previous theorem. Taking covariant differentiation in Berwald sense for Eq. (2.3) thrice with x^n, x^m and x^l , then applying Eq. (1.12), we get

$$\mathcal{B}_l \mathcal{B}_m \mathcal{B}_n H_{jk}^h = a_{lmn} P_{jk}^h + b_{lmn} (y^h g_{jk} - \delta_j^h y_k) - 2y^t c_{mn} \mathcal{B}_t (y^h C_{jkl})$$

$$\begin{aligned}
 & -2y^t d_{ln} \mathcal{B}_t(y^h C_{jkm}) - 2y^t \mu_n \mathcal{B}_l \mathcal{B}_t(y^h C_{jkm}) \\
 & - \frac{1}{n+2} \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n (R_k \delta_j^h - R_{jk} y^h + S_k F_j^h - S_{jk} y^h + 2 S_j F_k^h).
 \end{aligned}$$

Using Eq. (1.10) in above equation, we get

$$\begin{aligned}
 (2.5) \quad \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n H_{jk}^h &= a_{lmn} H_{jk}^h + b_{lmn} (y^h g_{jk} - \delta_j^h y_k) - 2y^t c_{mn} \mathcal{B}_t(y^h C_{jkl}) \\
 & - 2y^t d_{ln} \mathcal{B}_t(y^h C_{jkm}) - 2y^t \mu_n \mathcal{B}_l \mathcal{B}_t(y^h C_{jkm})
 \end{aligned}$$

if and only if

$$\begin{aligned}
 (2.6) \quad \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n (R_k \delta_j^h - R_{jk} y^h + S_k F_j^h - S_{jk} y^h + 2 S_j F_k^h) \\
 = a_{lmn} (R_{ik} \delta_j^h - R_{jk} \delta_i^h + S_{ik} F_j^h - S_{jk} \delta_i^h + 2 S_{ij} F_k^h).
 \end{aligned}$$

The equation (2.6) refers to required. Thus, we conclude

Corollary 2.1. *The tensor $(R_{ik} \delta_j^h - R_{jk} \delta_i^h + S_{ik} F_j^h - S_{jk} \delta_i^h + 2 S_{ij} F_k^h)$ behaves as tri-recurrent if the covariant differentiation in Berwald sense of third order for H_{jk}^h is given by Eq. (2.5) in $G(\mathcal{BP}) - TRF_n$.*

Taking \mathcal{B} -covariant derivative for Eq. (2.4) thrice with respect to x^n, x^m and x^l , then applying Eq. (1.13), we get

$$\mathcal{B}_l \mathcal{B}_m \mathcal{B}_n R_{jk} = a_{lmn} P_{jk} - \frac{1}{n+2} \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n [(1-n)R_{jk} + (3-n)S_{jk}].$$

Using Eq. (2.4) in above equation, we get

$$(2.7) \quad \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n R_{jk} = a_{lmn} R_{jk}$$

if and only if

$$(2.8) \quad \mathcal{B}_l \mathcal{B}_m \mathcal{B}_n [(1-n)R_{jk} + (3-n)S_{jk}] = a_{lmn} [(1-n)R_{jk} + (3-n)S_{jk}].$$

From equations (2.7) and (2.8), we conclude

Corollary 2.2. *The behavior R -Ricci tensor R_{ik} is tri-recurrent if and only if the tensor $[(1-n)R_{jk} + (3-n)S_{jk}]$ behaves as tri-recurrent in $G(\mathcal{BP}) - TRF_n$.*

In the following theorem, we infer the condition for R_{ijk}^h that be generalized tri-recurrent in Cartan sense.

Theorem 2.2. *In $G(P^h) - TRF_n$, the tensor $(R_{ik} \delta_j^h - R_{jk} \delta_i^h + S_{ik} F_j^h - S_{jk} \delta_i^h + 2 S_{ij} F_k^h)$ behaves as tri-recurrent if R_{ijk}^h is a generalized h -tri-recurrent tensor.*

Proof. Let us consider a $G(P^h) - TRF_n$, i.e, characterized by the condition (1.11). Taking covariant differentiation in Cartan sense for Eq. (2.1) thrice with x^n, x^m and x^l , then applying the condition (1.11), we get

$$\begin{aligned}
 R_{ijk(l)(m)(n)}^h &= c_{lmn} P_{ijk}^h + d_{lmn} (\delta_i^h g_{jk} - \delta_j^h g_{ik}) \\
 & - \frac{1}{n+2} (R_{ik} \delta_j^h - R_{jk} \delta_i^h + S_{ik} F_j^h - S_{jk} \delta_i^h + 2 S_{ij} F_k^h)_{(l)(m)(n)}.
 \end{aligned}$$

Using Eq. (2.1) in above equation, we get

$$R_{ijk(l)(m)(n)}^h = c_{lmn} P_{ijk}^h + d_{lmn} (\delta_i^h g_{jk} - \delta_j^h g_{ik})$$

if and only if

$$\begin{aligned} (R_{ik} \delta_j^h - R_{jk} \delta_i^h + S_{ik} F_j^h - S_{jk} \delta_i^h + 2 S_{ij} F_k^h)_{(l)(m)(n)} \\ = c_{lmn} (R_{ik} \delta_j^h - R_{jk} \delta_i^h + S_{ik} F_j^h - S_{jk} \delta_i^h + 2 S_{ij} F_k^h). \end{aligned}$$

The above equation refers to required.

Now, we have two corollaries related to the previous theorem. Taking covariant differentiation in Cartan sense for Eq. (2.2) thrice with x^n , x^m and x^l , then applying Eq. (1.14), we have

$$\begin{aligned} R_{rjkh(l)(m)(n)} = c_{lmn} P_{rjkh} + \mu_m (g_{ir} g_{jk} - g_{jr} g_{ik}) \\ - \frac{1}{n+2} (R_{ik} g_{jr} - R_{jk} g_{ir} + S_{ik} g_{jr} - S_{jk} g_{ir} + 2 S_{ij} g_{kr})_{(l)(m)(n)}. \end{aligned}$$

Using Eq. (2.2) in above equation, we infer

$$(2.9) \quad R_{rjkh(l)(m)(n)} = c_{lmn} R_{rjkh} + d_{lmn} (g_{ir} g_{jk} - g_{jr} g_{ik})$$

if and only if

$$\begin{aligned} (2.10) \quad (R_{ik} g_{jr} - R_{jk} g_{ir} + S_{ik} g_{jr} - S_{jk} g_{ir} + 2 S_{ij} g_{kr})_{(l)(m)(n)} \\ = c_{lmn} (R_{ik} g_{jr} - R_{jk} g_{ir} + S_{ik} g_{jr} - S_{jk} g_{ir} + 2 S_{ij} g_{kr}). \end{aligned}$$

Taking covariant differentiation in Cartan sense for Eq. (2.3) thrice with respect to x^n , x^m and x^l , then applying Eq. (1.15), we get

$$\begin{aligned} H_{jk(l)(m)(n)}^h = c_{lmn} P_{jk}^h + d_{lmn} (y^h g_{jk} - \delta_j^h y_k) \\ - \frac{1}{n+2} (R_k \delta_j^h - R_{jk} y^h + S_k F_j^h - S_{jk} y^h + 2 S_j F_k^h)_{(l)(m)(n)}. \end{aligned}$$

Using Eq. (2.3) in previous equation, we get

$$(2.11) \quad H_{jk(l)(m)(n)}^h = c_{lmn} H_{jk}^h + d_{lmn} (y^h g_{jk} - \delta_j^h y_k)$$

if and only if

$$\begin{aligned} (2.12) \quad (R_k \delta_j^h - R_{jk} y^h + S_k F_j^h - S_{jk} y^h + 2 S_j F_k^h)_{(l)(m)(n)} \\ = c_{lmn} (R_k \delta_j^h - R_{jk} y^h + S_k F_j^h - S_{jk} y^h + 2 S_j F_k^h). \end{aligned}$$

From equations (2.10) and (2.12), we conclude

Corollary 2.3. *In $G(P^h) - TRF_n$, the tensors $(R_{ik} g_{jr} - R_{jk} g_{ir} + S_{ik} g_{jr} - S_{jk} g_{ir} + 2 S_{ij} g_{kr})$ and $(R_k \delta_j^h - R_{jk} y^h + S_k F_j^h - S_{jk} y^h + 2 S_j F_k^h)$ behave as tri-recurrent if the covariant differentiation in Cartan sense of third order for R_{rjkh} and H_{jk}^h are satisfied by Eqs.(2.9) and (2.11), respectively.*

Two Results to Clarify the Relationship Between

Taking covariant differentiation in Cartan sense for Eq. (2.4) thrice with respect to x^n , x^m and x^l , then applying Eq. (1.16), we infer

$$R_{jk(l)(m)(n)} = c_{lmn}P_{jk} - \frac{1}{n+2} [(1-n)R_{jk} + (3-n)S_{jk}]_{(l)(m)(n)}.$$

Using Eq. (2.4) in previous equation, we get

$$(2.13) \quad R_{jk(l)(m)(n)} = c_{lmn}R_{jk}$$

if and only if

$$(2.14) \quad [(1-n)R_{jk} + (3-n)S_{jk}]_{(l)(m)(n)} = c_{lmn} [(1-n)R_{jk} + (3-n)S_{jk}].$$

From equations (2.14), we conclude

Corollary 2.4: *The behavior R -Ricci tensor R_{ik} is tri-recurrent if the tensor $[(1-n)R_{jk} + (3-n)S_{jk}]$ behaves as tri-recurrent in $G(P^h) - TRF_n$.*

3. Conclusions

The condition for R_{ijk}^h which be generalized tri-recurrent tensor in $G(BP) - TRF_n$ and $G(P^h) - TRF_n$ has been obtained. Further, various identities related to above mentioned spaces have been studied.

4. Significance of Study

In previous study, we discussed the relationship between P_{ijk}^h and R_{ijk}^h in generalized recurrent and bi-recurrent Finsler spaces in Berwald sense. The importance of this study is to find a generalization and study this relationship in a generalized recurrent Finsler space of third order with two connections.

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FULL PAPER**Estimation the Energy Spectrum of Charged Particles of High-Energy Cosmic Rays*****Prepared by******Lect.Dr.Abbas Rahi Raham
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Iraq*****Abstract**

Main cosmic rays exceeding energy of approximately 100 TeV are examined via the cascade of particles in the EAS_s. Any explanation of these particles requires a thorough understanding of the shape of the spectrum and the variations in the overall structure of cosmic rays. The interaction of elementary particles with the nuclei of air atoms inside the atmosphere produces huge amounts of charged particles. To characterize an energy spectrum features of cascade particles, a total number of elementary particles such as electrons, muons, pions and nuclei of iron atoms within the energy range (10¹⁴-10¹⁸) eV was calculated using MATLAB program. The theoretical results were compared with experimental measurements, which showed a decent compatibility of muon - electron within the range of energies mentioned above.

Keywords: Cosmic rays, Energy spectrum, Extensive Air Showers, Knee

Introduction

An energy spectrum, all cosmic ray particles ranges from about 1 GeV to more than 1020 eV, which are the highest single particle energies in the universe. Most of these particles are ionized atomic nuclei with relativistic energies. The origin of these extraterrestrial particles is shown, and its name is Cosmic Rays (CRs). Because of its very high energy and distribution properties, cosmic rays are originally thought to be outside the galaxy. Monitoring data with high-energy rapid special response reports can be divided into two types: spectra and chemical composition [1]. The chemical composition and energy spectrum can provide cosmic rays with accurate clues regarding the propagation and acceleration the most important mechanisms active the particles in the cosmos [2, 3]. The knee's origin area is understood through the spectrum of energies, which is frequently essential to ascertain the source of cosmic rays. Numerous experiments conducted in space to obtain a direct examination of the helium and proton nucleus energy spectrum have expanded to 100 TeV, [4, 5]. Due to a decrease in flow velocity with increasing power, the measurement of cosmic rays in excess of 100 TeV, by means of experiments carried out in space, is a challenge. To produce spectrum data over Several hundred TeV via large arrays of ground air showers. By observing a knee structures in a a few PeV across the entire energy range particles cosmic radiation from numerous tests [6, 7]. The KASCADE experiment discovered the first clue that such a behavior of CR component spectra is in fact occurring [8]. Hitler's simplified model of the evolution of a pure electromagnetic cascade may be used to extract the fundamental characteristics of the cascade's development in EAS_s [9]. Even though a vast dynamic range is covered, the spectrum seems to lack structure and is best represented by broken power-laws, some of which are located in the two areas mentioned above: The energy-closed knee area is approximately $E \sim 5.1015$ eV [10]. The area around the ankle that was detected at energy $E \sim 5.1018$ eV [11]. This research aims to estimate how many charged particles there are overall in the atmosphere such as electrons, photons, pions, and muons in a knee and ankle areas within the energy range (1014-1018) eV using MATLAB program, where the experimental results confirmed this estimate of muon and electron particles at the energy levels mentioned above [12].

Importance of study

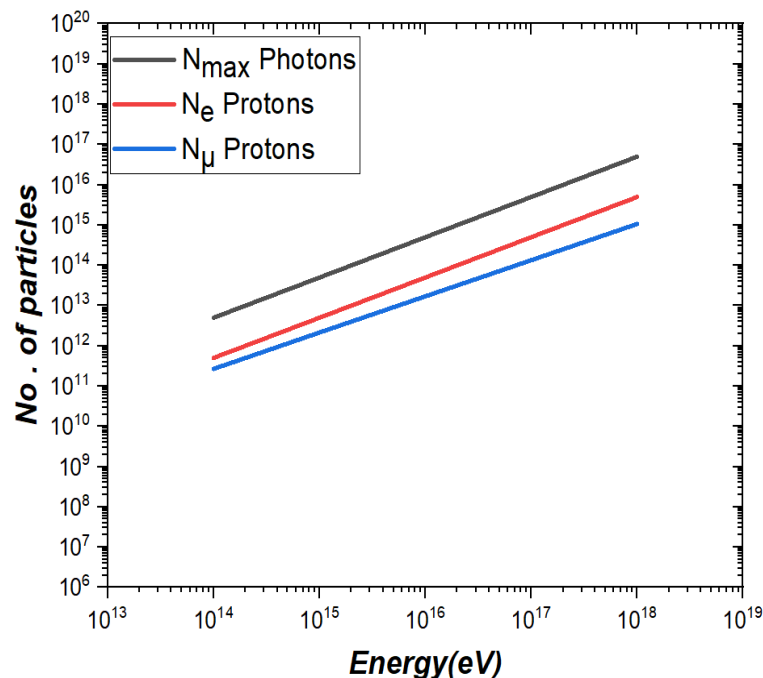
The importance lies in the study of a number of charged particles resulting from the interaction of elementary particles of cosmic rays with the nuclei of atmospheric atoms, that is, an explanation of the shape of the energy spectrum, the diversity of the total composition of cosmic rays and the conclusion of detailed information about these particles within the energy range of 1014-1018 eV in the EAS_s.

Methodology

The study of cosmic rays is one of the most important and challenging studies in the fields of astrophysics. The interaction of elementary particles within the atmosphere produces a huge amount of charged particles. To characterize the energy spectrum features of successive particles, the total number of elementary particles such as electrons, muons, ions and nuclei of iron atoms within the energy range between 10¹⁴-10¹⁸ eV was calculated using MATLAB program. The theoretical results were compared with experimental measurements [12], which showed a decent compatibility of both the muon and the electron within the range of energies above, due to the nature of the hadronic and electromagnetic interactions involved and the different decay properties of the particles in the EAS_s. Through these diagrams shows us that the photon curve of the number of charged particles is greater than the electron-muon curve of the number of protons produced on average, the first proton 10¹⁵ eV, will produce about 10⁶ particles at sea level, 80% of which are photons, 18% electrons, 1.7% muons, and about 0.3% hadrons, which enabled us to determine the properties of key particles by estimating the energy spectrum around the knee area of cosmic rays.

Theoretical framework

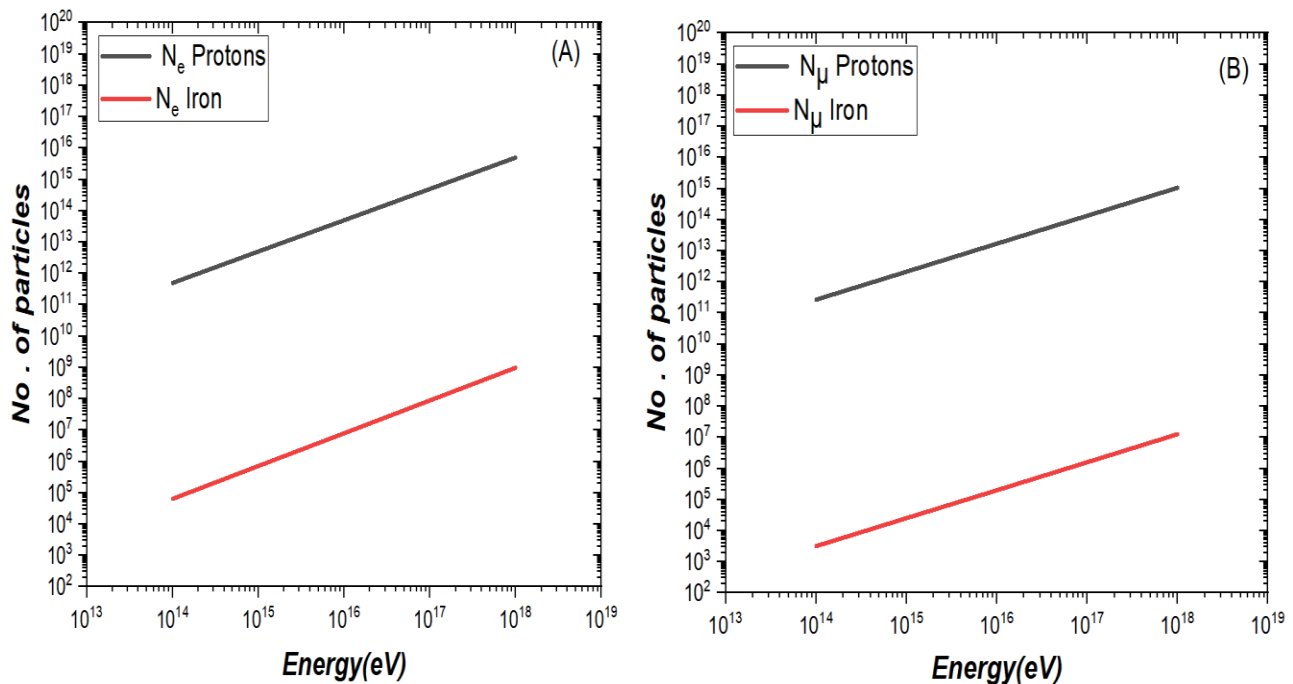
Based at the fundamental cosmic ray energy, the quantity of charged particles has been computed for electrons, pions, and muons at the energy range 10¹⁴-10¹⁸eV, as figure.1 illustrates. The reconstructed spectrum has a skewed slope and overestimates intensity The inference of an all-particle energy spectrum undoubtedly involves bias despite the fact that the energy estimate is objective overall due to changes in the energy estimate caused by correlation between the energy resolution and a sharply declining power-law spectrum (such as, lognormal propagation) are ignored. This graphic shows that the photon curve for charged particle count is greater than the electron and muon curves for proton count.



Estimation the Energy Spectrum

Fig. 1. The disparities between the maximal quantity of photons and the quantity of electrons and muons for elementary proton are represented by the quantity of particles in the atmosphere for each energy range as a function of fundamental energy 1014 - 1018eV.

The behavior of extremely high energy particles within the atmosphere with energies between 1014 and 1018 eV is seen in Figure 2. Figure A shows the quantity of electrons, which varies for the main protons and iron nuclei, whereas Figure B shows the quantity of muons, which varies a “protons and iron nuclei”. These variations can be attributed to the main energy and mass number of cosmic rays. The discrepancies between the maximal photon count and the electron and muon counts for iron nuclei as a function of original energy are depicted in figure C.



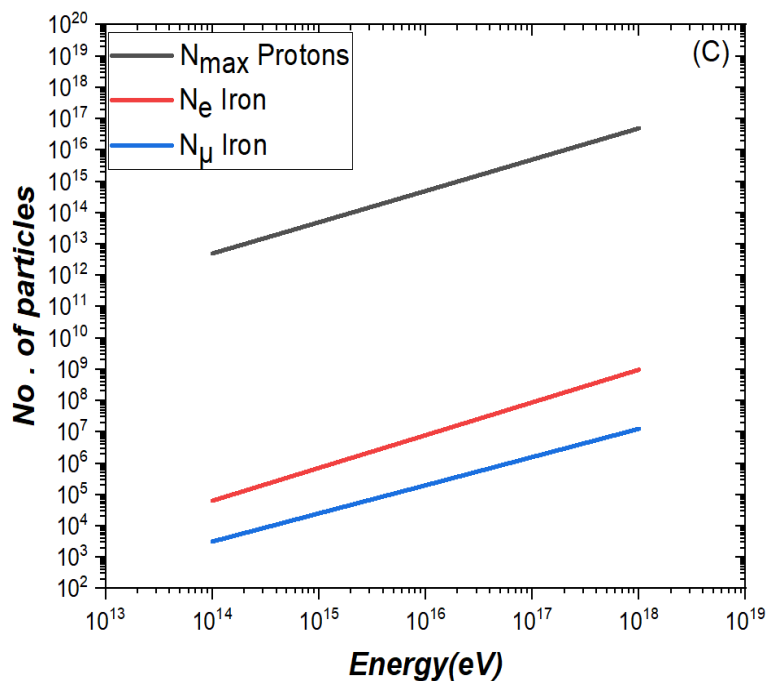


Fig. 2.The quantity of particles in the atmosphere between 1014 and 1018 eV, as a function of original energy; Fig. A shows the quantity an electrons in iron nuclei and primary protons; Fig. B indicates the quantity of muons contained in main nuclei of iron and protons; Fig. C depicts a variations in the maximum number of photons, electrons, and muons for iron nuclei.

In the energy range of 1014–1018 eV, Figure.3 illustrates how Pions' energy is dependent regarding cosmic rays' basic energy as a function of, n . Here, n represents a number of interactions, which is calculated using Equation (9), where $N_{ch}^{\pi} = 10$. Pions lose some of their energy with every interaction.

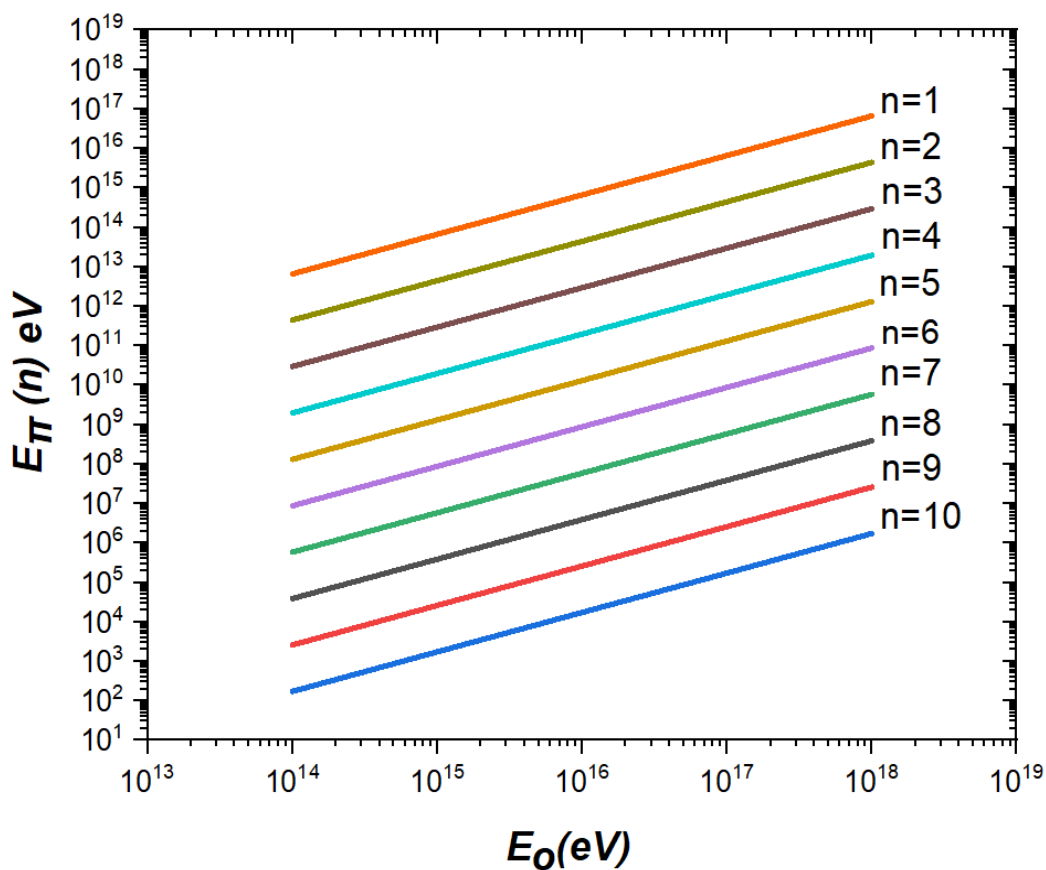


Fig.3 .The relationship, using Eq. (9) with $N_{ch}^\pi = 10$, in the energy range 1014 - 1018eV between the fundamental energy and the energy of pions.

In this figure 4, the experimental results CASA-MIA [12] in energy reconstruction based on the number of electrons and muons for the shower size in the energy range 1014-1018 eV that showed a decent compatibility between electron and muon within the range of primary energies are presented.

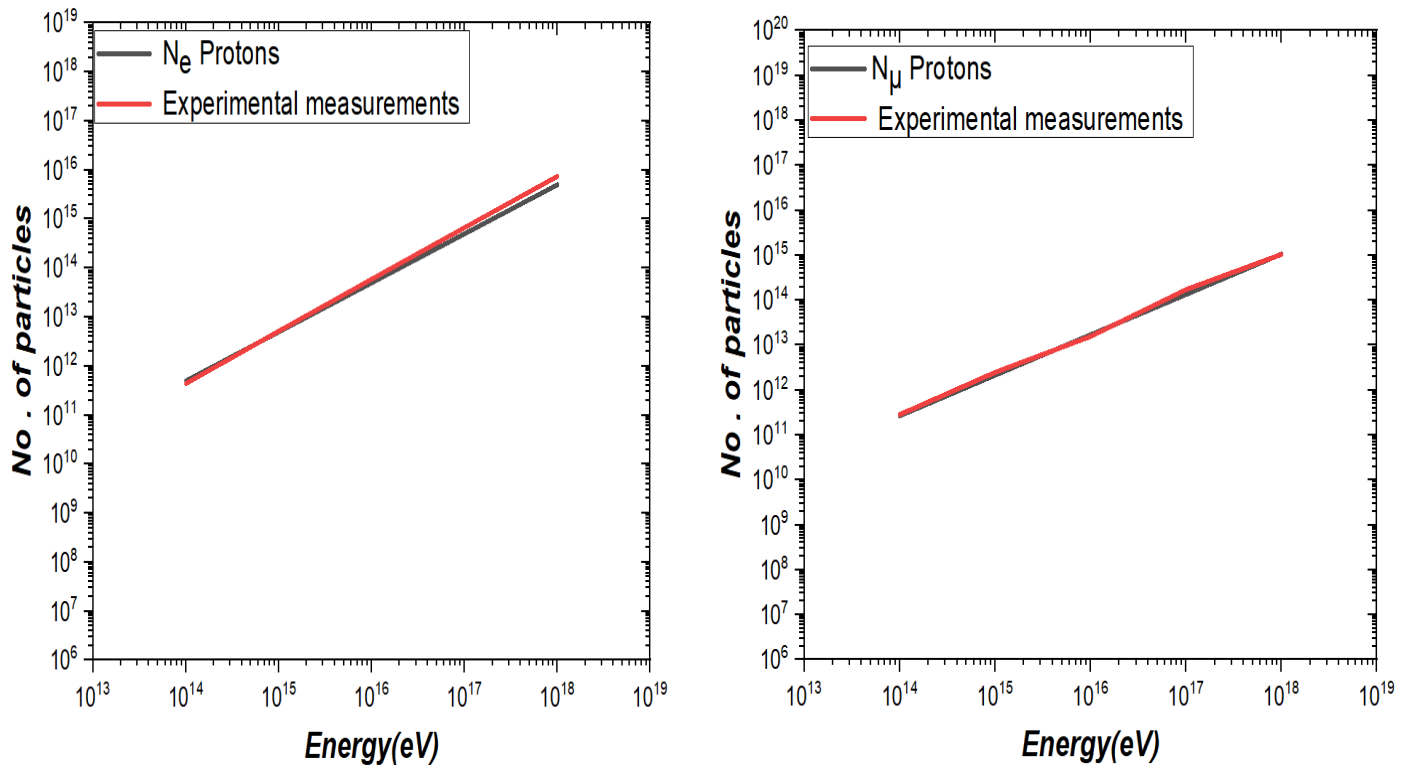


Fig 4. It presents the experimental results [12] of the quantity of electrons and muons in relation to an initial energy and their comparison with theoretical data within the energy range 1014-1018 eV.

We can see in figure 1. The number of charged particles of photons, electrons, and muons in the energy range 1014-1018 eV, which based on the initial cosmic ray energy, where the quantity of charged particles increases with the increase of the initial energy. In figure 2, we find that the behavior of particles relative to protons and iron nuclei differs at high energies due to the number of mass and initial energy on which these particles depend. In figure 3. The pion's energy that depend regarding the main energy as a function of, n in energy range 1014-1018 eV, the more reactions n pions lose part of their energy in each reaction, where n is the number of reactions. Figure 4. Experimental CASA-MIA [12] measurements of a number of electrons-muons charged particles in the energy range 1014-1018 eV with the theoretical data showing a decent compatibility of both electrons and muons within the range of the above energies.

Results

An EAS_s is a series of secondary particles formed from the interaction between primary cosmic radiation with high energy (such as P, C, He, Fe, etc) with the nuclei of atmospheric atoms such as (N, Ar, O, etc) [13]. Due to the nature of the hadronic and electromagnetic interactions involved and the decay properties of the various particles. At the average proton 1015 eV, approximately 106 particles will be produced at sea level, 80% protons, 18% electrons, 1.7% muons, and about 0.3 hadrons. Neutrinos will also be produced by degrading weak particles, but remain invisible through normal EAS experiments [14]. Every generation of EAS develops with its secondary particles carrying less energy per particle than the one before it. Particle count rises to the shower maximum, or X_{max}, at which point the particles' energy is insufficient to generate new ones [15]. The portion of hadronic energy is as follows:

$$E_h = N_\mu \xi_c^\pi \quad 1$$

Where ξ_c^π is a critical energy for pions, and (N_μ) is a quantity of muons, which is equivalent to pions (N_π); N_μ is stated as [16, 17]:

$$N_\mu = \left(\frac{E_0}{\xi_c^\pi}\right)^\beta \quad 2$$

With A = atomic mass number; $\xi_c^\pi = 20 \text{ GeV}$; $\beta = 0.90$,

$$N_\mu = \left(\frac{E_0}{\xi_c^\pi}\right)^\beta A^{1-\beta} \approx 1.69 \times 10^4 A^{0.10} \left(\frac{E_0}{1 \text{ PeV}}\right)^{0.90} \quad 3$$

Considering a shower that is started through the energy of a single photon E_0 . When there is energy in every particle ξ_c^e , which denotes a critical energy for electrons, the cascade achieves its maximum size $N = N_{max}$. N is the overall size of the shower for photons, and electrons, and it is expressed as [18]:

$$N_{max} = \frac{E_0}{\xi_c^e} \quad 4$$

The electron count at shower maximum is expressed as [16]:

$$N_e^{max} = \frac{N_{max}}{g} = \frac{E_0}{g \xi_c^e} \quad 5$$

Estimation the Energy Spectrum

Where g is the correction factor and is dependent on the energy threshold and electron and photon detection efficiency of the detectors. The relationship determines the number of electrons for $E_{em}=E_o$ [16, 19]:

$$N_e = \frac{E_{em}}{g \xi_c^e} \quad 6$$

$$N_e \approx 10^6 \left(\frac{E_o}{1PeV} \right)^{\alpha_1} \quad 7$$

Where $\alpha_1 = 1.03$; $\alpha_2 = 1.046$;

$$N_e \approx 5.95 \times 10^5 A^{1-\alpha_2} \left(\frac{E_o}{1PeV} \right)^{\alpha_2} \quad 8$$

After n atmospheric layers, a single cosmic ray proton with energy E_o enters the atmosphere, and we find that $N_\pi = (N_{ch}^\pi)^n$, where N_{ch}^π is the entire count of charged pions. With equal split of energy assumed upon particle formation, the entire amount of energy these pions carry is $(2/3)^n E_o$. Electromagnetic showers from π^0 decays have absorbed the remaining original energy E_o . Consequently, in atmospheric layer n , each charged pion has an energy of [18, 20]:

$$E_\pi = \frac{E_o}{\left(\frac{3}{2} N_{ch}^\pi \right)^n} \quad 9$$

The quantity of interactions required to reach $E_\pi = \xi_c^\pi$ therefore Eq. (9) becomes:

$$\xi_c^\pi = \frac{E_o}{\left(\frac{3}{2} N_{ch}^\pi \right)^n} \quad 10$$

Thus:

$$n \ln \left(\frac{3}{2} N_{ch}^\pi \right) = \ln \left[\frac{E_o}{\xi_c^\pi} \right] \quad 11$$

Following a specific number of $n = n_c$ across generations, therefore Eq. (11) turns into:

Estimation the Energy Spectrum

$$n_c = \frac{\ln[E_0/\xi_c^\pi]}{\ln(\frac{3}{2}N_{ch}^\pi)} \quad 12$$

With $N_{ch}^\pi = 10$; Eq. (12) becomes:

$$n_c = 0.85 \log_{10}[E_0/\xi_c^\pi] \quad 13$$

Conclusion

The estimation within the energy spectrum of charged particles at high energies of cosmic rays was characterized in this work. By obtaining the number of secondary particles such as photons, muons, electrons and pions in the EAS calculated in the energy range 1014-1018 eV for the proton and the primary iron. We can determine the properties of the main particles by estimating the energy spectrum around the knee and ankle region of cosmic rays by comparing it with the experimental measurements of CASA-MIA of electron-muon charged particles observed in the above energy range. In an effort to reduce several systematic uncertainties, especially the KASCADE experiment, looks for relationships among an greater quantity of EAS_s measurables. Generally, because there are only substantial ground-based detector installations, the results degrade, viewing EAS_s, can produce data from experiments due to a low flux from cosmic rays above 1 PeV. Rather, by comprehensive systematic examinations, it has discovered and quantified the underlying limits and suggested additional improvements. While there is conjecture that a spectrum may stretch past the GZK cutoff, there's currently no experimental evidence to confirm the source or cosmic origin of this GZK radiation. A characteristics due to this finding reveal a genuine enigma at the forefront of natural science with significant cosmic implications.

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FULL PAPER**Data Encryption****Prepared by**

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Abstract:

With the growing need for strong cyber security to safeguard the institutions systems and data from any incidents, whether from unintentional or deliberate cyberattacks, the methods used by institutions to improve their cyber security have changed. Our article will be devoted to one of the important data protection practices that institutions must pay great attention to data encryption

Key words: Cyber security, Enterprise systems, Data encryption

1-Introduction:

Cryptography, or encryption, has been known since 2000 BCE. Humans have used it to protect their secret messages, reaching its peak usage during wartime when battle plans and attack strategies were formulated. Most were sent as regular handwritten messages but were encrypted to prevent them from falling into enemy hands and thwarting those plans. It is noted that the first to use encryption in communication between army branches was the Pharaoh. The Chinese also used various encryption and cipher methods to send messages during wars so that if the message fell into enemy hands, it would be difficult to understand. The best method used in ancient times was the Caesar Cipher, named after Julius Caesar, one of the Roman emperors.

Data Encryption

In our current era, the need for cryptography has become urgent due to the interconnectedness of the world through open networks. These networks are used for electronic information transfer, whether between ordinary people or between private and public organizations, whether military or civilian. Therefore, it is essential to have methods to maintain information confidentiality. As a result, significant efforts have been made worldwide to find optimal ways to exchange data without revealing it. Research in cryptography continues due to the rapid development of computers and significant advancements in networks, especially the World Wide Web and the Internet.

2-Problem Statement:

There are two types of encryption: symmetric and asymmetric. The fundamental difference between them lies in their algorithms. Symmetric encryption algorithms use one key, while asymmetric encryption uses two different but related keys. This seemingly simple difference explains the functional differences between these two encryption techniques and the methods used.

3-Hypotheses:

The main difference between symmetric and asymmetric encryption is that symmetric encryption uses one key to encrypt data, while asymmetric encryption uses two different keys: a public key to encrypt data and a private key to decrypt it.

4-Study Objectives:

1. To understand symmetric encryption.
2. To understand asymmetric encryption.
3. To identify the advantages and disadvantages of symmetric encryption.
4. To identify the advantages and disadvantages of asymmetric encryption.

5-Importance of the Study:

The theoretical importance of this study lies in maintaining the electronic transfer of information, whether between individuals or between private and public organizations, and protecting it from potential breaches, hacking, or sabotage, which can impact their strategies, future plans, and growth in their respective sectors.

6-Theoretical Framework:

6.1-Cryptography

6.1.1-Uses of Cryptography:

Cryptography originated from the need to send sensitive information between military and political figures. Messages could be encrypted to appear as random text to anyone except the intended recipient. However, original encryption techniques have now been entirely deciphered and are sometimes found in puzzle sections of newspapers. Fortunately, significant advances have been made in security, relying on precise analysis and mathematics to ensure the security of today's algorithms.

As security evolved, cryptography expanded its scope to include various security goals, such as message authentication, data integrity, and secure computing, among many others. Cryptography is foundational to modern society, underpinning countless internet applications, from HTTPS to secure text and voice communications, and even digital currencies.

6.1.2- Symmetric Encryption:

Symmetric encryption uses a single key for both data encryption and decryption. This means that the key must be shared with the person you want to communicate with, and it must remain secret. If anyone else knows the key, they can decrypt, read, or alter the data. It is akin to using a locked box with a padlock; you send it to your friend who has a copy of the key. Only you and your friend can open the box and read its contents.

Examples of symmetric encryption include:

- Data Encryption Standard (DES)
- Triple Data Encryption Algorithm (3DES)
- Advanced Encryption Standard (AES)
- International Data Encryption Algorithm (IDEA)
- TLS/SSL Protocol

AES is a highly secure symmetric encryption technique that uses block ciphers of either 128, 192, or 256 bits to encrypt and decrypt data. Its effectiveness is well known, and it is commonly used to protect sensitive information in healthcare, banking, government, and other industries. Compared to other encryption techniques like DES, 3DES, and IDEA, AES is more secure. Breaking it would take billions of years, making it an ideal choice for data security.

The National Institute of Standards and Technology (NIST) no longer considers DES effective for protecting sensitive data from brute-force attacks and has fully withdrawn the

standard. Similarly, NIST is phasing out 3DES, which is more secure than DES, due to increasing security concerns. Although 3DES is still in use, it has been banned by NIST since 2023.

❖ **Advantages of Symmetric Encryption:**

- High speed in data encryption and decryption, making it suitable for large and sensitive data.
- Ease of use and implementation, requiring only one key for both parties.
- Strong reliability in protecting data from breaches and espionage.

❖ **Disadvantages of Symmetric Encryption:**

- Difficulty in distributing and storing the secret key between the sender and receiver, especially with a large number of users or sites.
 - Risk of losing, stealing, or leaking the secret key, which puts data at risk.
 - Lack of a mechanism to verify the identity of the sender or receiver or to ensure data integrity.
 - Security is compromised if the key is hacked, lost, or stolen since anyone with the key can read or alter the encrypted data.

6.1.3-Asymmetric Encryption:

Asymmetric encryption uses two different keys for data encryption and decryption. One key is the public key, which can be shared with anyone and is used to encrypt data. The other key is the private key, which must remain secret and is used to decrypt the data. These keys are mathematically related in such a way that they complement each other. It is similar to using a locked box with a special padlock; anyone can lock the box, but only you can open it with your private key.

Examples of asymmetric encryption include:

- Rivest–Shamir–Adleman (RSA)
- Digital Signature Standard (DSS)
- Elliptic Curve Cryptography (ECC)
- Diffie-Hellman Key Exchange
- TLS/SSL Protocol

❖ **Advantages of Asymmetric Encryption:**

- Key distribution is unnecessary: The challenge of securing key distribution channels is a long-standing issue in encryption. Asymmetric encryption eliminates the need for key distribution entirely. This is achieved by exchanging necessary public keys through public key servers without compromising the security of encrypted messages since public keys cannot be used to derive private keys.
- Secure private key exchange is unnecessary: For asymmetric encryption, it is essential to keep private keys secure and accessible only to authorized entities. Using unsecured communication channels for private key exchange could lead to key compromise and decryption of sensitive information, which is why ensuring the security of encrypted messages is crucial.
- Digital signature verification: Asymmetric encryption allows senders to use their private keys to verify that the message or file indeed came from them and not from an untrusted third party.

❖ **Disadvantages of Asymmetric Encryption:**

Asymmetric encryption is slower compared to symmetric encryption due to its longer keys and more complex computations. The use of long key lengths in asymmetric encryption is necessary to make it nearly impossible to derive private keys from public keys, a task that is theoretically tied to complex mathematical problems. However, this could change in the future.

In summary, asymmetric encryption prioritizes security over speed, whereas symmetric encryption prioritizes speed over security. Although symmetric encryption is not inherently insecure, poorly managed symmetric encryption systems still pose certain information security risks that can be mitigated using the fundamentals and principles of asymmetric encryption.

7-Results:

We can conclude that both symmetric and asymmetric encryption have their pros and cons. Symmetric encryption is faster and more efficient than asymmetric encryption because it uses one key instead of two. However, symmetric encryption has more security weaknesses than asymmetric encryption because it relies on a single key for both encryption and decryption. If the key is compromised or stolen, the data becomes vulnerable. Asymmetric encryption provides more security than symmetric encryption because it uses different keys for each party. If the public key is compromised or stolen, the data remains secure. However, asymmetric encryption is slower and less efficient than symmetric encryption due to its complex calculations.

8-Conclusion:

Both symmetric and asymmetric encryption methods have their unique ways of ensuring the security of our digital communications. Symmetric encryption, with its efficiency and speed, is best suited for encrypting large amounts of data, while asymmetric encryption offers greater security. Understanding the strengths and weaknesses of each is crucial to utilizing them effectively in different security scenarios. A hybrid approach, combining the benefits of both, is commonly used to maximize efficiency and security. The best choice depends on the specific situation.

9-Recommendations:

Implementing encryption is a critical step in protecting sensitive data from unauthorized access. However, it is not enough to simply apply encryption techniques without considering best practices and potential challenges. To ensure effective encryption, organizations must carefully assess their specific needs and consider various factors from different perspectives.

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