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Quality Assessment of a Traditional Makeup Foundation Sbdaj in Kurdistan-Iraq

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Abstract

The use of Sbdaj, the ancient and traditional mineral foundation, is a popular practice in Kurdistan Region Iraq. The research work is confined to a comparative analysis of traditional foundations (Sbdaj) and modern foundations (Vichy). The analytical tests were performed for heavy metals and major contents using X-ray fluorescence and inductively coupled plasma spectra after sample preparation in two different ways. Also, the UV spectrum and FT-IR spectroscopy of the Sbdaj foundation and Vechi Sunscreen have been taken. The revealed peaks of Infrared absorption of Sbdaj foundation are (3378; 2960; 2854; 1637; 1261; 1092; 1054; 799; 657) cm^{-1}, which allowed identifying the stretching band of (hydroxyl, methyl, carbonyl, silica group, ester) respectively, while obtained IR spectra for Vichy foundation (3392; 2959; 2856; 1639; 1409; 1261; 1044; 843; 673) cm^{-1} that identify the stretching and bending of (hydroxy, methyl, ester, methyl, silica, ether) respectively, that returns to the ingredients used in these foundations. The Contents of major (SiO_2, Al_2O_3) and trace elements (Pb, W, Nd, I, Sn, Cu, Ni, and Cl) were able to be determined by (XRF). (ICP-OES) used for identifying the presence of) Pb, Sb, Cd, Sr, Se, As, Zn, Ni, Mn, Cr, V, and Ti (The overall mean concentrations of heavy metals in Sbdaj varied between (0.194 to 62235.18 ppm). 0.194 ppm for Cd and 62235.18 ppm for Pb. The levels found in Sbdaj are more than the suggested safe limit for skin protection. The UV- absorption spectrum shows that Sbdaj contains blocking components that absorb UV radiations. It exhibits the same absorption band (318 nm) as the Vichy Sunblock.

1. Introduction:

Since before 4000 B.C., cosmetics have been a part of practically all human societies. It is well known that certain women in ancient Rome created cosmetics, including lead-based concoctions, to lighten skin [1]. Cosmetics were employed by upper-class women in Europe in the nineteenth century to draw attention to their femininity. Deformities, blindness, and even death were brought on by the excessive use of lead-based cosmetics to whiten the skin.

The whitening of the skin through heavy metals-based cosmetics in Kurdistan, Iraq using the Sbdaj foundation goes back more than 100 years. Sbdaj foundation is used to improve the appearance of human skin, it doesn't contain coloring, preservatives, and perfumes, it is a dry and loose oil-free face powder mixed with water it can be applied overnight and can be removed easily by soap and water. it can cover the skin, hide shine, zits, spots, absorbs oils, perspiration, and blemishes on the face. It can also be used to remove unwanted facial hair. Because of these properties, it has been considered a good product for years and is still being used to this day. However, no one has taken into consideration its bad side effects.

Exposure to UV from solar radiation can damage the skin [2]. The review research of powder used in makeup prod-

ucts serves as skin protection, UV protection, skin adhesion, makeup sustainability, and masking of skin flaws. Shape control, and surface treatment [3].

Studies demonstrate that lead can be absorbed via the skin, despite the fact that metal absorption through the skin is frequently disregarded [4], [5]. Within six hours of skin application, a study discovered that lead that has been absorbed via the skin can be found in perspiration, blood, and urine [6].

The analysis of cosmetic products is difficult due to their complex composition, and often involves a variety of methods, which can increase the possibility of making mistakes and increases the time of analysis. The solution to this problem may be the application of IR spectroscopic techniques. This is because minimal cosmetic sample preparation is required so that its composition is not significantly changed. The time of analysis is short and the results of such analysis are highly reproducible. Another advantage of IR spectroscopy is the ability to simultaneously obtain information about several of its components.

During the analysis of cosmetics with infrared spectroscopy techniques fingerprint method is used, so that IR spectroscopy can be used as an analytical sifting technique. The fingerprint region (1300-700) cm^{-1} has the characteristic arrangement of the molecule's bands. This range is used to identify a tested substance by comparing its spectrum with the spectrum of a model substance. The identity of both spectra in the fingerprint region is a confirmation of the identity of the tested compound with the standard one. Infrared spectroscopy methods allow not only for the determination of the composition of the cosmetic product in quantitative or qualitative terms, but can also be used in assessing the effectiveness of their components [5].

Furthermore, no studies have been done on Sbdaj to evaluate the kinds, amounts, and purposes of materials utilized in the production process. There are no published reports on any of the regional foundations.

The objective of this study was to determine the qualitative and quantitative multi-elements present in a traditional cosmetic foundation (Sbdaj) which is still used in Iraq, and a comparative analysis of a traditional foundation (Sbdaj) with a modern foundation (Vichy) by UV spectrum and FT-IR spectroscopy.

2. Material and Methods:

2.1 Origin of Sbdaj foundations available in Kurdistan:

The use of Sbdaj in Kurdistan goes back to the Industrial Revolution, it is not clear if it has come from Turkey, Iran, or the near Arabian countries. The Sbdaj as raw material which is an alloy of different metals is imported from different countries like Malizia, Iran, Turkey, and some Arabian countries. It is used for welding and covering the inner surface of some special pots that are made of copper.

Sbdaj Foundation is produced by melting down the Sbdaj using high temperature and an excess amount of lead is added and remains with a continuous stirring for about 4 hours until it becomes ash and left for another 8 hours in the kiln. After 12 hours of treatment with heat, it will be ready for sale. A part of the Sbdaj foundation is used for preparing a special type of soap used by women for washing their faces. Bath soap is shredded, sieved, put in a pot, and placed on the fire. Sbdaj foundation (powder) is gradually added to the mixture. Once it becomes firm, it is then poured into bowls, which then become what are called Sbdaj soap bars.

Sbdaj foundation and soap bars eventually reach the neighboring countries through tourists and businessmen.

Sbdaj is produced locally by women. Most of them have family roots in this business; they received training in Sbdaj foundation preparation from family members. There is no common and written procedure for the production process even if the same person is not using the same procedure continuously and no one can choose the types and the concentrations of the different metals since the raw material is received.

There are no regulations that apply to cosmetics on the market and the negative side effects are not registered.

2.2 Analyzing by X-Ray Fluorescence (XRF):

The Contents of major (SiO_2, Al_2O_3) and trace elements (Pb, W, Nd, I, Sn, Cu, Ni, and Cl) were determined by X-ray fluorescence (XRF), using Omnian calibration. The sample was oven-dried at 110°C for 24 hours and then crushed in an automatic agate mortar and pestle grinder passing sieve No. 200. The entail weight taken from the powder sample is 10gm mixed with 1 gm of Flux (Lithium tetraborate) later homogenized this mixture in a milling machine for 5 minutes. The processing is powder compound which means press powder pellet prepared from the homogenized sample. The diameter of the pellet is 37 mm.

2.3 Analyzing by Inductive Coupled Plasma Optical Emission Spectrometer (ICP-OES):

A 2100 DV Inductively coupled plasma-optical emission spectrometer was used for analyzing the Sbdaj Foundation to complete the results obtained by using XRF. The sample was digested by taking one gram of the sample dissolved in (6 ml) of HNO_3 and (3 ml) of HCl and heated up to 140^o C for about 30 minutes by multi-wave 3000 instruments. The same peroration is also used in the text analysis tool.

2.4 Analyzing by UV-Visible spectrum:

Analysis was carried out using Lambda 25, Ultra Violet, and Visible Spectrometer, the spectrophotometric analysis was carried out in the wavelength range: of 1200-190 nm with steps of 1nm, for studying the brightness of Sbdaj foundation, and obtaining the Ultraviolet absorption bands.

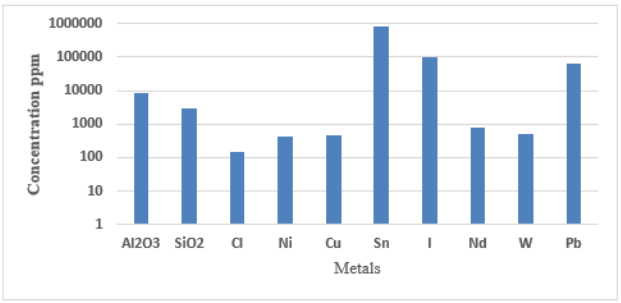

Figure 1. Elemental analysis of Sbdaj foundation using X-ray Fluorescence.

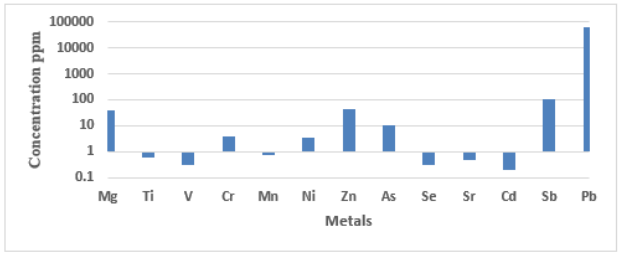

Figure 2. Elemental Analysis of Sbdaj Foundation using ICP.

2.5 Analyzing by FT-IR spectroscopy:

Spectra were recorded by FT-IR spectrometer (Perkin Elmer precisely) over the 4000-500 cm^{-1} range at room temperature, resolution 4 cm^{-1}, and maximum source aperture. Preparation of materials for spectroscopic measurement was based firstly on the application of a small amount of the greasy sample (Vichy) on the compressed KBr pellet or, in the case of powdery materials (Sbdaj), secondly the sample (∼5 mg) was mixed and ground in an agate mortar with 400 mg of spectroscopically pure dry potassium bromide to a fine powder and then it was pressed to form a disk less than 1 mm thick. Data were collected in the transmission mode at room temperature under air. Interferograms of 64 scans were averaged for each spectrum.

3. Results:

In this study, samples of Sbdaj powder were taken and analyzed for assessment of heavy metals by (ICP-OES) and (XRF). Results were presented in Table 1.

Concentrations in Sbdaj samples determined by (XRF) and by (ICP-OES) are shown in (Figure 1 and 2) respectively, the results of the mineral analysis showed that elements present in the highest concentration are (Sn, I, Pb, Al_2O_3, SiO_2, Nd, W, Cu, Ni, Cl, Sb, Mg, Zn, and As).

Figure 3 shows the results obtained by using the UV-spectrum, it shows that Sbdaj possesses an absorption band

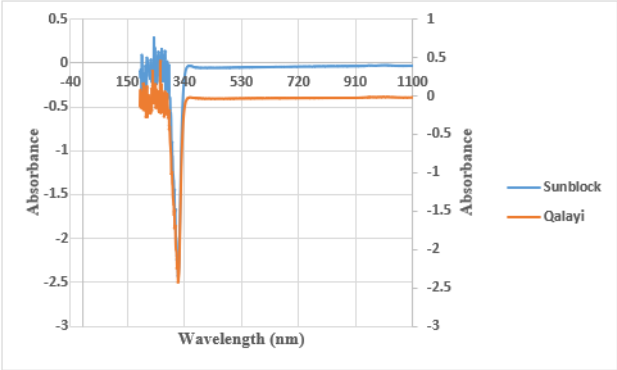

Figure 3. UV-Vis. spectra of Sbdaj foundation powder.

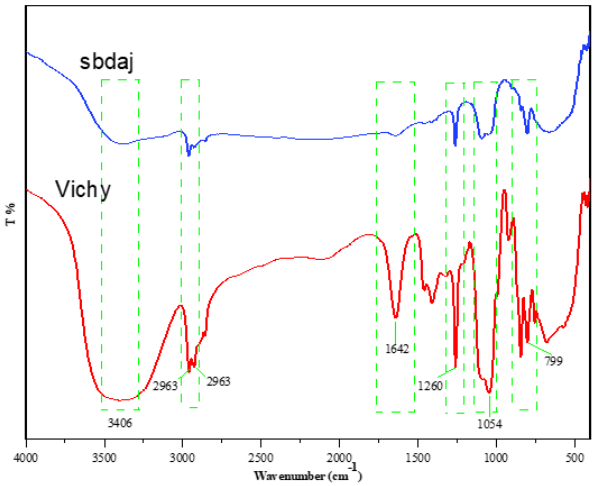

Figure 4. FT-IR spectra of traditional (Sbdaj) and modern (Vichy) foundation.

in the UVB region of the electromagnetic spectrum at 318 nm which is the same band possessed by Vichy sunscreen, a French industry product.

Figure 4 shows FT-IR spectra of both Sbdaj and Vichy foundation at IR region (4000-500) cm^{-1}, both spectra look nearly similar and appear typically characteristic of absorption bands. Each peak in FT-IR spectra corresponds to functional groups responsible for IR absorption. The peak assignment together with functional groups responsible for peak absorption in Figure 4 is shown in Table 2, and Table 3 for Sbdaj and Vichy foundations respectively.

4. Discussion:

Although there are no limit values for toxic elements to be used as cosmetics products in Iraq, it is obvious from the present study that the use of facial cosmetics like Sbdaj foundation exposes users to heavy metals. The concentration of lead 62117.79 ppm is high as compared with the US FDA

Table 1. Results for element concentration analysis by ICP-OES and XRF.

Table 1: Results for element concentration analysis by ICP-OES		Table 1: Results for element concentration analysis by XRF	
Elements	Concentration ppm	Elements	Concentration ppm
Mg	40.33	Al_2O_3	8640
V	0.291	Cl	148.2
Cr	3.887	Ni	426.8
Mn	0.777	Cu	469.7
Ni	430	Sn	792770
Zn	42.75	I	97760
As	10.301	Nd	777
Se	0.291	W	512.2
Sr	0.485	Pb	62000
Cd	0.194		
Sb	99.32		
Pb	62235.18		

limit for lead used in cosmetics which is 20 ppm [7], [8].

The concentration of Arsenic (As) is 10.3 ppm and of Antimony (Sb) is 99.32 ppm. A value more than 3ppm for (As) and 5ppm for (Sb) according to Canadian regularity limits [9] are considered technically avoidable [10], [11].

The frequent use of Sbdaj leads to hair loss in areas of the body exposed to it; this may be related to the presence of Arsenic with a concentration of 10.301 ppm. Ancient Turks made Rhusma a mixture of arsenic tri-sulphide quicklime, and starch to dissolve hair [12]. Arsenic does not only produce hair fall and skin diseases but also induces situations like cell stress which leads to other organ damage. On the other hand, it conducts with immunity and which finally linked with life-threatening cancer [13], [14].

The concentration of nickel 428.4 ppm exceeds the permissible limits of 5 ppm [15]. High levels of nickel in cosmetics increase the risk of allergic reactions [16], [17]. Copper concentration is 469.7 ppm, and toxicity of Copper can give rise to many psychological imbalances such as mood swings depression, anxiety, restlessness, and insomnia [18]. Iodine concentration is 97760 ppm, even though the actual concentration of iodine at which toxic symptoms may occur is unknown, systemic iodine toxicity has occurred following dermal exposures to iodine compounds, suggesting that these compounds of iodine are absorbed across the skin of humans [19].

The filtering of UV rays by Sbdaj is due to the presence of Zinc (42.75 ppm), the FDA has classified Zinc Oxide as a category of ingredient to be used in cosmetic products for blocking UV radiations [20].

The combination of zinc oxide with silica which is 2900ppm in Sbdaj acts as antibacterial activity and solar protection in cosmetic products [21]. The titanium of concentration 0.583 ppm also acts as a sunblock.

Titanium Dioxide acts as a natural sunblock and is three times a better covering agent than Zinc Oxide [22]. Aluminum Oxide is used as a factor with Titanium Oxide or Zinc Oxide to provide light stability in the makeup composition [23].

The presence of Silica, Zinc, Titanium, and Aluminum Oxide in Sbdaj acts as a natural sunblock leaving the skin pale. This is the desired skin color by the majority of people in the region, hence the reason for the continuous production and use of Sbdaj.

A significant concentration of Tin (Sn) has been found in Sbdaj 792779 ppm, this value is very high it can penetrate the body through skin contact [24].

Tungsten can enter the body through skin contact, and dermal exposure to Tungsten may result in localized irritation [25]. The concentration of Tungsten is 512.2 ppm in Sbdaj and it is high enough to cause a dermal effect. The concentration of Chlorine is 148.2 ppm, but no health effect was reported related to dermal exposure [26].

Neodymium concentration is 777 ppm, breathing the Neodymium dust can cause lung embolisms, and accumulated exposure damages the liver [27]. The levels of vanadium V, Chromium Cr, Manganese Mn, Selenium Se, Strontium Sr, and Cadmium Cd are small compared to other metals.

The use of Sbdaj Foundations exposes users to high levels of heavy metals. The toxicity of these metals is due to their ability to bind to oxygen, nitrogen, and sulfur groups in proteins, resulting in alterations in enzymatic activity [28]. The FT-IR spectra of the analyzed traditional foundation (Sbdaj) and modern foundation (Vichy) are shown in Figure 4, and Table 2 lists the functional groups that appear in the absorption bands in the spectra. A band indicating the presence of compounds -CH groups(2960, 2854 cm^{-1}), and a broad band of -OH at 3378 cm-1. The most intense band of Silica group is (1261-799 cm^{-1}), this band (657 cm^{-1}) and the band at 1054 cm^{-1} may also be indicative the presence of talc or mica[28], and carbonyl group is the band (1637 cm^{-1}).

These analysis results are consistent with the traditional foundation's (Sbdaj) ICP and XRF results, which show that the band indicates either talc or mica. Talc is a hydrous silicate

Table 2. functional groups responsible for peak absorption in FT-IR spectra for sbdaj foundation.

Frequency (cm^{-1})	Functional groups and mode the vibration
3378	OH (stretching)
2960	methylene(-CH_2-) group (stretching)
2854	Methyl(-CH_3) group (stretching)
1637	Carbonyl group (stretching)
1261	Si-CH_3 stretching
1092	C-O stretching
1054	Indicate the presence of talc or mica
799	Symmetric vibration of Si-O
657	Indicate the presence of talc or mica

mineral made of magnesium (Mg), silica (SiO_2), and contains trace amounts of aluminum, iron, manganese, and titanium. In contrast, mica is a monoclinic mineral with an octahedral complex aluminum layer sandwiched between two tetrahedral SiO-layer.

Table 3 shows the functional groups responsible for absorption bands in FT-IR spectra for modern foundation (Vichy), the broadband in the range (3200-3550 cm^{-1}) indicates the presence of intramolecular OH -bonding. The bands in 3000-2800 cm^{-1} (2959, 2856 cm^{-1}) indicate the presence of Aliphatic hydrocarbons in the tested foundation. The latter may be confirmed by analyzing the spectra in 1409 cm^{-1} (Aliphatic – CH groups) in Vichy, the band of SiO in the 1261-843 cm^{-1} range indicates the presence of silicate in Vichy foundation, the band (1642 cm^{-1} and 1044 cm^{-1}) characteristic for triisosterate (ester compound) as one of the ingredients of Vichy foundation. the sharp bands of 1261 cm^{-1} indicate the presence of Silica which refers to tri-ethoxysily Ethylene, and the presence of band 673 cm^{-1} may also indicate the presence of Talc or Mica [29]. Another compound whose presence can be confirmed when analyzing the obtained IR spectra is polyethylene glycol [29]. That is one of the ingredients of

Table 3. functional groups responsible for peak absorption in FT-IR spectra for Vichy foundation.

Frequency ($cm-1$)	Functional groups and mode the vibration
3392	OH (stretching)
2959	methylene(-CH_2-) group (stretching)
2856	methyl(-CH_3) group (stretching)
1639	Carbonyl group (stretching) of the ester bond
1409	methylene (-CH_2) group (bending)
1261	Si-CH_3
1044	C-O stretching
843	Symmetric vibration of Si-O (indicates the presence of talc or mica)
673	Indicate the presence of talc or mica

Vichy foundation. The bands characteristic for that compound are visible at 3392, 1639, 1409, 1044, and 843 cm^{-1}.

5. Conclusion:

Due to the high levels of heavy metals found in Sbdaj, widely used as a traditional cosmetic in the Kurdistan region, they must be thoroughly evaluated for their safety. Continuous use of this cosmetic product can increase the heavy metal level in the human body beyond acceptable limits. Quality control should test such items and assess if they are within the framings of the final product, and community awareness on the matter are necessary.

Strict legislation must be established to ban the use of Sbdaj, as the risks of this product outweigh the benefits, for more analysis of foundation FT-IR spectroscopy is used, which can be regarded as a rapid method for analysis of the different types of foundation.

From the analysis, the spectra of the two foundations appear that Sbdaj has nearly the same absorption band spectra as Vichy, which has nearly the same ingredient that contains paraffin, glycol, and silica compound also Talc or Mica, which is safe to use and identical to properties of cosmetic.

The result of this study shows that all essential quality of good cosmetics will be present in traditional foundation (Sbdaj), which consist of ingredients that can be used as a sunblock (biologically active), likely it is low cost and easily available in local market and it can be a brand as a Vichy foundation that is high -cost makes up.

Therefore, efforts were important to understand the indigenous knowledge about the use of (Sbdaj)as a traditional

foundation. The utilization of indigenous traditional cosmetics will increase the importance of the local cosmetic industry.

Selection of the appropriate technique must be dictated by the physical state, the content of water, consistency, and homogeneity of the cosmetic sample.

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Declarations:

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تقييم جودة المكياج التقليدي (السبداج) فى كردستان العراق

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الخلاصة

يعتبر استخدام (السبداج) المكياج المعدني التقليدي امرأ شائعاً في العراق وخاصة في كردستان. البحث المقدم يتضمن دراسه مقارنه للمكونات الكيمياويه لمسحوق السبداج ومستحضر اخر عصري وعالمي بماركه فيشي (*Vichy*) المستخدم لنفس الغرض، ذلك بإجراء الاختبارات التحليلية للمعادن الثقيلة والمحتويات الرئيسية باستخدام مضان الأشعة السينية وأطياف البلازما المقترنة بالحث بعد تحضير العينة بطريقتين مختلفتين. أيضا، تم أخذ طيف الأشعة فوق البنفسجية والتحليل الطيفي $FT-IR$ لأساس السبداج وواقي الشمس *Vichy* . القمم المكشوفة لامتصاص الأشعة تحت الحمراء لأساس السبداج هي (3378 ؛ 2960 ؛ 2854 ؛ 1637 ؛ 1261 ؛ 1092 ؛ 1054 ؛ 799 ؛ 657) cm^{-1} ، والتي سمحت بتحديد نطاق التذبذب الخطى ل (هيدروكسيل، ميثيل، كربونيل، مجموعة سيليكا، استر) على التوالي، بينما تم الحصول على أطياف الأشعة تحت الحمراء لأساس فيشي (3392 ؛ 2959 ؛ 2856 ؛ 1639 ؛ 1409 ؛ 1261 ؛ 1044 ؛ 843 ؛ 673) cm^{-1} ،التي تمثل نطاق التمدد ونطاق الانحناء لكل من (هيدروكسي، الميثيل، الإستر، الميثيل، السيليكا، الأثير) على التوالي، التي تعود إلى المكونات المستخدمة في هذه المستحضرات. تم تحديد محتويات العناصر الرئيسية (SiO_2 و Al_2O_3) والعناصر (Pb و W و Nd و I و Sn و Cu و Ni و Cl) بواسطة (XRF) . وبأستخدام ($ICP-OES$) تم تحديد وجود (Pb و Sb و Cd و Sr و Se و As و Zn و Ni و Mn و Cr و V و Ti). اظهرت النتائج بان نسبه المعادن الثقيلة في المكياج التقليدي يتراوح ما بين (0.194 إلى 62235.18 جزء في المليون). 0.194 جزء في المليون لكادميوم و 62235.18 جزء في المليون للرصاص. هذه النسب اعلى بكثير من الحد المسموح به للاستعمال. اظهرت الاشعه فوق البنفسجية للمستحضرين واحتواء كلتا المادتين على حزمه امتصاص للاشعة الفوق البنفسجيه عند الطول الموجي (318 نانومتر) وهذا يساعد على وقايه الجلد عن اشعة الشمس.

الكلمات الدالة: السبداج؛ فيشي؛ المعادن الثقيلة؛ البلازما المقترنة بالحث؛ التحليل الطيفي بلأشعه تحت الحمراء و تحويل فورير.

التمويل: لايوجد.

بيان توفر البيانات: جميع البيانات الداعمة لنتائج الدراسة المقدمة يمكن طلبها من المؤلف المسؤول.

اقرارات:

تضارب المصالح: يقر المؤلفون أنه ليس لديهم تضارب في المصالح.

الموافقة الأخلاقية: لم يتم نشر المخطوطة أو تقديمها لمجلة أخرى، كما أنها ليست قيد المراجعة.