ISRAEL ANTI-DRUG AUTHORITY

The Hebrew University of Jerusalem

The study of chemical differences of hashish from different sources seized in Israel.

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תקציר

קנאביס, בצורת הצמח והשרף, הוא הסם הפופולרי ביותר בישראל בשנים האחרונות. עד 2005, היו המקורות העיקריים של שרף הקנביס (הידוע גם כחשיש) בשוק הסמים הישראלי לבנון והודו. החשיש ממקורות אלה יכול להיות מובחן על ידי המראה החיצוני שלו. מטרת מחקר זה הייתה לבדוק האם יש הבדל באיכות החשיש מכל מקור .לצורך כך, כימתנו את הקנבינואידים הראשיים, קנבידיול (CBD), תתרהידרוקנבינול (THC) וקנבינול (CBN) של חשיש שנתפס בתפיסות משטרה ממקורות ידועים - לבנון, הודו ומרוקו, שהועברו למעבדה לכימיה אנליטית של המחלקה לזיהוי פלילי במטה הארצי של משטרת ישראל, ולאחר מכן לאוניברסיטה העברית לאנליזה כמותית.

התוצאות, המבוססות על תפיסות רבות ושונות, הראו כי CBD של חשיש מלבנון השתנה מ-5.69% ל-12.79% (ממוצע של 8.98 ± 0.59%) , THC של חשיש מלבנון השתנה מ-0.93% ל-4.20% (ממוצע של 2.38 ± 0.27%) , CBD של חשיש ממרוקו השתנה מ-1.52% ל-5.14% (ממוצע של 3.72 ± 0.19%), THC של חשיש ממרוקו השתנה מ-5.08% ל-13.41% (ממוצע של 9.21 ± 0.40%), CBD של חשיש מהודו השתנה מ-0.78% ל-13.13% (ממוצע של 4.59 ± 1.07 %), ו-THC של חשיש מהודו השתנה מ-0.53% ל-16.45% (ממוצע של 6.35 ± 1.50%).

באותו זמן, זוהו כמה קנבינואידים אחרים, שנמצאו בדגימות בכמות נמוכה יותר (זוהו - cannabidivarol , CBDV Δ^9-tetrahydrocannabivarol - Δ^9-THCV , cannabivarol - CBV , cannabichromene - CBC , monomethyl cannabigerol - CBGM , Δ^8- tetrahydrocannabinol - Δ^8 -THC , cannabielsoin - CBE ו-cannabigerol – CBG) . הדגימות, בעיקר מלבנון, מרוקו והודו, הוערכו לפנוטיפ הכימי (סוג תרופה וסוג סיבים) במטרה לקבוע את המקור הגיאוגרפי של דגימות אלה.

דגימות של חשיש מזויף שנתפסו בישראל ובצ׳כיה עברו אנליזה רגילה כצמח קנביס. ״חשיש ״ כזה יכול לסכן את בריאות המשתמש.

בנוסף, הוערך אופן השימוש בקנביס רפואי בישראל. נחקרו ההומוגניות של צמרות התפרחת הנקביות עם וללא העלים הקטנים שמסביב וגם רק של העלים הקטנים שמסביב, בצמחים שונים מאותו זן הקנביס, ובתוך צמח קנביס אחד. מהתוצאות נראה כי יש חשש שמטופל, גם כאשר הוא משתמש באותו זן ובאותה כמות של קנביס רפואי, יכול לעשן כמויות שונות של החומר הפעיל במסגרת הטיפול. מכאן, שמטופל אינו יכול להשתמש בעישון בניצן אחד, אלא יש לספק לחולים חומר צמחי הומוגני בעל תוכן ויחס קבועים של הקנבינואידים החשובים.

אם מטופל אינו יכול לסבול את העוגיות או את הטיפות השמנוניות מתחת ללשון, השיטות הנותרות הן עישון או אידוי. הצמח צריך לעבור סטריליזציה לשימוש בצורת אינהלציה בקרב חולים עם פגיעה במערכת החיסונית. נחקרה יעילותם של סוגים שונים של סטריליזציה.

דגימות מאותו זן קנאביס הומוגני הראו ריכוזים שונים של קנבינואידים לאחר סינון עם מסננות בעלות גודל רשת שונה. סינון פשוט יכול לתת חומר בכמות THC של כמעט פי שניים גבוהה יותר מאשר בצמרות התפרחת.

ריכוז הקנבינואידים מהצמח יכול להיות מוגבר על ידי הכנה פשוטה שנקראת "חשיש בועה". הוכח כי באמצעות שיטה מכאנית פשוטה זו אפשר להכין קנבינואידים טהורים יותר.

זנים שונים של קנאביס רפואי שגודלו בישראל הוערכו על פי תוכן קנבינואידי כמותי (CBD נמוך ו-THC גבוה, CBD גבוה ו- THC נמוך, CBD גבוה ו-THC גבוה, ובערך באותו ריכוז CBD ו-THC).

מוצגת סקירה של כל הזנים המשמשים לגידול קנאביס רפואי בישראל.

מוצגות תוצאותיהם של ניתוחים של מוצרי קנאביס שונים המיועדים לטיפול מכל המגדלים (צמרות התפרחת הנקביות, תמצית קנאביס בשמן צמחי, תמצית קנאביס, עוגיות קנאביס, חמאת קנאביס לאפיית עוגות, תמיסת קנאביס, קרם עור מקנאביס ותכשירים אחרים).

Abstract

Cannabis, both herbal and resin, has been the most popular illicit drug in Israel in recent years. Until 2005, the main sources of cannabis resin (known also as hashish) to the Israeli drug market were Lebanon and India. Hashish from these sources can be distinguished by its external appearance. The aim of this study was to find if there is any difference in the quality of the hashish from each source. For this purpose, we quantified the main cannabinoids, cannabidiol (CBD), Δ^9-tetrahydrocannabinol (Δ^9-THC), and cannabinol (CBN) of hashish from different police seizures of known origins, Lebanon, India and Morocco that had been submitted to the Analytical Chemistry Laboratory of the Division of Identification and Forensic Science (DIFS) at the Israeli National Police Headquarters and subsequently to the Hebrew University for quantitative analysis. The results, based on many different seizures showed that CBD of hashish from Lebanon varied from 5.69% to 12.79% (an average 8.98 ± 0.59%), THC of hashish from Lebanon varied from 0.93% to 4.20% (an average of 2.38 ± 0.27 %), CBD of hashish from Morocco varied from 1.52% to 5.14% (an average of 3.72 ± 0.19%), THC of hashish from Morocco varied from 5.08% to 13.41% (an average of 9.21 ± 0.40 %), CBD of hashish from India varied from 0.78% to 13.13% (an average of 4.59 ± 1.07%), and THC of hashish from India varied from 0.53% to 16.45% (an average of 6.35 ± 1.50 %).

At the same time several other cannabinoids, present in the samples in lower amount, were identified (cannabidivarol - CBDV, Δ^9-tetrahydrocannabivarol - Δ^9-THCV, cannabivarol - CBV, cannabichromene - CBC, cannabielsoin – CBE, cannabigerol monomethyl ether - CBGM, Δ^8-tetrahydrocannabinol - Δ^8-THC, and cannabigerol - CBG). The samples, predominantly from Lebanon, Morocco, and

India were evaluated for chemical phenotype (drug type and fiber type) in aim to determine the geographical origin of these samples.

Samples of false hashish seized in Israel and Czech Republic were worked-up for analysis and analyzed as usual for cannabis plant. Such "hashish" can endanger the health of a user.

I also evaluated the way of use of medicinal cannabis in Israel. Homogeneity of the female flowering tops with or without surrounding small leaves and just only surrounding small leaves from different plants of the same strain of cannabis and inside one cannabis plant was studied. From the results it is justified concern that patient even when using the same strain and the same amount of medicinal cannabis can smoke different amounts of the active compound for treatment. It means that patient cannot use for smoking just one bud, but it is necessary to supply patients with homogenized plant material with constant content and ratio of important cannabinoids.

If the patient cannot tolerate the cookies or the sublingual oily drops, the remaining methods are smoking or evaporation. The plant for inhalation must be for immunocompromised patients sterilized. The effectiveness of different kinds of sterilization was studied.

Samples of the same homogenized cannabis strain revealed different concentration of cannabinoids after sieving with different mesh size sieves. Simple sieving can give material with almost twice higher amount of THC than in the flowering tops.

Concentration of cannabinoids from the plant can be increased by preparation simple so called "bubble hash". It was proved that with this simple mechanical method can be prepared in much more pure cannabinoids.

Different strains of medicinal cannabis cultivated in Israel were evaluated according to the quantitative cannabinoid content (low CBD and high Δ^9-THC, high CBD and low Δ^9-THC, high CBD and high Δ^9-THC, and approximately the same content of CBD and Δ^9-THC).

Review of all strains used for medicinal cannabis cultivation in Israel is presented.

Results of analyses of different cannabis products for treatment from all growers are presented (female flowering tops, cannabis extract in plant oil, cannabis extract, cannabis cakes, cannabis butter for cakes baking, cannabis tincture, cannabis skin cream, and the other preparations).

Introduction

הדו"ח הבא מתאר מחקר שנעשה במשך 3 שנים על דגימות חשיש. הנתונים מתייחסים למחקר שנעשה אחת לחצי שנה וכוללים אנליזה ואבלואציה של קנאביס רפואי.

This report gives a brief overview of a three-year study of seized hashish samples analyses and evaluation of medicinal cannabis samples.

Part I – Seized hashish samples

A scientific literary review.

Cannabis, both herbal and resin, is the most popular illicit drug in Israel and accounts for about 70% of all the drug seizures that were analyzed in the Analytical Chemistry Laboratory of the Division of Identification and Forensic Science (DIFS) at the Israeli National Police Headquarters in the years 1995-2005. In recent years, cannabis resin, known also as hashish, has become more popular among Israeli drug users, who prefer it on herbal cannabis use and seek for new sources of supply. Most of the hashish enters Israel from Lebanon while in recent years India and Morocco have become a popular source of hashish for Israeli drug consumers.

Cannabis sativa L. (hemp) is a plant native to Central Asia that has spread all over the world and is probably the most widely used recreational and illegal drug in the world. Cannabis is a dioecious plant. K-N-B (probably ka-na-ba or qu-nu-bu), the early Sumerian/Babylonian word for cannabis hemp, enters the Indo-Semitic-European language family base, making it one of humankind's longest surviving root words. Already nine or ten thousand years ago the earliest known fabric was woven from hemp. 4700 years ago the first written record of cannabis use is made in the pharmacopoeia of Shen Nung, one of the fathers of Chinese medicine [1, 2].

Today about 30,000 publications appeared on the *Cannabis* subject. In *Cannabis* and its phytochemical products, hashish and marihuana, almost 900 natural compounds up-to-date were identified. One hundred and twenty of them are so called cannabinoid compounds (cannabinoids), which are typical for and present only in *Cannabis* plant [3, 4].

To evaluate the quality of *Cannabis* plant (e.g. drug type versus fibre type), several classifications, based on so called phenotype, in the past were suggested. The phenotype ratio (percentage of cannabinol + percentage of Δ^9-tetrahydrocannabinol divided by percentage of cannabidiol) was used to differentiate between drug-type and fibre-type cannabis plants. When the phenotype ratio was greater than 1.0 the plant was classified as drug-type; when less than 1.0 it was classified as fiber-type [5, 6].

In the past we studied the influence of climatic, meteorological, agricultural, and ecologic conditions on different types of *Cannabis*, cultivated in the same region. We proved that different meteorological conditions during different seasons of vegetation period and in the course of one vegetation period can influence the amount of the cannabinoid compounds in the plants, what can influence also the phenotype of the plants. Such *Cannabis* plant cultivated for fibers can be in favorable year drug-type plant [7-10].

Today it is accepted, that if the content of the Δ^9-THC exceeds in the dry flowering tops 0.3%, *Cannabis* is classified as drug-type [11, 12].

Methodology

Standard samples of the main cannabinoid compounds (cannabidiol – CBD, Δ^9-tetrahydrocannabinol - Δ^9-THC, and cannabinol – CBN) were isolated and purified in our laboratory by extraction and separatory methods (column chromatography, preparative thin-layer chromatography).

Procedure

20 mg of ground hashish sample was extracted with methanol and filtered through cotton in a capillary. Final concentration equals extract from 2 mg of

hashish with 50 μg internal standard (tetracosane) in 1 ml. Marihuana was extracted by the same way for final concentration equals extract from 5 mg of marihuana with 50 μg internal standard (tetracosane) in 1 ml.

One μl of this sample was injected to GC/MS for analysis.

Instrumentation

For quantitative analysis the samples were analyzed by GC/MS in a Hewlett Packard G 1800B GCD system with a HP-5971 gas chromatograph with electron ionization detector. The software used was GCD PLUS CHEMSTATION.

Conditions of the analysis

Column: SPB-5 (30 m x 0.25 mm x 0.25 μm film thickness). Experimental conditions: inlet, 250°C; detector, 280°C; splitless injection/purge time, 1.0 min; initial temperature, 100°C; initial time, 2.0 min; rate, 10°C/min; final temperature, 280°C. The helium flow rate, 1 ml/min.

Standards and solutions

Concentrations in methanol from 25.0 to 100.0 μg/ml of cannabidiol, Δ^9-tetrahydrocannabinol, or cannabinol were used for calibration curve together with 50.0 μg/ml tetracosane as internal standard.

Results

Hashish samples worked-up in different external appearance – big "sole", thin "chocolate", and “disk” were analyzed quantitatively for the content of three main

cannabinoid compounds – CBD, Δ^9-THC, and CBN – with the help of GC/MS. After separation it was, of course, possible to identify the other minor cannabinoids. As it was not the aim of this work, only several other cannabinoids, easily visible on chromatograms were identified qualitatively (CBDV, Δ^9-THCV, CBV, CBC, CBE, CBGM, Δ^8-THC, and CBG).

The appropriate cannabinoid acids, which are thermally unstable, are real cannabinoids in the plant and neutral cannabinoids originate from them by decarboxylation during ripening, drying and storage of the samples. They are also decarboxylated after injection to the gas chromatograph.

Several typical gas chromatograms with identified cannabinoids in hashish are shown on Figs. 1 – 5. These are samples of known origin from Lebanon, Morocco, and India. For comparison of these different places of origin, samples were compared for cannabidiol (Chart bar 1), Δ^9-tetrahydrocannabinol (Chart bar 2) and cannabinol (Chart bar 3) content in descending order of the found amounts of the appropriate cannabinoids.

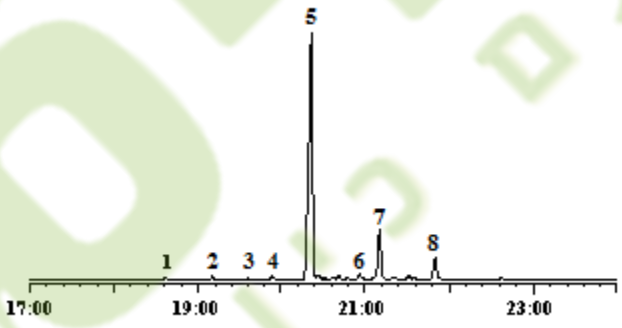

Fig. 1 Hashish sample (sole) from Lebanon.

Key: 1 – cannabidivarol (CBDV), 2 – mw 314□□3 - Δ^9-tetrahydrocannabivarol (Δ^9-THCV),□□ 4 – mw 314, 5 – cannabidiol (CBD; 17.24%), 6 – cannabielsoin (CBE), 7 - Δ^9-tetrahydrocannabinol (Δ^9-THC; 5.53%), 8 – cannabinol (CBN; 2.78%)

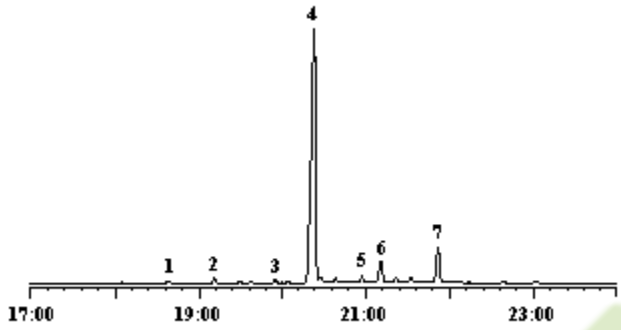

Fig. 2 Hashish sample (sole) from Lebanon.

Key: 1 – cannabidivarol (CBDV), 2 – mw 314, 3 – mw 314, 4 – cannabidiol (CBD; 9.42%), 5 – cannabielsoin (CBE), 6 - Δ^9-tetrahydrocannabinol (Δ^9-THC; 0.93%), 7 – cannabinol (CBN; 2.20%)

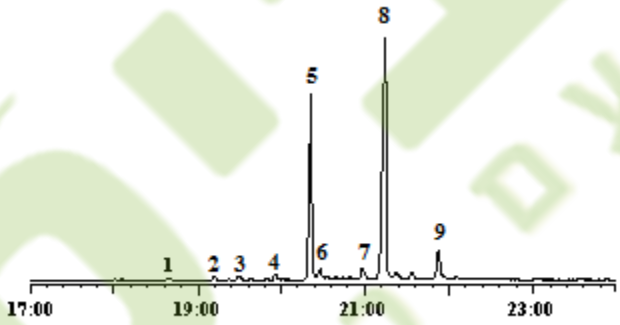

Fig. 3 Hashish sample (chocolate) from Morocco.

Key: 1 – cannabidivarol (CBDV), 2 – mw 314, 3 - Δ^9-tetrahydrocannabivarol (Δ^9-THCV), 4 – mw 314, 5 – cannabidiol (CBD; 2.98%), 6 – cannabichromene (CBC), 7 - cannabigerol monomethyl ether (CBGM), 8 - Δ^9-tetrahydrocannabinol (Δ^9-THC; 9.35%), 9 – cannabinol (CBN; 1.23%)

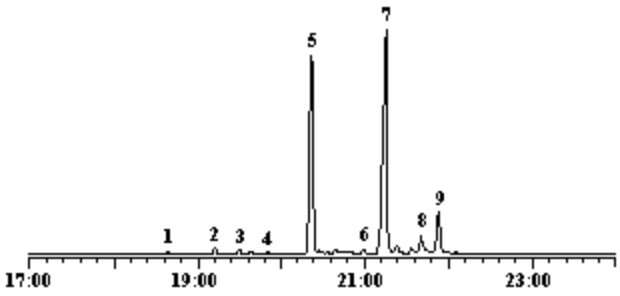

Fig. 4 Hashish sample (disk) from India.

Key: 1 – cannabidivarol (CBDV), 2 – mw 314, 3 - Δ^9-tetrahydrocannabivarol (Δ^9-THCV), 4 – mw 314, 5 – cannabidiol (CBD; 7.45%), 6 - Δ^8-tetrahydrocannabinol (Δ^8-THC), 7 - Δ^9-tetrahydrocannabinol (Δ^9-THC; 16.45%), 8 – cannabigerol (CBG), 9 – cannabinol (CBN; 3.33%)

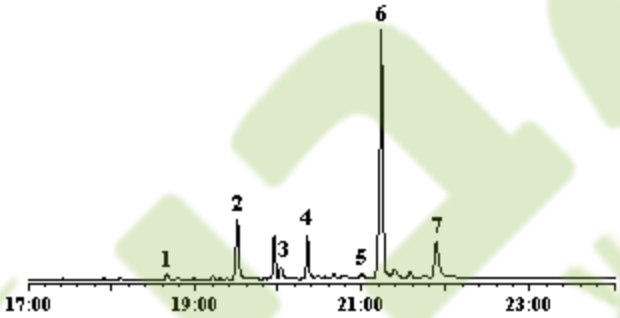

Fig. 5 Hashish sample (disk) from India.

Key: 1 – cannabidivarol (CBDV), 2 – Δ^9-tetrahydrocannabivarol (Δ^9-THCV), 3 – cannabivarol (CBV), 4 – cannabidiol (CBD; 0.74%), 5 - Δ^8-tetrahydrocannabinol (Δ^8-THC), 6 - Δ^9-tetrahydrocannabinol (Δ^9-THC; 11.70%), 7 – cannabinol (CBN; 1.98%)

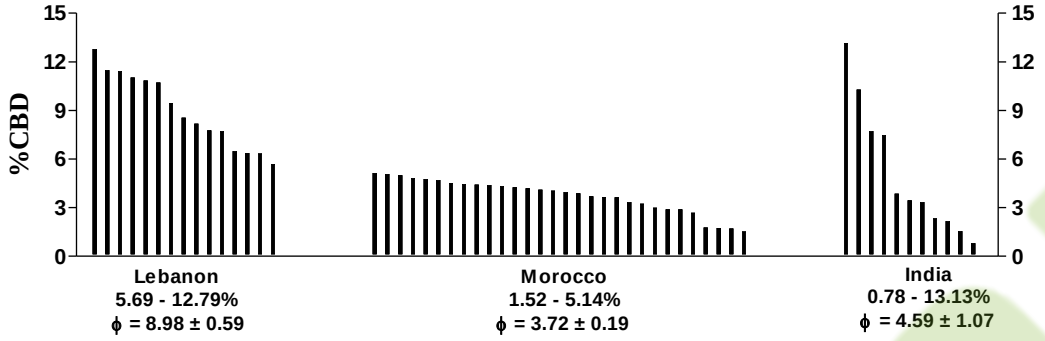

Chart bar 1. Cannabidiol content in the samples of known origin (samples arranged according to the descent content of CBD).

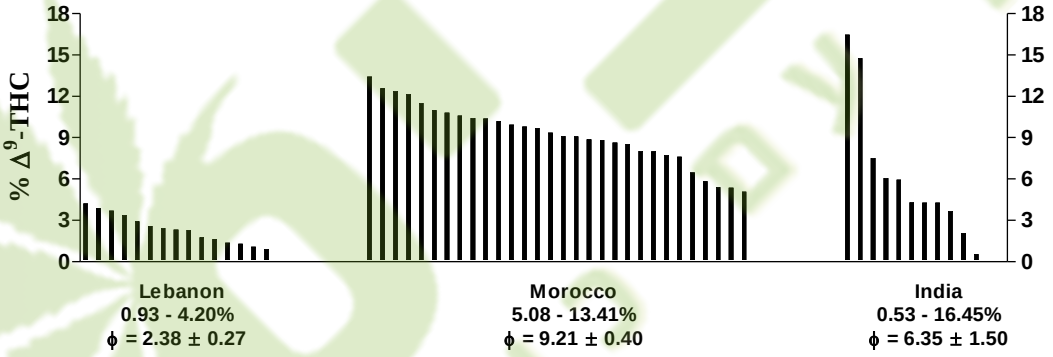

Chart bar 2. Δ^9-tetrahydrocannabinol content in the samples of known origin (samples arranged according to the descent content of Δ^9-THC).

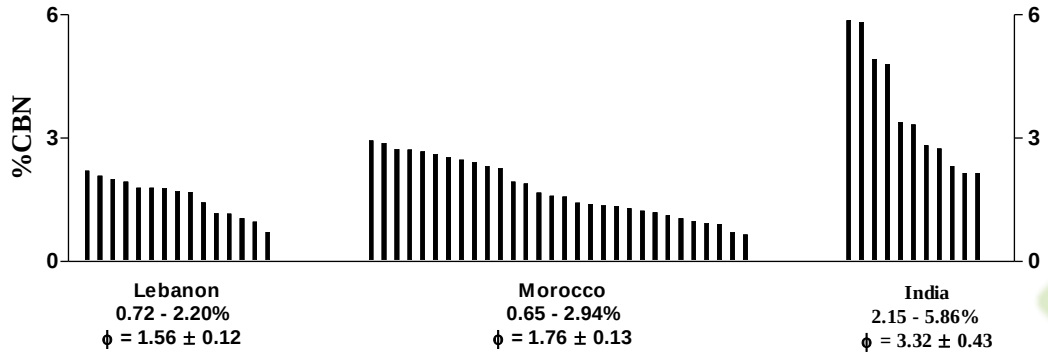

Chart bar 3. Cannabinol content in the samples of known origin (samples arranged according to the descent content of CBN).

Finally, each sample was evaluated according to the ratio of the three main cannabinoids (THC + CBN/CBD) and samples of different known origin were such compared (Chart bar 4).

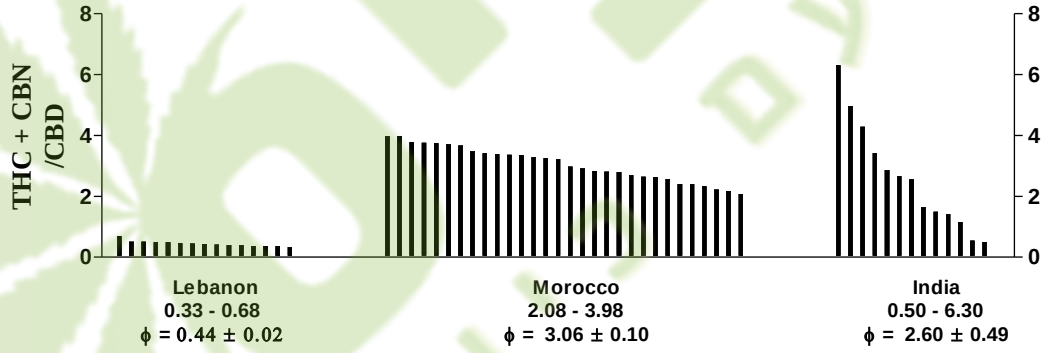

Chart bar 4. Phenotype of the samples of known origin (samples arranged according to the descending value of the phenotype) with three different used evaluations.

Discussion

To compare our result with the published ones is not such easy, as one can expect.

Different batches of cannabis resin from Lebanon were differentiated by comparing the principal cannabinoid contents – CBD, CBDA, CBN, and THCA [13]. Relations between chemical composition and geographical origin of cannabis studied Jenkins [14]. In cannabis of Morocco origin CBD, THC, and CBN were quantified. Cannabis plants from seeds of Morocco origin were cultivated in United Kingdom. In resin from Morocco illicitly imported to United Kingdom THC was quantified [15]. Quantitative determination the average levels of Δ^9-THC content of cannabis (leaves and inflorescences) in its 180 fresh male and female plants (0.1-2.2 per cent), 52 dry female plants (0.2-7.5 per cent) and 13 powdered plants (5.5-11.3 per cent) was published by Stambouli et al. [16] Male and female plant material (e.g. marihuana) was evaluated for CBD and THC content [17]. The aim to estimate geographical origin of cannabis samples with hydrocarbon content [18], cannabinoids content [7, 19, 20] and complex chemical profiles (cannabinoids and non-cannabinoids) [21] one can find in the literature [14,18].

Stability of Cannabis sativa L. samples (charas, ganja, and bhang) and their extracts, on prolonged storage was studied in India [22]. In all samples CBD, THC and CBN were quantified. Wild cannabis from different altitudes and locations, collected in northern India was analyzed quantitatively for ten different cannabinoids. The data obtained were compared with data obtained from the same variants grown in Mississippi [23].

Cannabinoid constituents (CBD and THC) of male and female Cannabis sativa from Lebanon and Morocco quantified Ohlsson et al. [24].

Variation in the THC content in illicitly imported Cannabis products of Lebanon, Morocco and India origin was determined [25, 26]. The same authors compared samples chemical features (CBD and THC content) in cannabis plants grown in United Kingdom from seeds of Morocco and India origin [27, 28].

Most of the hashish samples were of Lebanon, Morocco, and India origin. Analysis of these samples gave us possibility to compare the main cannabinoid amounts in samples of these three countries (Table 1). The chemotype appears to be genetically determined while the individual cannabinoid concentrations can be influenced by ecological factors.

Cannabidiol content (Chart bar 1) is high in hashish of Lebanon origin and low in Morocco ones. Samples from India showed spectrum from high to low CBD content. In all hashish samples of known origin CBD varied from 0.78% to 13.13%. Δ^9-Tetrahydrocannabinol content (Chart bar 2) is low in hashish of Lebanon origin and high in Morocco ones. Samples from India showed again spectrum from high to low Δ^9-THC content. The variation of Δ^9-THC content was from traces to 16.45%. Cannabinol content (Chart bar 3) is almost the same in the samples of Lebanon and Morocco origin and rather higher in hashish of India origin. All samples varied from 0.65% to 5.86% of CBN.

Phenotypic index is compared in Chart bar 4. Hashish of Lebanon origin shows fibre-type phenotype and Morocco drug-type phenotype. The only information we found in literature [20] concerning phenotype of hashish of Lebanon origin – 0.465 - is in agreement with our results (0.33 – 0.68). In hashish of Lebanon origin we detected also cannabielsoin. Hashish of India origin shows different hashish types from fiber- to drug-type phenotype. Phenotypic index and the amounts of the three main cannabinoids in the sample is very useful information about country of

origin, but one must take in account the history of the sample (country of origin, type of the plant [cultivated for fibers or for drug abuse], origin of the cultivated seeds, climatic and ecologic conditions in the year of cultivation and age of the analyzed sample), what usually in the seized samples is unknown.

Some samples of India origin showed higher amounts of propylcannabinoids. Cannabielsoin was identified rather in the samples of Lebanon origin. To identify country of origin of hashish samples, the three main cannabinoids have only informative value and it looks that some other compounds would be taken in account for this purpose (as for example terpenoid variation), but even in this small groups of samples were significant differences.

As there is not any generally used method for samples comparison (exact conditions how to work up the samples for analysis), we were unable to compare our results with the published ones. Nevertheless our results showed valuable values for comparison of resins of different sample origin.

Recommendation

Even when hashish became today already partly obsolete (as today cannot compete with highly active marihuana), analysis of it is still very important for forensic purposes. During analyses of hashish seized in Israel we can evaluate its activity, quality and ratio of so called cannabinoid compound, what can give us also picture about its origin. As common are seized hashish samples of Morocco or Lebanon origin, these two countries of origin can be easily distinguished after analysis of the three main cannabinoids (CBD, THC, CBN) as is described above. Samples of India origin are more complicated, but every time the content of

cannabinol is high. To distinguish between these three hashish samples the shape is also helpful.

Part II - Fake hashish

During the last years there is a new effort to earn money by illegal business with false hashish. The danger of this business is evident. Person buying these products obtain "hashish" which has almost nothing or nothing at all with real product (e.g. hashish) from Cannabis plant. The danger is serious – it is not only illegal sale, but also fraud and the last but not the least endangering the health of the buyer after smoking of such "hashish". Such "hashish" can be especially dangerous when used as medicinal cannabis, as in many countries use of medicinal cannabis is prohibited and patients in effort to treat themselves buy cannabis products on black market, what is for them every time potentially dangerous as from health and/or economic point of view.

Recently was seized in Israel and Czech Republic false hashish, which after analyses proved, that there are even no traces of the compounds, typical for Cannabis products. This gave us an opportunity to compare these samples after its analyses.

Samples of false hashish seized in Israel with strong smell of henna (Lawsonia inermis) were worked-up for analysis and analyzed as usual for cannabis plant. The conditions for analysis stayed the same as for cannabinoids. There was no other effort to find any compounds outside these conditions. The only exception was to check if there are as adulterations any other psychoactive compounds. The aim of

this study was to provide information without any additional analyses after such sample is analyzed for forensic purposes.

The sample seized in Czech Republic was without any typical smell and was worked-up by the same way as the sample from Israel.

For qualitative analysis the samples were analyzed by GC/MS in a Hewlett Packard G 1800B GCD system with a HP-5971 gas chromatograph with electron ionization detector. The software used was GCD PLUS CHEMSTATION.

Identification of some peaks was based on matching of their MS spectra with pure standards, reference information and the NIST 2005 and Wiley 7th Mass Spectral Libraries.

All the main identified compounds are in presented in Table 1. Several typical gas chromatograms with identified compounds in false hashish are shown on Figs. 6 – 9. As there is evident, that the main content compounds are from coniferous plants (the most probably from certain pine) and henna (Lawsonia inermis), we bought henna powder and compared the studied part of spectrum with this samples (light and dark henna). We did not find any other compound, typical for any other plant when analyzed samples using above mentioned conditions.

Table 1. Comparison of the compounds identified in two false hashish samples with the same one which are present in coniferous plants and henna.

compound	**Israel**	**Czech republic**	**pine resin**	**dark henna**	**light henna**
1 tetradecanoic acid	x	x		x	x

2 hexadecane-1-ol	x	x		x	x
3 palmitoleic acid	x	x		x	x
4 hexadecanoic acid	x	x		x	x
5 9-octedecen-1-ol	x	x		x	x
6 octadecan-1-ol	x	x		x	x
7 linoleic acid	x	x		x	x
8 oleic acid	x	x		x	x
9 α-linolenic acid	x	x		x	x
10 octadecanoic acid	x	x		x	x
11 pimaric acid	x	x	x		
12 sandaracopimaric acid	x	x	x		
13 palustric acid	x	x	x		
14 isopimaric acid	x	x	x		
15 dehydroabietic acid	x	x	x		
16 abietic acid	x	x	x		
α-humulene	x	x	x		
β-caryophyllene	x	x	x		
caryophyllene oxide	x	x	x		
dehydroabietic acid methyl ester	x	x	x		
α-longipinene	x		x		
(+)-longicyclene	x		x		
longifolene	x		x		
δ-cadinene	x		x		
isopimara-7,15-diene	x		x		
neoabietic acid	x		x		

linoleic acid	x				x
dodecanoic acid		x		x	
palmitelaidic acid		x		x	
cyclohexadecane	x	x			
oleyl alcohol	x	x			
1,4-benzenedicarboxylic acid	x				
D-glucose	x				
nonanoic acid		x			

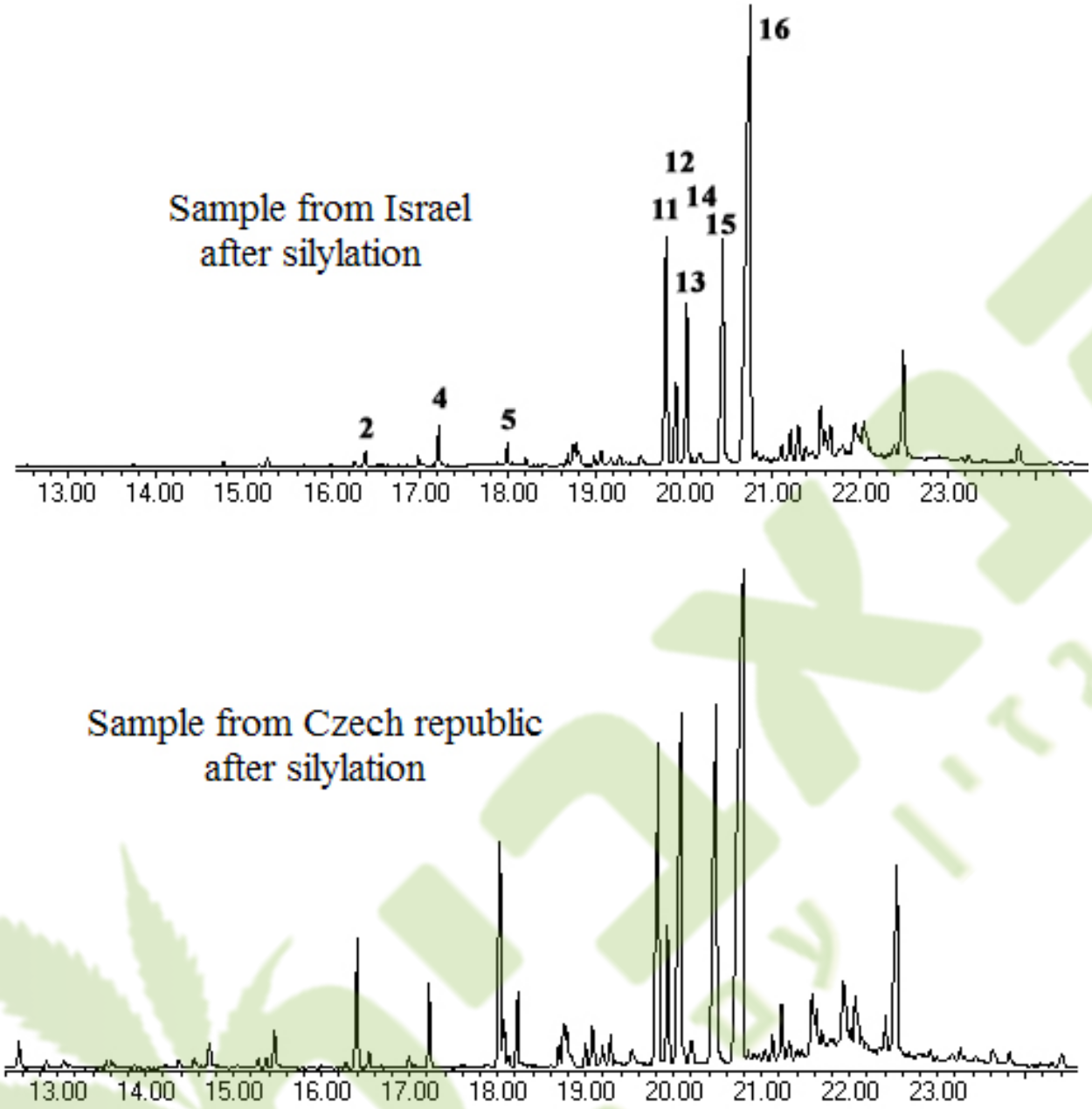

Fig. 6. Two different false hashish samples comparison under the same experimental conditions. Key: see Table 1.

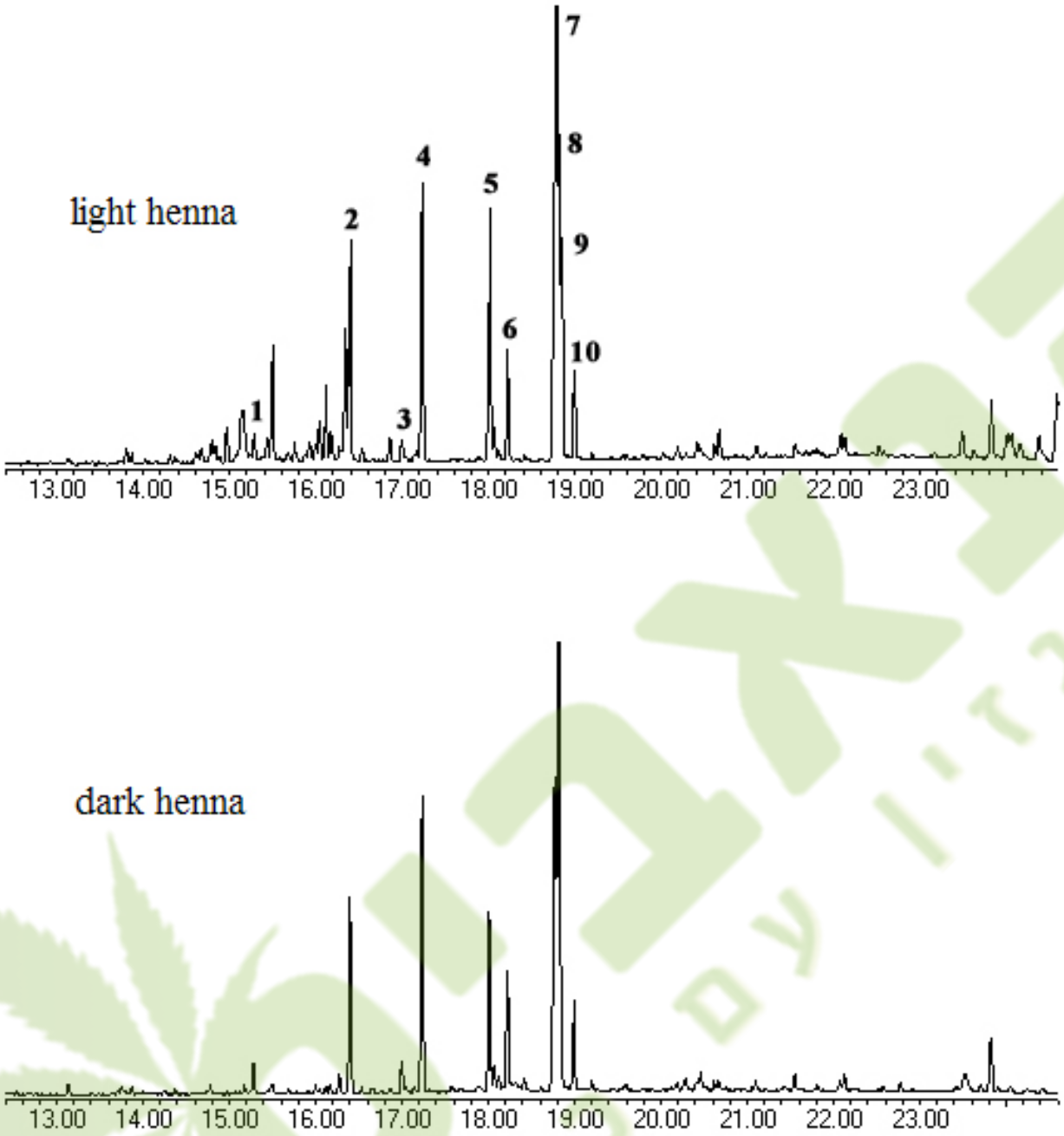

Fig. 7. Light and dark henna comparison under the same experimental conditions as false hashish. Key: see Table 1.

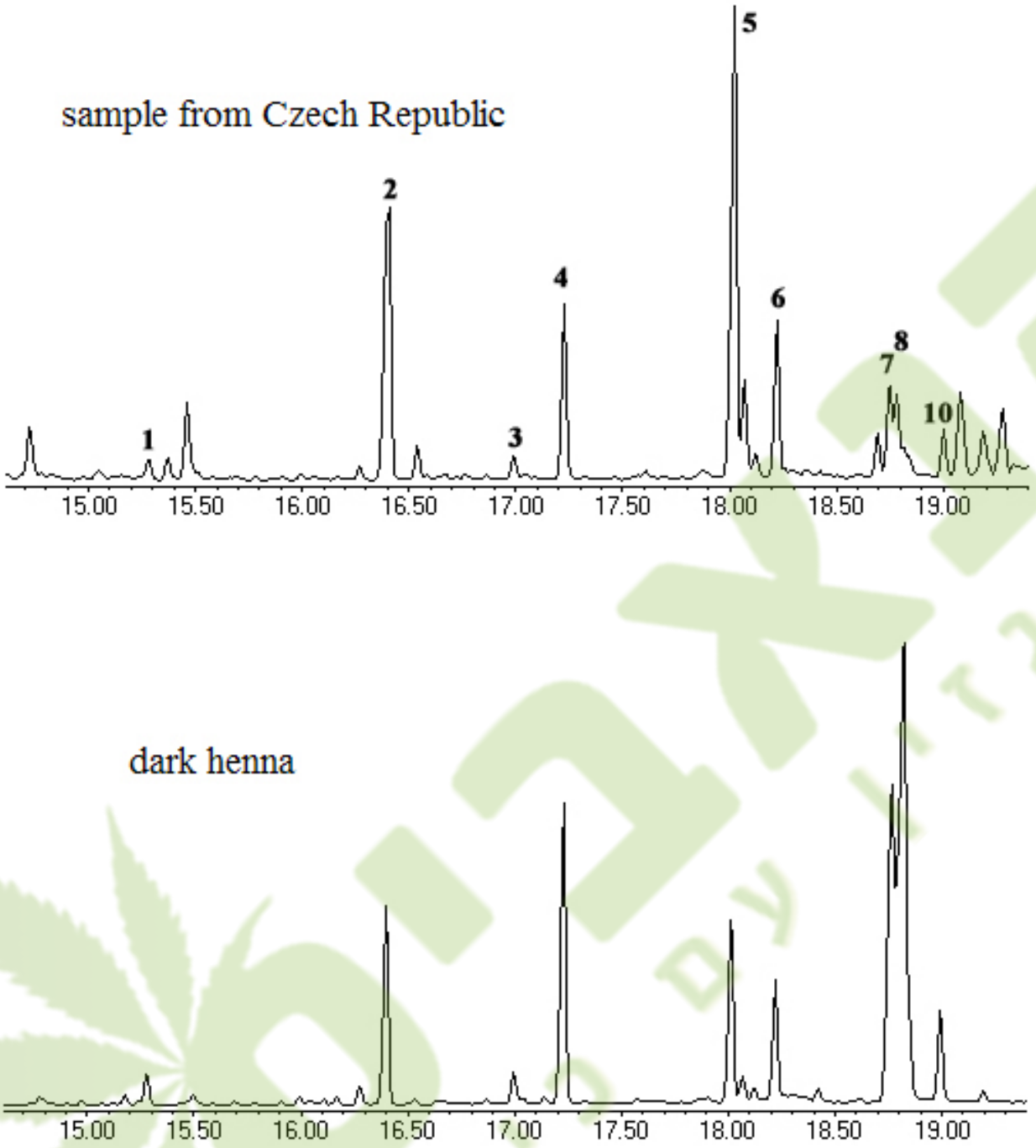

Fig. 8. Sample from Czech Republic and dark henna comparison (selected a part of chromatogram with for henna interesting compounds). Key: see Table 1.

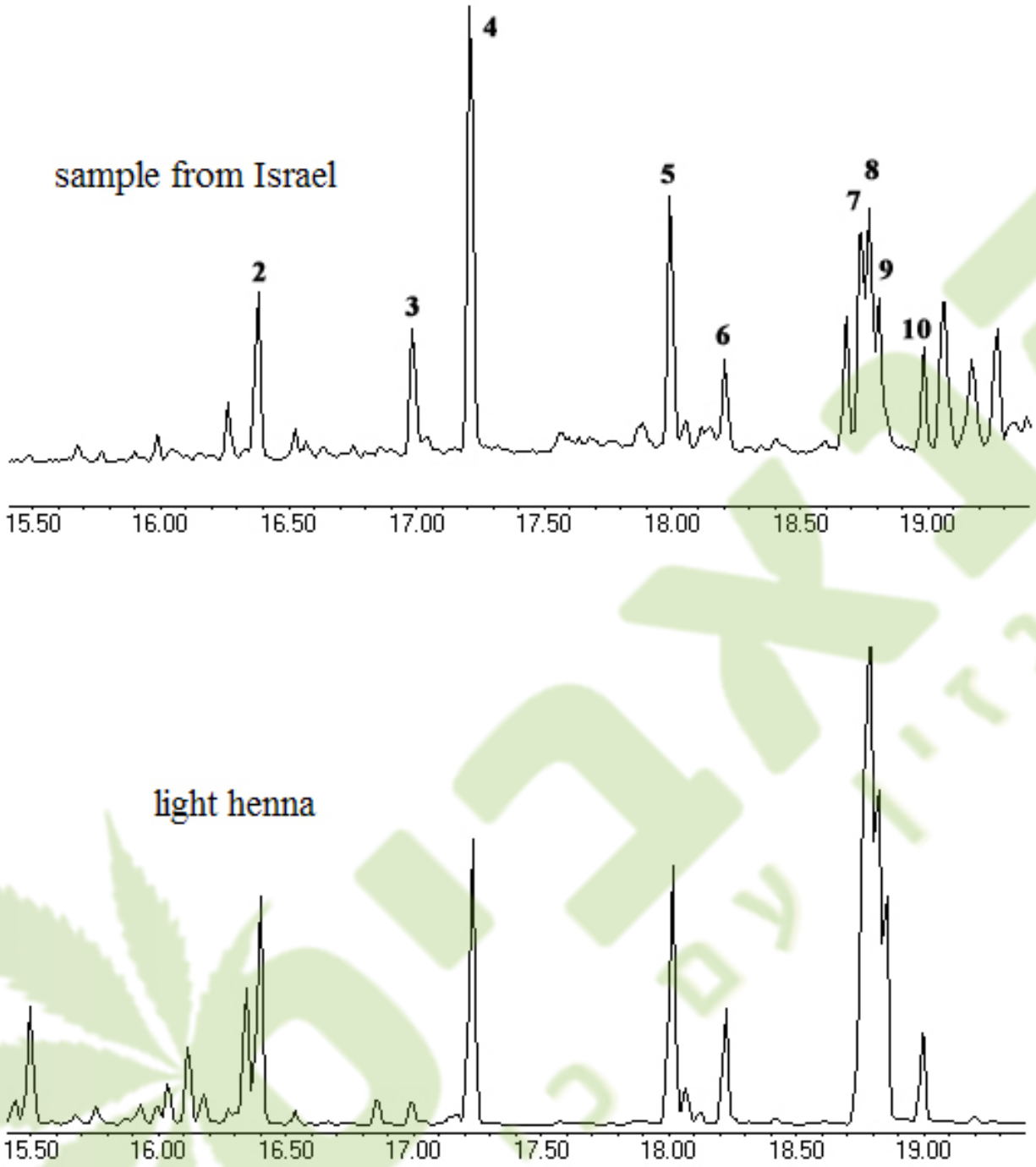

Fig. 9. Sample from Israel and light henna comparison (selected a part of chromatogram with for henna interesting compounds). Key: see Table 1.