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Variations of tetrahydrocannabinol content in cannabis plants to distinguish the fibre-type from drug-type plants*

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ABSTRACT

There are many different species of cannabis plants, but their psychoactive properties mainly depend on the concentration of tetrahydrocannabinol (THC), which may vary according to genetic factors and environmental influences. On the basis of the THC content all cannabis plants are divided into fibre-type and drug-type plants. The fibre-type plant does not exceed 0.4 per cent of THC while the drug-type plant usually contains up to 5 per cent of THC, though higher percentages (up to 10 per cent) have been reported. A study of the characteristics of cannabis seeds and the influence of environmental conditions on the content of THC in cannabis plants grown in northern, southern and insular Italy has shown that the fibre-type plants contain mean values of THC in a range from 0.058 to 0.299 per cent. The content of THC in the drug-type plants grown in Sicily and Tuscany ranged from 0.82 to 1.31 per cent $\pm$ 0.49 per cent. In 1984, the Commission of the European Communities prepared a regulation to prevent diffusion of the drug-type cannabis, providing that raw material could not be imported if its THC content exceeded 0.5 per cent from 1984 to 1987 and after that period the maximum limit would be set up to 0.3 per cent.

Introduction

Both the fibre-type and drug-type plants contain different concentrations of Δ^9-tetrahydrocannabinol, and other cannabinoids, including isomeric Δ^8-tetrahydrocannabinol, cannabinol (CBN) and cannabidiol (CBD). The concentration of cannabinoids in a cannabis plant depends on genetic factors and on environmental influences such as light, temperature, moisture and oxygen. In a mature plant the maximum content of psychoactive substances is in the flowering tops, much less in the leaves and traces only in the stems and branches [1, 2].

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The intensity of psycho-active activity of the preparations derived from cannabis* mainly depends on the concentration of tetrahydrocannabinol (THC) and to a certain degree on the mode of cannabis use. Cannabis is mainly smoked and less often inhaled or eaten. The intensity of the effects of cannabis use also depends on whether pure cannabis material (such as marijuana and hashish) is taken or cannabis in combination with other psycho-active substances, such as tobacco [3]. Cannabis smoking or inhalation acts much faster than its oral use. The inhalation of THC is 2.6 to 3 times more effective than THC ingestion [4]. The use of THC develops a high degree of tolerance, which requires substantial increase (10 to 20 times) of the initial doses [5].

The pharmacologic activity of THC use is usually measured in humans by the effects of such use on the heartbeat frequency, memory, attention, alert state, muscular co-ordination and electroencephalogram. In most cases THC dosage of 3 to 4 mg or higher give rise to significant changes in these parameters.

Characteristics of cannabis plants

The THC content of the different species of cannabis plants varies according to genetic and environmental factors [6, 7]. In the fibre-type plants the THC content does not exceed 0.4 per cent, while in the drug-type plants it exceeds this level, usually up to 5 per cent; but higher percentages, even up to 10 per cent, have been reported [2].

To distinguish the fibre-type from drug-type cannabis plants the following ratio was proposed: (CBN percentage + THC percentage)/(CBD percentage) [8, 9]. If the obtained ratio is greater than 1, the cannabis plant is classified as drug-type, and if it is less than 1, as fibre-type [8, 9]. In some cases, a young plant with a THC content less than 0.4 per cent can, however, be classified as drug-type, although the percentage of the active substances of the plant is low [10].

The fibre-type plants are legally cultivated in some regions of the Mediterranean area. During the last ten years there has been some uncertainty in the Italian law concerning the content of psycho-active substances in cannabis plants, which has led to a number of interventions of the legal authorities against the cultivators of the fibre-type cannabis plants [11].

* The term "cannabis" in this article refers to cannabis plant, resin and the psycho-active cannabinoids.

THC contents of fibre-type cannabis plants in Italy

During 1978 and 1979 the Agriculture and Forests Society, supported by the Istituto Superiore di Sanità, carried out research on the characteristics of different types of cannabis seeds and the influence of environmental conditions on the content of THC in the growing areas of northern, southern and insular Italy [12, 13]. During the first year of the project ten species of genetically differentiated hybrids were planted. During the second year of the project the aim of the research was to evaluate the individual variability of the THC content in the two species: *Carmagnola* and *Eletta Campana*. The first of the two species had previously yielded the lowest and the latter the highest THC content.

One hundred plants, 50 male and 50 female, were analysed in the Hygiene and Prophylaxis Laboratory of the Forlì Province [14]. The following analytical conditions were adopted: the chloroformic extract of the plant material was chromatographed on 1.2 m × 0.3 cm ID column of 2 per cent OV 17 supported on 80–100 mesh Chromosorb WHP. The separation temperature was 235° C using helium as carried gas and decachlorophenyl as internal standard. The mean values of the THC content of the plants grown in the three areas ranged from 0.058 to 0.299 per cent of the total dry substance. The THC content in flowering tops of the male plants was considerably smaller than in the female plants. In *Carmagnola* species, the THC content for the male plants ranged from 0 to 0.04 per cent and a similar result was obtained for the female plants. In *Eletta Campana* species, the THC content of the plants grown in the two peninsular areas of Italy for both male and female plants ranged from 0 to 0.04 per cent, whereas in the area of insular Italy it ranged for male plants from 0.12 to 0.16 per cent and for female plants from 0.20 to 0.24 per cent.

THC contents of drug-type cannabis plants in Italy

The minimum THC content (0.82 per cent) was found in flowering tops of female fecundated cannabis plants seized by police in Sicily and the maximum (0.96 per cent) in female non-fecundated plants [15]. In both cases plants were cut at the beginning of the flowering stage. The THC content found in 114 young and adult cannabis plants in Tuscany was 1.31 per cent ±0.49 per cent [16].

Regulation to prevent diffusion of drug-type cannabis plants

The results of research carried out in Italy and other countries in Europe have made it possible clearly to distinguish fibre-type from drug-type cannabis plants. Such a distinction is based on the percentage of THC

content found in a given cannabis plant. In order to avoid the diffusion of the drug-type cannabis plants, the Commission of the European Communities reached an agreement in 1984 to regulate the matter [17]. The following are the main points of the regulation draft:

(a) The import of cannabis and cannabis seeds, not offering enough guarantees for the safeguard of human health, should be avoided; to this end controls on the imports of this product should be set up;

(b) Raw cannabis may be imported only if its THC content in weight, compared to the weight of an adequately defined sample, does not exceed 0.5 per cent for the period 1984—1987 and is less than 0.3 per cent for the following years;

(c) Sample-taking as well as analyses of the THC content should be performed according to a uniform method to be followed by the countries of the European Community;

(d) The determinations needed for the analyses must be carried out on a sample of the product to be imported and the sample must be prepared and dried according to specified conditions;

(e) The sample includes the upper third of the plant or the entire plant deprived of the stems and seed, in case the upper third of the plant cannot be separated;

(f) The sample should be dried to constant weight under control.

With a view to revising the schedule of the Single Convention on Narcotic Drugs [18], some Member States have expressed the opinion that, on the basis of THC content, the distinction should be made between the drug-type and fibre-type cannabis plants, setting as a discriminating value a threshold content ranging from 0.3 per cent to 0.5 per cent of THC obtained from the flowering tops and from the leaves of any section of the plant.

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