Variability of Alkaloid Content in Accessions of Winter Poppy Ecotype (*Papaver somniferum* L.)

F. Petheő, J. Bernáth and A. Sztefanov
Department of Medicinal and Aromatic Plants
Szent István University
H-1052, PO Box 53
Hungary, Budapest

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**Abstract**

In Hungary, 10 poppy cultivars of “spring-sown” type are registered with different alkaloid contents of dry capsule. There is only one cultivar 'Kozmosz’ of “winter” poppy ecotype with medium-high alkaloid content (4-6%). Our idea was – in conformation with international efforts observed in poppy breeding – to select plant material of winter type with low-, high-, or special alkaloid content, which can be cultivated under the Hungarian ecological conditions. A total of 30 winter poppy populations of gene bank origin were involved into the investigations. The quantitative and qualitative determination of morphine, codeine and thebaine were done with thin-layer chromatography and densitometric evaluation. All populations seemed to have middle alkaloid content ranging their mean morphine content between 1.5 and 4.5 % with individual values of 0.2-10.0%. The relatively high individual variability found in the alkaloid content of populations provides an excellent basis for the further selection.

**INTRODUCTION**

Poppy is one of the most important medicinal plants. The processing of opiate-alkaloids in the pharmaceutical industry has increased during the last two decades and further increase is expected. Hungary provides about 4-10 % of the production of morphinan alkaloids in the world. A total of 10 poppy cultivars of “spring-sowing” type are registered for producing industrial raw material as well as seed in Hungary (Anonymous, 2000). Of these have high alkaloid content and are cultivated under controlled conditions only. The other ones produce capsules with medium-high alkaloid content (4-6 %) and can be cultivated without restrictions. Furthermore there is only one cultivar Kozmosz’ of “winter” ecotype (autumn-sown and over-wintering in rosette stage). This ecotype is widely spread in the surrounding countries, especially in Bulgaria. It is an advantageous characteristic of winter poppy that the seed and dry capsule production is higher with 30-50 % in Hungary, comparing to the spring ecotype (Földesi, 2000). Our idea was – according to the international poppy breeding efforts (Bernáth and Németh, 1999) – to look for plant material with low-, high-, or special alkaloid content, which can be cultivated under the Hungarian ecological conditions. Investigations have been started by the comparative analysis of cv. ’Kozmosz’ and other “autumn sown” types available in gene banks of Hungarian, as well as in collection of our Department.

**MATERIALS AND METHODS**

A total of 30 different winter poppy populations of gene bank origin were involved in investigations. Field experiments have been done at the Experimental and Research Station of the Department, at irrigated area. Poppy seeds were sown 29th, September, 1999 into blocks of 5 m², plant density was set 50 x 5-10 cm with thinning. Mechanical weed-control was applied. Morpho-phenological observations were done during the growing season. Capsules were harvested at the stage of full ripening in the case of all populations, which varied according to length of their vegetation cycle. Analysis of active compounds were done with TLC method worked out at the
RESULTS AND DISCUSSION
In the course of investigations, 30 populations of different origin were studied. As a result of the comparative analysis of alkaloid content the following results were obtained:

In the case of cultivar 'Kozmosz' 4 % was the average morphine content of the dry capsule (individual values ranged between 1 % and 7 %), while 0.5 % of codeine, 0.7 % of thebaine, 0.2% of narcotine were determined (Fig. 1).

The alkaloid content measured in populations of Hungarian gene-bank origin with bluish-grey seed-colour can be characterised as follows:

- comparing to cv. 'Kozmosz' lower alkaloid accumulation level was measured in majority of populations, however, the average value of morphine content was 4.5 % (with 1.5 and 10 % extreme values). Furthermore 0.5 % accumulation of codeine, 0.7 % of thebaine and 0.1% of narcotine was observed,

- in the case of 6 other populations the average values of morphine ranged between 1.5 % and 3 % and there were some individuals in which the morphine was found in traces, only (Fig. 2). On the other hand, codeine, thebaine and narcotine contents were similar to or lower than that of the 'Kozmosz'.

The alkaloid content measured in bluish-grey seeded population of Moroccan origin was as high as 3 % morphine (with individual values of 0.2-6 %), 0.2 % codeine, 0.3 % thebaine and 0.1 % narcotine levels in average (Fig. 3).

The other 21 populations involved in the experiment could be characterised by unfavourable features, e.g. open capsules, brown or light grey seed colour. Their average morphine content was 1.5-3.5 % showing low accumulation levels of codeine, thebaine and narcotine, similarly to the other populations.

According to our results all populations of winter poppy which were investigated by us have a middle level alkaloid content ranging between 1.5 and 4.5 % of morphine. However, there is a large variability within populations in conform with results of earlier investigations of similar subject (Dobos and Vetter, 1997). Based on these findings the individual selection of populations completed with selfing - would result in a winter poppy cultivar of high productivity similar to the individual selection applied in the case of spring populations with success (Petheő et al., 2000) satisfying the demand of pharmaceutical industry. At the same time this form of selection may be effective to produce cultivars of low alkaloid content, (Straka et al., 1993), which may be a goal of our further selection too, getting morphine free winter poppy lines as well.

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Literature Cited

**Figures**

Fig. 1. The frequency-diagram of individuals of the cultivar `Kozmosz` according to the morphine content of the dried poppy capsule

Fig. 2. Average morphine content of dry capsules of winter poppy populations
Fig. 3. The frequency-diagram of individuals of winter poppy population with Moraccan origin according to the morphine content of the dried poppy capsule.