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Challenges and Opportunities in Genetic Improvement of Essential Oil-Bearing Damask Rose (*Rosa damascena*): A Review

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Abstract: Damask rose cultivated for essential oil production mainly used in perfume industry. Due to the highly perishable flowers, post-harvest handling of the flowers prior to oil extraction would be considered as a key point in rose essential oil production. Besides its major application in aroma and cosmetic industries, rose essential oil has been reported with valuable pharmacological properties such as antibacterial, antioxidant, and cytotoxic activities. Plant breeders are being encouraged to develop new damask rose cultivars with improved oil content and higher flower yield qualities due to rising market demand. The aforementioned qualities can be improved using traditional breeding methods such as clonal selection and intra-specific hybridization. But, through the convention breeding method creation of genetic variation is time taking, and the preservation of the authentic scent and quality of the rose oil is very difficult. Recent breakthroughs in molecular-markers techniques, genomics, and transcriptomics, have resulted in large volumes of data being generated in damask rose. Several attempts have been undertaken to accelerate the breeding of *R.damascena* using molecular technologies. However, due to the species' high heterozygosity and polyploidy nature, translating the findings of such studies to practical breeding remains a significant challenge. This review paper outlines recent advances in conventional and modern molecular breeding procedures, as well as their potential uses and limitations in improving the oil-bearing rose.

Keywords: Damask Rose, Cosmetic Industries and Essential oil.

Introduction

Rosa damascena Mill is the hybrid between *R. gallica* and *R. phoenicia* and is the member of Rosaceae family with more than 200 species and 18,000 cultivars around the world. *R. damascena* as the king of flowers has been the symbol of love, purity, faith and beauty since the ancient times. It was originated from Iran and essential oil extracting from its

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flowers has been started since 7th century A.D. It was brought to Europe and has been cultivated in European countries. Nowadays, Bulgaria and Turkey are the main producers of *R. damascena* essential oil in the world and the Bulgarian *R. damascena* oil is the known best ones. These components contribute mainly to the perfumery values of rose oil (Baydar and Baydar 2005).However, some minor components such as damascenon and rose oxides are considered for adding value of more than 90 percent to the total aroma impression in the essential oil of *R. damascena* (Baldermann *et al.* 2009). Moreover, there are many factors besides genotype that also play a major role in determining the quality of rose oil such as propagation method, growth condition, harvesting procedures, method of distillation, time and level of pruning, time of flowers harvesting, storage of plant material, and prevailing climatic conditions (Babu *et al.*, 2002, Kumar *et al.*, 2013, Kumar *et al*. 2016a, Thakur *et al*. 2019).

Damask Rose (*Rosa damascena*)

Clonal Selection, infra-specific hybridization, and cross-breeding.

The fragrance and cosmetic industries, which are the main consumers of rose oil, are keen on protecting and maintaining the rose oil's unique scent and purity. The preservation of the authentic scent and quality of the rose oil is an absolute prerequisite for oil rose breeding

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programs (Rusanov *et al.* 2009a). As a result, conventional clonal selection has been extensively used for the production of R.damascena cultivars with high oil content.

Rose essential oil:

Rose essential oil is pharmacologically and cosmetically known as the main product. Studies showed that the oil exhibited antibacterial, analgesic, anti-inflammatory, antitussive, antispasmodic, and hypnotic effects. However, proved analgesic and antinociceptive, hypoglycemic, and laxative properties have also been reported from other rose preparations as the main ingredient. The mentioned study also showed that the amount of rose alcohol was increased from 55.25% to 83.41%, with increasing of the pressure and temperature (13). However, in our research, geraniol was not detected in samples yielded traditionally.

Application of biotechnological tools

In the genetic improvement of damask rose, conventional breeding methods depends primarily on the selection of morphological traits from a huge population, which is a time-consuming process (Canl and Kazaz, 2009). Furthermore, identifying genotype just based on

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morphological variation would be insufficient, as they are strongly influenced by environmental factors (Mostafavi *et al.*, 2021). The application of biotechnological tools will help in the transfer of novel traits like disease.

IMPROVEMENT OF OIL-BEARING DAMASK ROSES

Prerequisites and limitations rose oil production is a very old industry based on cultivation of damask rose cultivars originating from one superior genotype (*R. damascena* 'Trigintipetala'). The cultivation of other rose cultivars results in distillation of considerably lower amounts of rose oil possessing a different composition and odour. The century old traditions to produce the finest quality of rose oil, its high and constantly growing price and well established world market make rose growers, rose oil producers and consumers very conservative and reluctant to introduce and use new genotypes since they will likely result in rose oils with a different composition and odour. Thus, the preservation of the traditional odour, essential characteristics and composition of the extracted rose oil are the ultimate prerequisites for evaluation of new rose cultivars as well as any changes in flower collection and distillation practices. This is the main reason cross-breeding is traditionally avoided in the improvement of oil-bearing damask roses.

Current status of oil rose breeding

As discussed above, hybridization was generally not applied for the improvement of oil-bearing damask roses. Some hybrids of *R. damascena* with *R. gallica* and other rose species demonstrate greater tolerance to diseases and extreme environmental conditions. In spite of this, they have not been used for industrial cultivation since the characteristics of the obtained rose oil did not match rose oil standards (Staikov and Kalaijiev 1980).

Conclusions

Damask rose cultivated for essential oil production mainly used in perfume industry. Due to the highly perishable flowers, post-harvest handling of the flowers prior to oil extraction would be considered as a key point in rose essential oil production. Besides its major

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application in aroma and cosmetic industries, rose essential oil has been reported with valuable pharmacological properties such as antibacterial, antioxidant, and cytotoxic activities.

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