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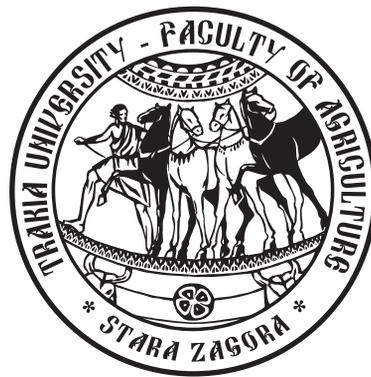
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Accumulation dynamic of *Ruta graveolens* L. essential oil

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Abstract. In the vegetation of rue the content of essential oil in fresh leaves herb doesn't change and it maintains constant value of 0.1%. However, there are significant changes in content of essential oil of the inflorescence in order of 4-5 times with the lowest values 0.07 -0.1% in stage beginning of blossoming and the highest 0.26-0.49% in stage wax ripeness. Important changes in content of essential oil occurred after the drug drying – it increased to 4-5 times in leaves and inflorescence gathered in stage full blossoming, but in wax ripeness with 2.8 times. The essential oil composition has presented that the main ingredient 2-undecanone increased slightly from 62% in stage full blossoming to 70-73% in stage wax ripeness. In same time 2 – nonanone decreased from 21% to 14%. In some samples gathered in stage wax ripeness has been observed increasing of 2-nonanone to 21%.

Keywords: *Ruta graveolens*, essential oil

Introduction

Rue (*Ruta graveolens* L., *Ruta hortensis* Mill. is perennial herb from family *Rutaceae*. Dry herb gathered in time of blossoming has a wide phytotherapeutic effect toward insomnia, bacterial infection in gallstone disease and reproductive system, arthritis, epilepsy, sexual weakness and etc.(Manolov and Manolova, 2005). Rue essential oil has light yellow to transparent white colour with green tint, with strong sharp specific scent and bitter taste, dissolves itself in 70% ethanol 1:4. Its perfumery valuation is high and one is used successfully perfumery and cosmetics purposes. The essential oil quality and its perfumery valuation are affected largely by content to 2-undecanone that is the highest in unripe fruit distillation. (Mustyace, 1988)

The rue occurs in wild form in the Mediterranean, the Balkan Peninsula, Baltic and Crimea. In Bulgaria the natural habitats are extremely limited and there exist along the Black Sea, the Rhodope mountains, low parts in Balkan mountain and north-east part of the country. The rue is protected by Bulgarian law it is included in Bulgarian red book such as a variety endangered to disappearing wherefore exploring opportunities for cultivation in Bulgaria is especially important(Anchev et al., 1995).

Initial experiments to rue cultivation in Bulgaria has been taken since about 60 years, 30 years later species was investigated in detail about ecological, biological, physical and chemical studies by Antonina Vitkova. There are controversial dates in respect of appropriate gathering technology of raw material rue. From one hand several explorers have ascertained that during vegetation the highest values essential oil have been reported in stage green – ripe fruits.(Claben and Knobloch, 1985; Mustyace, 1988). From another hand in technology about growing and harvesting rue has recommended the hay-making to be done in stage end of blossoming in height 12-15cm from soil surface (Staikov et al., 1969; Mustyace, 1988; Vitkova, 1998) The aim of current study is to optimize the technology of rue gathering by reason of these controversial opinions.

Material and methods

Plant material has been gathering from marked plants grown in collection garden in Institute of roses and aromatic plants during 2004-2009 year. Microdistillation analyses has been made by water distillation in laboratory glass apparatus of British pharmacopoeia type Klevendzher modified by Balinova and Diakov for 2 hours. A gas-chromatography analysis has been made by Gas chromatograph – Paiunicam 204 with flame ionization detector, non-polar capillary column 30m lengths and etc.

Results and discussion

The content of essential oil in inflorescence of rue varies in widely borders from 0.7% to 0.49%. Investigation conducted about dynamics of accumulation of essential oil during rue vegetation indicates the highest values are reported in stage wax ripeness. The variations in content of essential oil in the leaves material are insignificant; they alter about 0.1% in fresh herb that means there isn't transfer from one plant organ to another during vegetation. Synthesis and accumulation of essential oils in rue are performed predominantly in the generative organs and they are mainly revealing during seed forming stage. Investigated population of rue is too heterozygous both morphological indication and its ability to accumulate essential oil in the inflorescent. In phase wax ripeness of the essential oil content in different samples ranged from 0.26 to 0.49 percent. In order not to affect this high heterozygous on research indicators we have compared the data obtained for a single specimen in various stages of its development. Averaged data are shown in Figure 1.

We have to mark off that rue haven't blossomed simultaneously in autumn period, therefore the flowering period is very long with them and harvest have inflorescences in various stages of development, which determines the decrease in content of essential oil by about 17%. In stage full seed forming essential oil content decreases with 30% toward preceded stage and dry material

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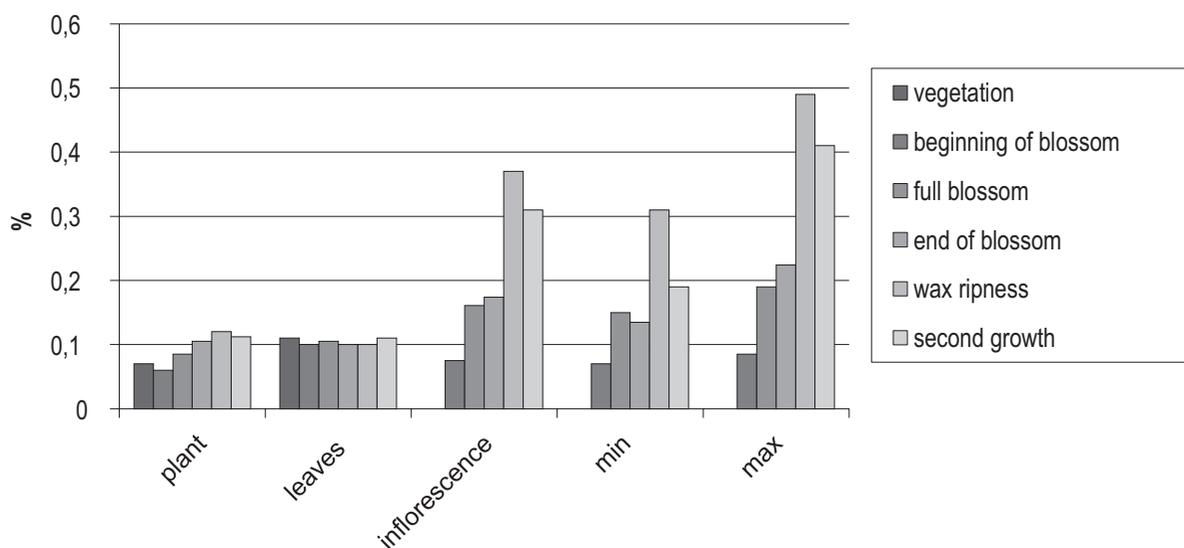


Figure 1. Essential oil accumulate dynamics in Rue

contents 0.7 – 0.83%. The plant waste product contains significant amounts essential oil in order of 0.43% after seed material clean, it can be successfully utilized and distilled.

Perfumery evaluation of rue essential oil is high and it is attributed largely to the content of 2-undecanone. Conducted gas-chromatography analysis of different rue sample indicates that there is different hemorases in investigated population therefore the component composition observe of essential oil in rue vegetation in crucial have to compare the results of the same samples. We could say about observed samples that haven't got significant changes in component composition during the vegetation. The main component – 2- undecanone increases with 6-9 % in stage wax ripeness in relation to previous stages. There was reported 2-nonanon increases with 24%, but not all models, some even was marked decrease by 8%. In the later stage of inflorescence development have second time decrease of citronellol and 2 dodecanone content. Dry of raw plant affects upon essential oil component composition only

Table 1. Component composition of essential oil of the inflorescences of *Ruta graveolens*

Components	End of blossom	Wax ripeness	
		Fresh	Dry
α-pinene	trace	trace	0.01
β-pinene	0.01	0.02	0.02
1,8 cineole	0.03	0.03	0.03
2-nonanon	8.4	10.46	10.47
2-octanole	trace	0.02	0.06
2-nonyl acetate	0.03	0.06	0.04
2-decanone	0.54	0.7	0.86
citronellol	1.08	0.43	1.33
2-undecanone	66.7	71.9	73.2
nonanole	0.38	0.45	0.39
2-dodekanone	1.88	0.91	1.48
2-undecanole	2.22	1.90	0.80

in content of the minimal ingredients. In this case we have 2 times decrease of 2-undecanone and 3 times increase of citronelol. Changes has been reported and in 2-dodecanone and 2-decanone but they haven't been registered in all samples. The date of investigation of essential oil components are given in Table 1.

In determination of optimum stage for rue harvest have to done differential – in depend of purpose will be used raw material. In use for phytoterapeutic aim the gathering of overhead plant material have to done in stage beginning of blossom to stage full blossom. During this stage of plant development have been accumulated the high quality of rutin – 3.3%, quinoline- 0.5%, total alkaloid mixture –1.4%, furanocoumarins – 0.9% (Vitkova 1998, Poutaraud 2000). The researchers conducted by us present that optimum stage for rue harvest in purpose essential oil is stage wax ripeness of the fruits, when the results are the high in quantity and quality relation.

The height of mowing is substantial factor has to influence from one hand to quality of gathered raw material and from another hand upon the distillation efficiency and the content of essential oil. Based on observations that the rue stems and leaves accumulate low levels essential oil and they are ballast, unnecessary components by distillation, we recommend the rue mowing to be done high (20-30cm) under the inflorescence. In formation of significant woody stem part in the plats which make difficult agricultural event affecting to the soil, it should have been eliminated on high 20-30 cm from the soil surface in the term before beginning of active vegetation (month of march and april).

Other important point influencing upon the process of distillation efficiency and the content of essential oil is drying material affection. The results are given on Figure 2. The content of essential oil in leaves and inflorescence gathered in stage full blossom increases from 4 to5 times but in inflorescence in stage wax ripeness with 2,8 times. The quality is increased after drying only in the distillation of dry inflorescence gathered in stage full blossom. The inflorescences gathered in optimum stage – wax ripeness have loss of essential oil from 20 to 35% after drying. Rue raw material is mowed and can be stay on shadow short time but full row material drying is economically unjustified events, therefore it should preferably be distilled into fresh state in phase wax ripeness.

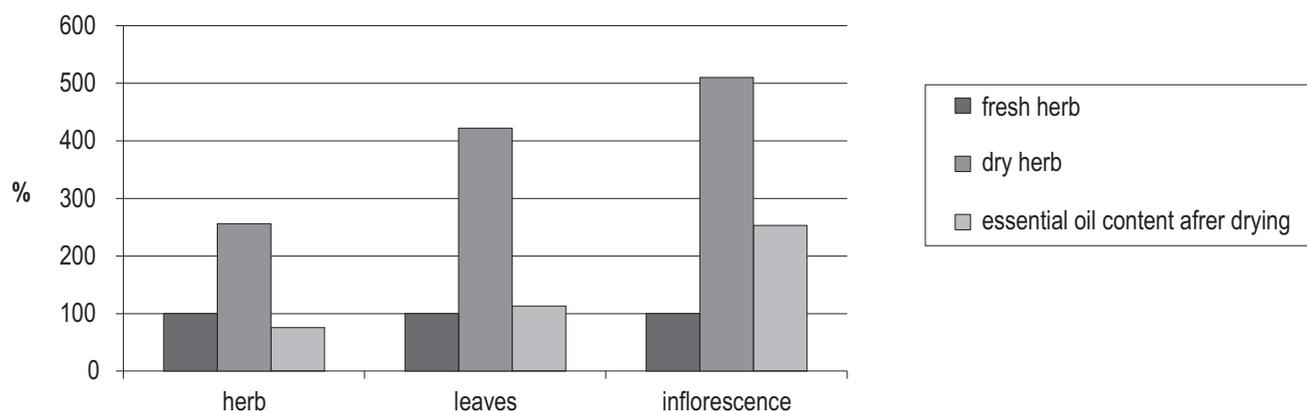


Figure 2. Change in essential oil content and components as a result of drying

Conclusion

Rue can be grown for essential oil obtaining and the plants have to be mowed in stage of inflorescence - wax ripeness, the height of mowing is 20-30 cm under the inflorescence. It is distilled in fresh state for better oil content.

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