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DETERMINATION OF SEPARATING PERFORMANS OF NEW DESING THRESHING UNIT FOR SAGE

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Abstract

For many years, mechanization of harvesting and threshing has been successfully implemented for various crops and has been developed depending on technological progress. However, the processes of threshing, separating and cleaning of medicinal aromatic plants are carried out by conventional methods (by hand) after the products are dried. This case leads to damage in the product, loss of labor and yield. In order to help to overcome these disadvantages and separate the dried products from the foreign materials such as stalk, spall and dust special separating systems designed depending on the plant are needed.

In this study, the separation-cleaning performances required for Sage (Salvia officinalis), for our country and the Mediterranean Region, have been determined. Performance values and working limits of the separating unit for sage (Salvia officinalis) have been determined. The separating unit is consisting of chassis, mainframe, two sieves, which have adjustable vibrating, velocity and inclination features, sieve housings, inclination adjusting mechanism and material outlet unit. The performance as separating efficiency, work efficiency and specific power consumption of separating unit were determined.

In order to determine the separation performances of the separating unit, 3 different sieves type experiments were performed depending on the amount of 3 different feedings. Experiments were carried out at 3 different sieve speeds and 3 different sieve slopes for sage. Each trial was performed in three replicates.

According to the study results, separating efficiency for sage (Salvia officinalis) used in the study changed between 41.44% and 97.89%. Work efficiency of separation unit changed between 0.69 kg/h and 6.00 kg/h. In different operations, specific power consumption of separation unit varied between 3.52 kW/kg and 30.06 kW/kg.

Key words*: Sage (Salvia officinalis), separating, design, aromatic plant.*

INTRODUCTION

Sage plant (*Salvia officinalis* L.), one of the most characteristic aromatic plants of the Dalmatian karst, is a popular kitchen herb and member of the mint family (Generalić, 2012). It is used in cosmetics, perfume and medicine. (Tucker et al., 1980; Chalchat et al., 1988). It is also known as a great tonic for a number of ailments.

The importance of cultivation of medicinal and aromatic plants like sage plant has been increased due to the increasing demand for medicinal and aromatic plants in fields such as spices, beverages, perfumes and cosmetic industries as well as the pharmaceutical industry. (Anonymous, 2012).

It has been taken considerable steps about the medicinal-aromatic plant mechanization and different types of separating systems with the increasing demand for medicinal and aromatic plants used in harvesting and threshing machines.

Sieves and eccentrics moving the sieves are used in the separating system in parallel with the developing technologies.

The time of material on the sieves, sieve type, the amount of the material and the sieve inclination are important parameters for efficiency of separating (Kutzbach, 2003).

Harvesting, threshing, separating and cleaning medical aromatic plants is very important.

In recent years, numerous studies have carried out on sage plants, but work on the separating and cleaning system for this plant is limited.

In this study, being an important issue for medicinal and aromatic plant mechanization in our country and the Mediterranean Region, separation-cleaning unit performances required for Sage (*Salvia officinalis*) have been determined.

Performance values and working limits of the separating unit for sage (*Salvia officinalis*)

specified. In order to determine the separation performances of the system separating efficiency, work efficiency and specific power consumption values have been designated.

MATERIALS AND METHODS

The specific separating unit designed for sage has been used during the performance experiments.

The separating unit consists of chassis, mainframe, two sieves, which have adjustable vibrating, velocity and inclination features, sieve housings, inclination adjusting mechanism and material outlet unit (Figure 1).

For this study, sage (*Salvia officinalis*) plants were harvested by hand from the experimental field in Suleyman Demirel University, Isparta, Turkey.

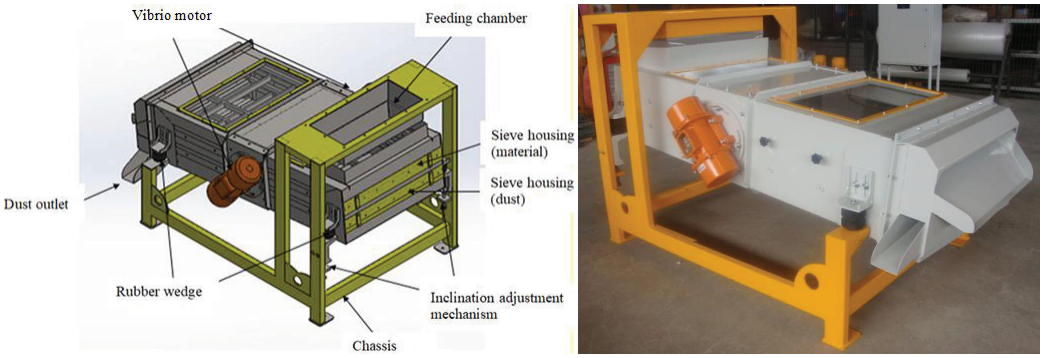

Figure 1. The separating unit used in the experiments

Sage (*Salvia officinalis*) plants have been dried in the rooms at 35°C after harvesting.

When medicinal plant materials are prepared for use in dry form, the moisture content of the material should be kept as low as possible in order to reduce mould damage and other microbial infestation (Máthé, 2015).

Therefore, the moisture content value of sage plant has been selected as 10.1%d.b. between 10-12%.

In order to determine the separating performance of system for sage plant the experiments have been conducted at 3 different sieves type content as 4-20, 6-20 oblong sieves and 10 mm round hole sieve.

The sieve velocity of the unit has been determined as 35, 40 and 45 Hz. 3 different sieves inclination of separating unit have been adjusted as 14, 15.8 and 17.6%.

The product feeding rates have been determined as 190, 380, 570 kg/h. Each experiment has been performed in 3 replicates. The operating parameters of the separating unit for sage plant carried out at 3 different sieve types have been given in Table 1.

Table 1. The operating parameters of the separating unit for sage plant

Sieve velocity (Hz)			Sieve inclination (%)		
1	**2**	**3**	**1**	**2**	**3**
35	40	45	14 (8°)	15.8 (9°)	17.6 (10°)

RESULTS AND DISCUSSIONS

According to results of the experiments conducted with different sieves for sage plant, depending on sieve velocity, feeding rate and sieve inclination of the separating unit, the separating efficiency values have been range from 41.44% to 97.49%.

The separating unit efficiency values for sage plant depending on the 3 different sieve types have been given in Figure 2.

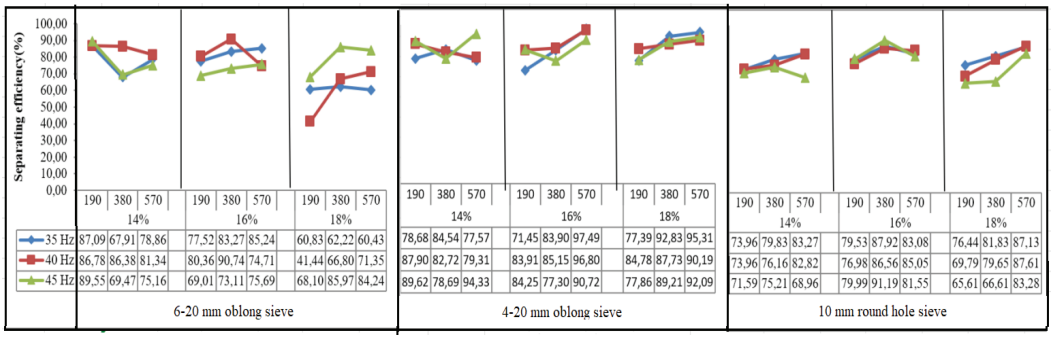

Figure 2. The effect of sieve velocity, feeding rate and sieve inclination on the separating efficiency with different sieve types

As a result of the separating experiments for sage depending on the sieve types, the highest separating efficiency value has been found at 15.8% sieve inclination, 380 kg/h feeding rate and 40 Hz of sieve velocity with 6-20 oblong sieve type. The lowest separating efficiency has been observed experiments conducted with 10 mm round hole sieve at 17.6% sieve inclination, 190 kg/h feeding rate and 40 Hz of sieve velocity. The separating efficiency value of the system were found low in the experiments carried out with 10 mm round hole sieve.

The triple interaction of sieve velocity, feeding rate and sieve inclination on the separating efficiency with 3 different sieve types have been found statistically significant ($p<0.05$).

According to the result of the study conducted depending on the sieve types for sage plants, sieve velocity, feeding rate and sieve inclination of the separating unit, the work efficiency values have been given in Figure 3.

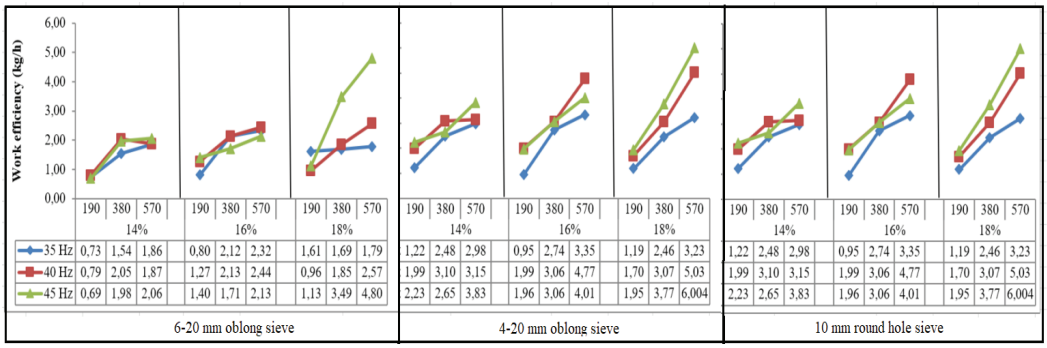

Figure 3. The effect of sieve velocity, feeding rate and sieve inclination on the work efficiency with different sieve types

The triple interaction of sieve velocity, feeding rate and sieve inclination on the separating efficiency with 3 different sieve types have been found statistically significant ($p<0.05$).

According to the result of the study depending on the sieve types for the sage plant, the work efficiency values has been found to be low at 4-20 mm oblong sieve type. The lowest value observed at 45 Hz sieve velocity, 190 kg/h feeding rate and 14% sieve inclination as 0.69 kg/h. The work efficiency values changed between 0.69 kg/h and 6.004 kg/h. The highest work efficiency value has been determined at 17.6% of sieve inclination, 45 Hz sieve velocity and 570 kg/h feeding rate in the experiment conducted with 6-20 oblong sieve.

Specific power consumption is one of the most important parameters for designing systems and must be known in order for the proper system performance of separating unit for sage plant.

The specific power consumption values of separating unit for sage plant carried out with 3 different sieve types have been presented in Figure 4.

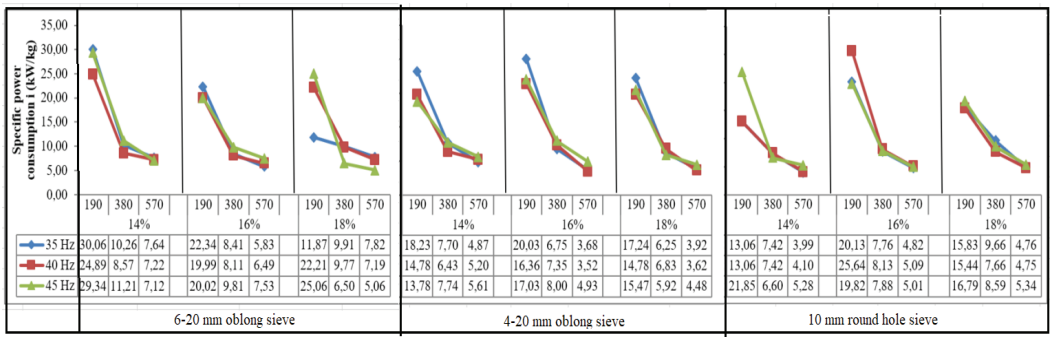

Figure 4. The effect of sieve velocity, feeding rate and sieve inclination on the specific power consumption with different sieve types

The specific power consumption values of the system according to the measured values depending on the sieve types for the sage plant, sieve velocity, feeding rate and sieve inclination of the separating unit, varied between 3.52 kW/kg and 30.06 kW/kg.

The triple interaction of velocity, feeding rate and sieve inclination on the specific power consumption with 4-20, 6-20 oblong sieves and 10 mm round hole sieve have been found statistically significant ($p<0.05$).

While the specific power consumption of separating unit for sage plant has been lowest at 15.8% sieve inclination, 570 kg/h feeding rate and 40 Hz of sieve velocity with 6-20 oblong sieve type, it has been highest at 14% sieve inclination, 190 kg/h feeding rate and 35 Hz sieve velocity with 4-20 oblong sieve type.

CONLUSIONS

In this study, separating unit performance values and working parameters have been determined for the sage plant, which has important cultivating areas for our country and Mediterranean region. The separating efficiency, work efficiency and specific power consumption values of threshing unit for the sage plant have been determined.

When the separation unit for sage plant is examined in terms of separating efficiency, it has been suggested to operate with 10 mm round-hole sieve at 570 kg/h feed rate, 35 Hz sieve velocity and 17.6% sieve inclination.

On the other hand, it is suggested that for the high work efficiency, separating unit can be performed with 6-20 mm oblong sieve, at 570 kg/h feed rate, 45 Hz sieve velocity and 17.6% sieve inclination. In order to reduce specific power consumption of the unit the parameters must be selected as 15.8 sieve inclination, 570 kg/h feeding rate and 40 Hz sieve velocity with 10 mm round- hole sieve.

According to the results, it can be said that the most suitable sieve type for sage plant is 10 mm round-hole sieve. The optimum sieve inclination is 17.6% and the sieve velocity is 40 Hz.

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REFERENCES

Anonymous, 2012. Tıbbi ve Aromatik Bitki İşletmelerinin Yapısal Analizi, Batı Akdeniz Tarımsal Araştırma Enstitüsü Müdürlüğü, Antalya.

Chalchat J.C., Michet A., Pasquier B., 1998. Study of clones of *Salvia officinalis* L. yields and chemical composition of essential oil. Flavour and Fragrance Journal, 13 (1), pp. 68-70.

Generalić I., Skroza D., Šurjak J., Možina S.S., Ljubenkov I., Katalinić A., Šimat V., Katalinić V., 2012. Seasonal variations of phenolic compounds and biological properties in sage (*Salvia officinalis* L.). Chemistry & biodiversity, 9 (2), pp. 441-457.

Máthé Á. et al, 2015. Medicinal and aromatic plants of the world: scientific, production, commercial and utilization aspects (Vol. 1). Springer.

Kutzbach H.D., 2003. Approaches for Mathematical Modelling of Grain Separation. International Conference on Crop Harvesting and Processing. CD version, 2, Kentucky USA

Tucker A.O., Maciarello M.J., 1990. Essential oils of cultivars of Dalmatian sage (*Salvia officinalis* L.). J. Essent. Oil Res. 2, 139-144.