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Research Article

Physical and Chemical Properties of Obtained *Tanacetum parthenium* Extract by Soxhlet System

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Abstract – In this study, freshly collected *Tanacetum parthenium* in Elazığ (Türkiye) is separated from its stems and cleaned. This sample of prepared is dried in an oven at 60 °C for 4 hours and ground. Extraction has been performed with ethyl alcohol (C_2H_5OH) for 5 hours using Soxhlet system. In this system, the solvent is heated, evaporated, and the hot vapor of the solvent condenses and falls onto the powder sample. The amounts of sample, working time, and solvent used in the experimental studies have been optimized. Response surface methodology (RSM) is used in optimization studies. The findings of RSM model and experimental data have been statistically assessed. The assessment of the quality of the extract can be evaluated based on its quantity, color, and components. The density and viscosity of the obtained extract have been determined. Besides, as the grain size of *Tanacetum parthenium* powder decreases, the surface area increases, therefore the extraction time is reduced. The results show that at 78 °C and 5.7 hours, 9.6 grams of biomass has the maximum efficiency. Also, the composition of *Tanacetum parthenium* extract has been analyzed by gas chromatography−mass spectrometry (GC-MS).

Keywords – Extraction, Tanacetum Parthenium, Soxhlet System, Response Surface Methodology, Optimization

I. INTRODUCTION

Today, plant extracts are widely used in many sectors. For example, it is used in industries such as pharmaceuticals, dyes, fertilizers, and food. Different methods are preferred in obtaining plant extracts. In general, it is desired to recover the extract without disturbing its chemical and physical structure. *Tanacetum parthenium* in Soxhlet system can be easily extracted with solvent vapor.

Tanacetum parthenium plant extract is used in this research. *Tanacetum parthenium* species are known to have insecticidal properties thanks to the natural compounds in the ester structure called pyrethrums they contain. These compounds bind to sodium channels in insects and delay the opening of these channels, causing the insect to die [1,2].

Extracts of such plants are used especially to remove house and warehouse pests such as lice and fleas. *Pyrethrum roseum* is naturally found among these plant species in our country. It is found naturally as a plant species in Eastern Black Sea and Eastern Anatolia Regions. As a result of the analysis, it has been determined that this species has a high insecticide effect [3,4].

Generally, dried and powdered flowers of these species are used. *Tanacetum parthenium* is produced in many countries and is preferred as a natural insecticide. The toxicity of pyrethrums to humans and other warm-blooded animals is very

low compared to synthetic insecticides [5,6].

Pyrethrum likes a temperate climate and continues its development at a temperature of about 10 °C to start flowering. The yield of dried flowers may be highest under warm conditions, but it is important to collect the flowers when the inflorescence pyrethrum yield is optimum. During the flowering period of this plant, there are harvesting and drying stages. The harvest period is short with flowering and completes its development within a month. Commercial enterprises make economic production by collecting such plants in seasonal periods [7].

High-quality pyrethrum extract is produced regularly and evaluated in appropriate industries. The use of this extract highlights the fight against insecticides without using chemicals such as mosquito control in living areas. The preference for such solutions in the future highlights the healthier effects of living spaces. The use of such extract formulations has become increasingly common in areas such as homes and gardens [7].

Pyrethrum is already included in most lists of approved organic insecticides worldwide and is supported by a comprehensive suite of toxicological studies. Therefore, pyrethrum has inevitably become a dominant insecticide. With organic agriculture, the production of such plants becomes widespread and finds a place for itself in the commercial sector. However, it becomes important that this extract can be produced and marketed at low prices [7].

In this research, natural extracts are obtained from *Tanacetum parthenium* species collected near Elazığ (Türkiye). This study is to obtain high-efficiency extract from biomass by Soxhlet system. Product quality is increased by optimizing both experimental working conditions and biomass amounts by RSM.

II. MATERIAL AND METHOD

Biomass leaves (*Tanacetum parthenium*) are extracted in Soxhlet device. Ethyl alcohol is used as a solvent and the extraction process is carried out to the ground plant leaves with the steam of ethyl alcohol at a temperature of 78 °C. In the optimization processes of experimental studies, evaluations are made using response surface methodology (RSM). *Tanacetum parthenium* is extracted by taking 2 g, 4 g, 6 g, 8 g, 10 g, and 12 g. Working times in Soxhlet extraction are carried out for 2 h, 3 h, 5 h, 6 h, and 7 h. Figure 1 shows Soxhlet system used to obtain the plant extract. In Figure 2, the image of *Tanacetum parthenium* genus collected in Elazığ (Türkiye) is given. The solvent chosen, operating temperature and time are important parameters in an efficient extraction process. Also, the composition of the obtained extract has been determined by GC-MS analysis. GC-MS analysis of the extract has been analyzed by Shimadzu brand QP 2010 Ultra model device.

Figure 1. Soxhlet system for the biomass extract

Figure 2. *Tanacetum parthenium*

III. RESULTS AND DISCUSSION

It is understood from the statistical analyses that the experimental data give results compatible with RSM [8]. It is seen that the values of R^2 (0.9837),

adjusted R^2 (0.9605), and standard deviation (1.92) are compatible. The variation of the effective parameters according to RSM results in the experiments performed in the extract is shown in Figure 3 and Figure 4. Besides, the effect of biomass amount and time on the efficiency has been evaluated in Figure 5 and Figure 6.

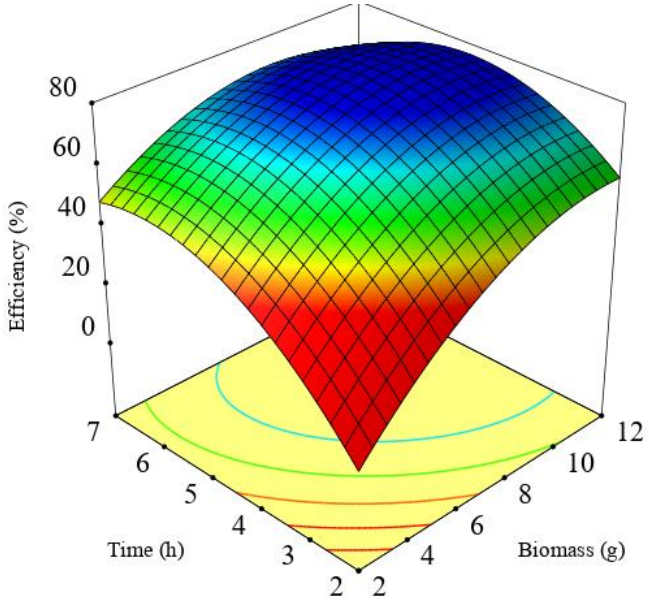

Figure 3. Effect of time and biomass on the extract efficiency (3D)

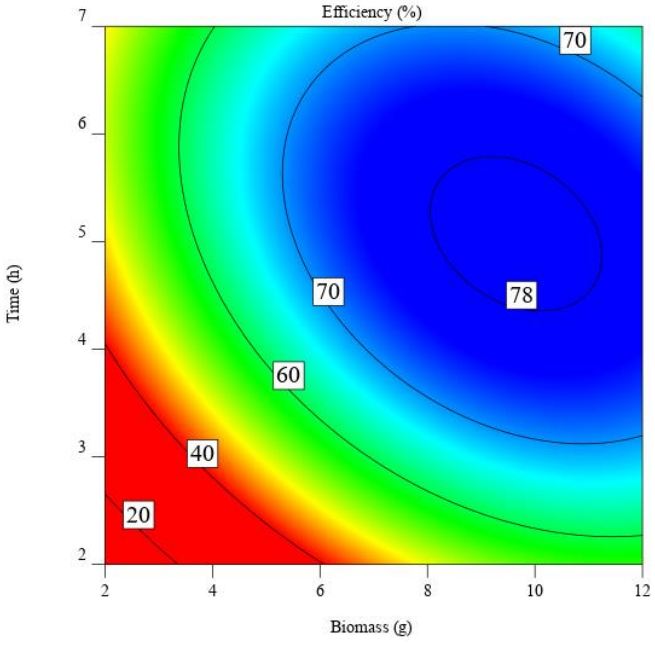

Figure 4. Effect of time and biomass on the extract efficiency (2D)

Figure 5 and Figure 6 show the statistical evaluation between RSM model results and experimental data.

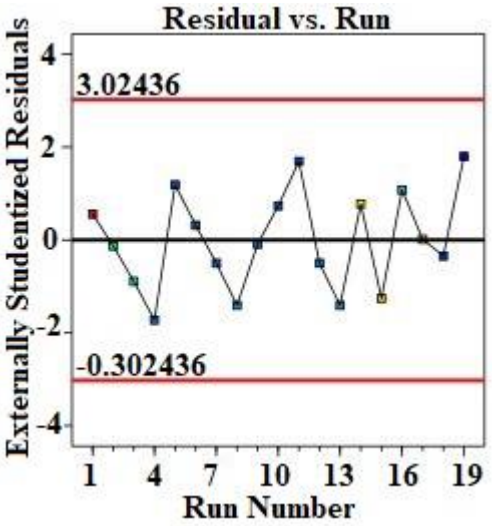

Figure 5. Evaluation of data statistically in RSM

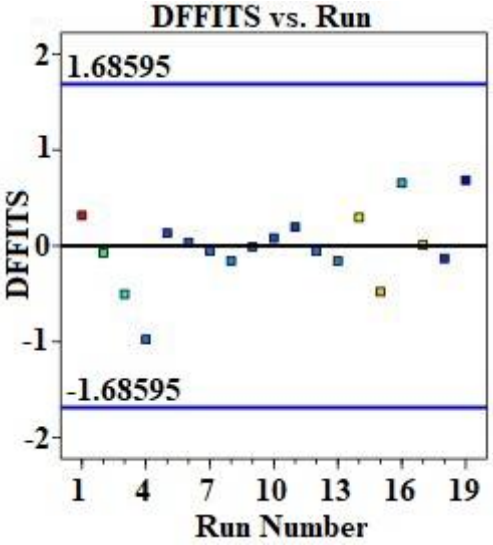

Figure 6. The distribution between DFFITS and Run N.

In the equation below, the efficiency (E) is given as a polynomial function of time (t), and biomass (M). The relationship between experimental data and RSM is expressed in this model equation.

$$E\ (\%) = -71.76041 + 13.73574 \cdot M + 33.41060 \cdot t - 0.68 \cdot M \cdot t$$
$$-0.533016 \cdot M^2 - 2.64635 \cdot t^2$$

Table 1 shows the components of the extract obtained from *Tanacetum parthenium* according to GC-MS analysis results. As seen in the table, there are many important compounds in the composition of extract obtained from *Tanacetum parthenium*. The sum of components given in Table 1 represents the extract. The amount of ethyl alcohol used as a solvent in this plant extract was calculated as approximately 76.97 wt.%. This value is excluded from the weight amounts of the

total ingredients given in Table 1.

Table 1. GC-MS analysis results of the extract

Components	**%**
Acetic acid	0.86
Borneol	1.37
Camphor	0.43
Chrysanthenone	0.56
Dazomet	3.68
Farnesol	0.32
Limonene	2.28
Trans-β-Farnesene	0.45
XMC	0.26
2-Methoxy-4-methyl phenol	2.26
XMC	0.09
Thiocyclam	0.35
Naphthalene, 1,3-dimethyl- (CAS) 1,3-	0.55
1,4:3,6-Dianhydro-.alpha.-d-glucopyranose	2.72
Oxamyl	1.03
3-Hydroxycarbofuran	0.67
Methoprene	0.45
1,2-Benzenediol	3.01
2,3-Dideoxyribonolactone	1.98
2-(1-Naphthyl)acetamide	0.32

IV. CONCLUSIONS

In this study, experimental studies have been carried out by optimizing the amount of biomass, and time by RSM. RSM results have been determined by statistical analysis and their compatibility with the experimental data is compared [9]. According to the results, 9.6 grams of biomass gives the highest efficiency at 78 °C and 5.7 h.

According to GC-MS analysis results, *Tanacetum parthenium* components and amounts indicate that the extract has a rich composition.

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