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*Research Article*

# GROWING POSSIBILITIES OF MEDICINAL AND AROMATIC PLANTS IN GREENHOUSES CLIMATIZED BY BIOGAS POTENTIAL IN TEKIRDAĞ REGION

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***ABSTRACT***

*Medicinal and aromatic plants that are generally grown in natural environment and obtained by collection from these natural environments cannot meet the need.In this respect, it is possible to increase the possibility of growing medicinal and aromatic plants by providing the necessary climatic conditions especially with greenhouse systems. In the greenhouse, the highest cost is the provision of air conditioning. In this respect, greenhouse air conditioning system can be provided with renewable energy or waste materials. In this study, information on some medicinal and aromatic plants that can be grown in greenhouses conditioned by biogas which can be produced from wastes of bovine and ovine animal production structures in Tekirdağ region where agriculture and animal husbandry are carried out intensively in our country and waste evaluation can be obtained without being subject to low cost medical and aromatic plants. intended. For this purpose, biogas potential and energy production opportunities of each district of Tekirdağ were determined and medicinal and aromatic plants that can be grown by providing greenhouse air conditioning were determined. As a result of the research, Capers (Capparis spinosa) (Barbera and Lorenzo, 1984), Rosemary (Rosmarinus officinalis) (Ayanoğlu et al., 2016), Poppy (Papaver somniferum linnaeus) (Erdurmuş and Öneş, 1990), Mint (Mentha piperita) (Anonim, 2019), which can be easily provided with biogas production potential in Tekirdağ region and which have high economic returns with demand. Medicinal Sage (Salvia officinalis) (Bağdat, 2008), Gojiberry (Lycium barbarum) (Anonim, 2015a; Anonim 2015b), St. John's Wort (Hypericum perforatum) (Bayram ve ark., 2002), Lemon Balm (Melissa officinalis) (Anonim,2019) has been concluded that medicinal and aromatic plants such as can be grown.*

***Keywords:*** *Medical and aromatic plants, Greenhouses systems, Greenhouse air conditioning, Biogas.*

## 1.INTRODUCTION

Medicinal and aromatic plants, as well as therapeutic properties of essential oils, cosmetic products, coloring dyes, plant protection products and products produced from these products are used in many products such as intermediates (Lubbe ve Verpoorte, 2011). The annual market value of medicinal and aromatic plants is about $ 60 billion (Kumar, 2009).

When evaluated in terms of climatic characteristics and agricultural potential, our country has a large medicinal and aromatic plant growing potential. Grown plants can be used in a wide range of fields such as medicine, cosmetics, foodstuffs. In order to properly evaluate the market opportunities of medicinal and aromatic plants, the products must be of a certain quality and quantity. In particular, cultivation of suitable varieties according to ecological requirements, breeding studies, post-harvest procedures will help improve the production and marketing opportunities of medicinal and aromatic plants (Bayram ve ark., 2010).

As a result of the bond between humans and plants dating back centuries, humanity has used nature as a natural pharmacy and has grown medicinal and aromatic plants for various purposes such as spices, food, medicine and healing. Although the demand for short-term medicinal and aromatic plants has been reduced with the introduction of unnatural substances, the interest that has arisen due to the damage of artificial substances has gathered around medical and aromatic plants **(**Özçelik ve Balabanlı,2005).

The unconscious removal of the plants causing the disruption of natural vegetation leads to the destruction of rare and endemic plants (Özhatay ve Atay, 1997). The global markets and the pharmaceutical industry are evaluating products of high quality and hence the so-called standard. In today's conditions, supply of high quality products and sufficient standard conditions in our country is met by the collection of plants grown in natural environment and these plants need to be brought to the desired conditions with regular and modern culture (Faydaoğlu ve Sürücüoğlu, 2011).



Greenhouse can be defined as providing the most suitable environmental conditions and plant growing environments when the climatic conditions do not allow plant growing, and to obtain high economic yields throughout the year. In this respect, ventilation, heating, cooling and lighting in greenhouse systems are the most important factors to be considered in planning (Öneş, 1986; Arıcı, 1999). Plants in greenhouse systems have adapted to average temperatures of 17-27 °C. Optimum values are between 15-20 °C at night and 22-28 °C at daytime. (Castilla ve Hernandez, 2007).

Produced as a result of fermentation of biogas, animal husbandry and plant based organic wastes under anaerobic conditions odorless, colorless, lighter than air and a blue flame burning event occurs (Anonim,2004). Depending on the amount of methane contained in its composition, it has a heat value in the range of 17-25 MJ /$m^3$. 1 $m^3$ of biogas is equivalent to 1,46 kg of coal or 5,76 kWh of electricity (Yılmaz ve Atalay, 2004; Anonim 2005).

The highest share in biogas energy production is 85% and the rest is composed of livestock-based wastes. When animal husbandry is considered as waste sources, approximately 93% of the total is from cattle and sheep and the rest is from poultry (Balat, 2005).

## 2. MATERIAL AND METHOD

Tekirdağ province is located in Thrace region of our country. Its geographical coordinates are 26°40′-28°10 ′ east longitudes 40°35′ 41°35 ′ northern latitudes. Tekirdağ, which has Black Sea climatic characteristics along the Marmara Sea, has the characteristics of cold weather in summer and drier semi-continental climate in summer. (Anonim, 2007).

The average temperature and average sunshine duration of Tekirdağ province during the 12 months between 1938 and 2018 are given in the table below (MGM, 2018). When the average values are examined, it can be said that there is no value below 0 °C in winter and this situation creates a positive value for greenhouse cultivation. As you move from the coast to the inner parts, temperatures decrease slightly with the effect of blackness and do not make a big difference.

**Table 1.** Average temperature and sunshine duration of Tekirdağ province (General Directorate of Meteorology 2019)

| TEKİRDAĞ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Temperature (°C) | 4,7 | 5,4 | 7,3 | 11,8 | 16,8 | 21,3 | 23,8 | 23,8 | 22,0 | 15,4 | 11,0 | 7,1 | 14,0 |
| Average insolation (hours) | 2,7 | 3,3 | 4,2 | 5,8 | 7,6 | 8,9 | 9,8 | 8,9 | 7,3 | 4,8 | 3,3 | 2,5 | 69,1 |

**Figure 1.** Tekirdağ province map


In order to determine biogas potential in Tekirdağ province, the number of bovine and ovine animals was reached according to TÜİK records. For this purpose, in 2018 Çerkezköy, Çorlu, Ergene, Hayrabolu, Kapakli, Malkara, Marmara Eregli, Muratli, Saray, Suleymanpasa and Sarkoy districts in 2018, the total number of animals in cattle and ovine production structures, the amount of waste generated in accordance with these numbers and the amount of waste biogas-derived energy potentials were calculated. The highest energy potential among the districts and the energy potential of the provinces in general were calculated. With the calculated amount of energy, it was found that some medicinal and aromatic plants with high economic yield that can be grown in greenhouses where air conditioning process will be made, meet the general climate demands.

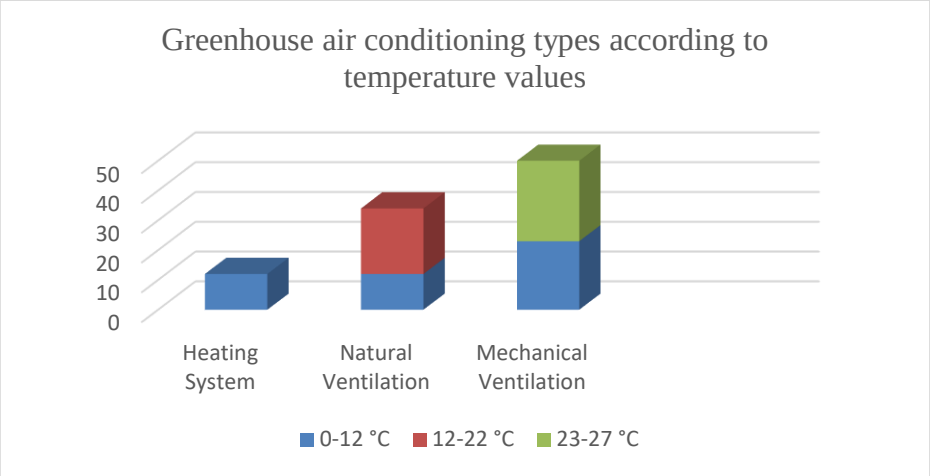
The aim of this study was to determine the biogas potential of Tekirdağ region and to determine the medicinal and aromatic plants that can be grown in greenhouses where air conditioning and energy can be produced.

## 3. FINDINGS AND DISCUSSION

### 3.1.Air Conditioning in Greenhouse Conditions According to Temperature Values

In order to achieve the desired yield in greenhouse systems, when the external temperatures fall below 12 °C, natural ventilation should be operated between 12-22 °C and cooling system should be operated between 22 and 27 °C (Zabeltitz, 2011). The average temperature in Tekirdağ is below 12 °C in November, December, January, February, March and April. In this respect, there is a need for heating in the greenhouse activities to be held in Tekirdağ in 6 months of the year. Natural ventilation is required in May, June, September and October, while natural and mechanical ventilation can be utilized in July and August as the temperature is not very high.

**Figure 2.** In greenhouse air conditioning requirements according to outdoor temperature






Plants grown under greenhouse conditions are generally temperate climate plants in the range of 17-27 °C. In terms of greenhouse air conditioning, the minimum value is 15 °C for heating and the maximum value is 35 °C for cooling (Alpay ve Erdem, 2018). Plants with climatic demand under these values can be grown without air conditioning according to natural climatic conditions.

### 3.2.Medicinal and Aromatic Plant Growing in Greenhouse Conditions

Within the scope of the research, the general climatic characteristics of some medicinal and aromatic plants that are determined according to the indoor air temperature values according to outdoor air temperature values and which can be grown by air conditioning in greenhouse conditions are summarized as headings. The selected plants were selected from medicinal and aromatic plants with high economic returns and demand in the market.

**3.2.1.Capers *(Capparis spinosa)*** (Barbera and Lorenzo, 1984) naturally grows in optimum conditions at 13 °C, but the best range is 13-20 °C. Outside the temperature, the appropriate humidity value changes to 6.3 - 8.3 pH (Ölmez et al., 2011; Akgül, 1996; Barbera and Lorenzo, 1984). Apart from the temperature condition of the caper plant to be grown under greenhouse conditions, it is also important to ensure proper humidity.

**Figure 3.** Capers (*Capparis spinosa*)

**3.2.2.Rosemary *(Rosmarinus officinalis)*** (Ayanoğlu et al., 2016). is a type of plant that can be considered frost resistant in the range of 20-25 °C in terms of temperature requirements. Since it does not like excess water, irrigation is not necessary. Despite this situation, it can grow in some rainy areas, but the growing soil should not be too wet (Ayanoğlu et al., 2016).

**Figure 4.** Rosemary (*Rosmarinus officinalis*)



**3.2.3.Poppy *(Papaver somniferum)*** (Erdurmuş and Öneş, 1990) seeds can germinate at 4 °C. If the soil temperature is lower, the seeds remain germinated. Plants whose output is late and caught in the frost event during the cotyledon period are damaged by frost. In the first stage, then the leaves are seen to be lost (Erdurmuş and Öneş, 1990).

Poppy plant which needs a total temperature of 2300-2700 °C during the growing period loves the sun and heat (Erdurmuş.ve Öneş, 1990). In this respect, it is of great importance to ensure sufficient temperature conditions in the poppy plant to be grown in greenhouse conditions.

**Figure 5.** Poppy (*Papaver somniferum*)

**3.2.4.Mint *(Mentha piperita)*** (Anonim, 2019) increases the amount of oil contained in hot climate conditions. The best development temperature range is 12-15 °C. Seeds can germinate in the 20-30 °C range (Anonim, 2019). Mint, which does not like to grow in shady areas, does not like high light intensity. In this respect, the shading in greenhouse conditions and the lighting systems used should be considered

**Figure 6.** Mint (*Mentha piperita*)

**3.2.5.Medicinal Sage (*Salvia officinalis*)** (Bağdat, 2008) is a heat-loving plant, and its natural growing conditions are sunny and sheltered from the wind. It becomes more efficient when watering. Aromatic properties, can be used for landscaping, cosmetic and vegetable dye sage can be found in soap formation (Bağdat, 2008).

**Figure 7.** Medicinal Sage (*Salvia officinalis*)



**3.2.6.Gojiberry (*Lycium barbarum*)** (Anonim, 2015a; Anonim 2015b) is a plant that loves sunlight and can develop between -27 °C and 39 °C. The so-called worm grape plant is resistant to dry summer conditions, the highest yield is obtained when drip irrigation (Anonim, 2015a; Anonim 2015b).

**Figure 8.** Gojiberry (*Lycium barbarum*)

**3.2.7.St. John's Wort (*Hypericum perforatum*)** (Bayram ve ark., 2002) is more light demand in germination period, but there is a demand for semi-shaded and abundant sunny climate (Bayram ve ark., 2002). When the frost resistant gantry is grown in greenhouse conditions, care should be taken not to over-operate the shading system.

**Figure 9.** St. John's Wort (*Hypericum perforatum)*

**3.2.8.Lemon balm (*Melissa officinalis*)** (Anonim,2019) is a shade-resistant plant that loves heat and sunny areas. Desired dorms cannot be obtained in areas with high humidity and shade (Anonim,2019). In this respect, warm conditions should be ensured for the sons to be grown in greenhouse conditions. Measures should be taken against high humidity and the shade system should not be opened because it does not like shade.

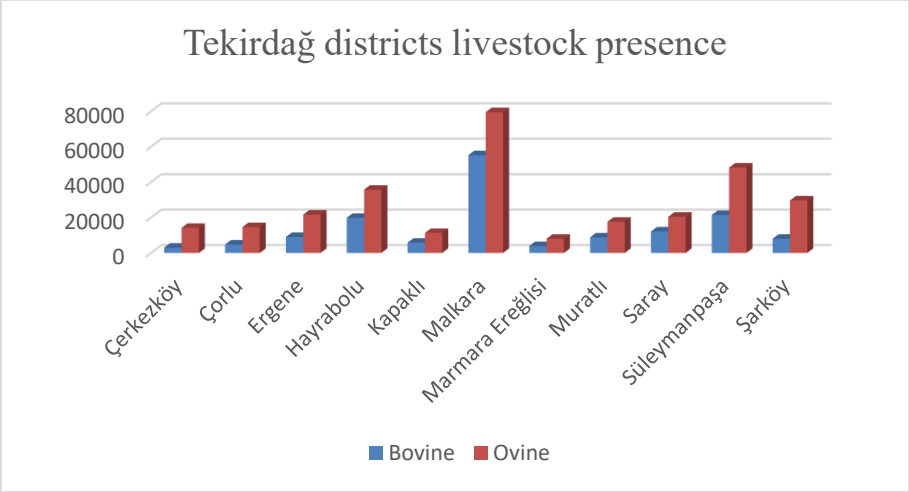
**Figure 10.** Lemon balm (*Melissa officinalis*)



### 3.3.Determination of Biogas Potential of Tekirdag Province

The number of bovine and ovine animals determined within the scope of the research is given below in districts. (TÜİK, 2019). Malkara is the district with the highest number of bovine animals, and Çerkezköy is the district with the lowest number of cattle. When evaluated in terms of ovine animal assets, the highest number of animals is in Malkara district and the least animal is in Marmara Ereğlisi district. The numbers of animals in the districts are given in the graph below.

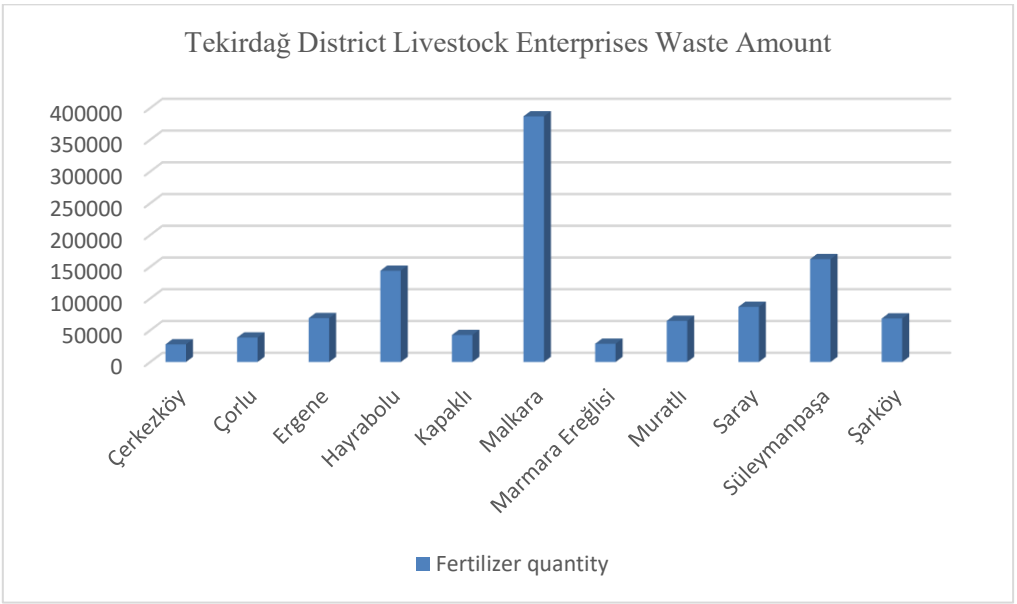
**Figure 11.** Tekirdağ districts livestock assets




After determining the number of dovine and ovine in the province, the amount of waste generated in these animal production structures was determined daily. The amount of fertilizer for bovine animals is 6 tons / year and for sheep animals is 0.7 tons / year. According to fertilizer amounts, the amount of biogas that can be produced was 0.42-0.60 $m^3$ / day in cattle and 0.37-0,61 $m^3$ / day in sheep (Toruk and Eker, 2012). According to these ratios, the amount of fertilizer and biogas potential in terms of cattle and sheep production originating from animal production structures calculated on districts of Tekirdağ province are given in the following figures.

**Figure 12.** Amount of waste originating from livestock enterprises in Tekirdağ province



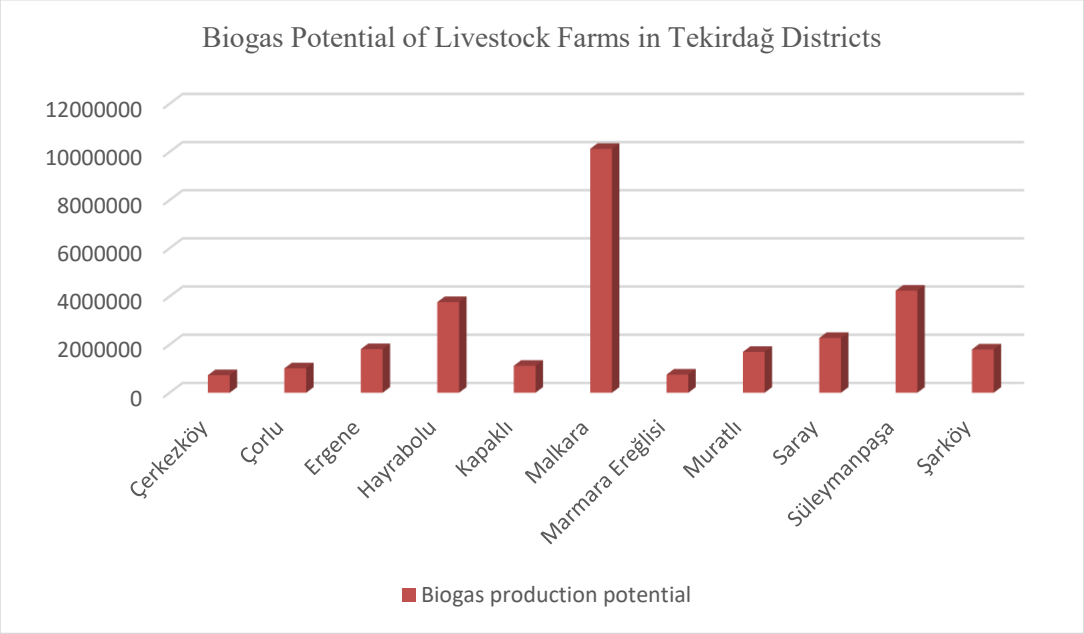



When the total wastes originating from cattle and ovine livestock enterprises are evaluated, it is seen that the highest amount is in Malkara district and Süleymanpaşa and Hayrabolu districts follow this district in quantity. The least amount of waste was found in Marmara Ereğlisi and Çerkezköy.

## 4. RESULTS

When evaluated in terms of energy production potential with biogas, Malkara has the highest production potential in direct proportion to the amount of waste. Merkez (Süleymanpaşa) and Hayrabolu are also districts with high biogas production potential. Despite having a certain production potential, Çerkezköy and Marmara Ereğlisi districts have the lowest settlements compared to other districts.

**Figure 13.** Biogas production potential originating from livestock enterprises in Tekirdağ province






There is a potential of biogas and energy production due to animal husbandry grown in all districts of Tekirdağ. In particular, enterprises with a large number of animals can produce energy along with biogas tanks as well as animal production structures. They can also use this energy in greenhouses with climate control to be established around livestock enterprises and carry out greenhouse activities. In particular, medicinal and aromatic plants supplied from the natural environment meet the demand decreasing day by day with these products can be grown in greenhouse conditions is possible to achieve high yield.

Caparis (Capparis spinosa), Rosemary (Rosmarinus officinalis), Poppy (Papaver somniferum linnaeus), Mint (Mentha piperita), Medicinal Sage (Salvia officinalis), Gojiberry (Lycium barbarum), Yellow Centaur (Hypericum perforatum) It is possible to grow medicinal and aromatic plants such as lemon balm (Melissa officinalis) in greenhouses conditioned by biogas energy in Tekirdağ conditions. In terms of medicinal and aromatic plants, it is possible to mention that many plants with medicinal and aromatic properties can be produced in the desired amount at the desired time in greenhouse conditions, since the desired temperature is generally 10-35 °C. It is of great importance to increase the studies in this field and to support the cultivation of medicinal and aromatic plants in greenhouse conditions, especially with good agricultural practices.

By providing greenhouse air conditioning with biogas energy, animal manure, which is an environmentally damaging waste, can be turned into an input for agricultural production. In this way, conservation of natural resources and energy savings can be achieved, and supply of the necessary raw materials in the field of medicine and medicine in today's conditions will be realized at the lowest costs.

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