

STATUS OF PUMPKIN SEED PRODUCTION IN TURKEY

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Abstract

Pumpkin seed contains very valuable nutrients and may have some beneficial health effects. The aim of this study was to overview status of pumpkin seed production in Turkey. The production has sharply risen from 11.500 tons in 2015 to 42.181 tons in 2016. The area has also indicated sharp increase from 172.580 da to 628.441 tons in the same period. The first section provides introduction of topics, and later nutrition value of pumpkin seed, taxonomy, production, bottlenecks and breeding efforts are summarized. They have several advantages such as their short vegetation time that just fits the Central Anatolia conditions where vegetation time available is too short for many other crop plants, net profit per de compared to the other crop plants, extended storability, etc.

Keywords: *Cucurbita pepo*, pumpkin, seed production.

1. INTRODUCTION

Pumpkin seed (*Cucurbita pepo* L.) is popular in Turkey with the production of 42.000 tons per year, and has several advantages due its short vegetation time, higher nutritional value and net financial benefit compared to grain crops in highland of Turkey. Common growing areas range in elevations from 1000 to 2200 m from the sea level, which may create environmental stress due to extreme temperature differences during day and night. We started surveying possible bottlenecks in production such as genotype, yield, quality and quantity of fertilizer applied for production and pollen characteristics. For example, up to 40% of seeds are empty with no nutritional value. High elevation, low level and inappropriate fertilizer application, rain-fed irrigation are some of the potential causes of low yield (30 to 50 kg per da in non-irrigated and 50 to 100 kg per da in irrigated fields). Viability of pollens is also major concern mainly due to extreme temperature differences between day (>30°C) and night (<10°C). We estimate that elevation, extreme temperature difference and nutritional status of the soils and water availability are mainly responsible for low yield in pumpkin seed. Pumpkin seeds have some exceptional properties that may provide some health benefits. In addition to the consumption as cookies/appetizers, they have some medicinal roles. Avoidance of parasites, rich fatty acid composition, protein, mineral nutrient and amino acids were some of the properties. They have relatively short vegetation time. Their growing degree day value is nearly 1200 (sum of temperatures above 10°C), which is mostly met at the end of August. This review may help shaping pumpkin seed breeding and production methods in Turkey.

2. NUTRITION VALUE

Pumpkin seed contains very valuable nutrients. In example, of recommended dietary allowance, an handful of seeds (34.5 g) per day provides 1/3 of vitamin E, 46.2% of Mg, 28.7% of Fe, 52% of

Mn, 24% of Cu, 16.9% of proteins, 19.7% of unsaturated oil and 17.1 of zinc (Anonymous 2008). Ermis et al. (2010) investigated contents, including oil, vitamin and mineral composition, of *C. pepo* seeds collected from the region. Oil composition, protein, vitamin E and mineral substances differ between fresh (sun dried) and roasted seeds with more oil in roasted ones. In general oil ratio was between 35% and 48%. Of total oils, oleic acid and linoleic acid contents are 40-58% and 30-40%, respectively. Their humidity, protein, saturated and unsaturated oil ratios are somewhat similar. However their vitamin E contents are markedly different. Sun-dried pumpkin seed consist of 3.8-4.5 mg/100 g of vitamin E whereas roasted seeds contain as much as 13-18 mg/100 g of the same vitamin (Ermis, 2010).

Their medicinal effects were investigated by many researchers. Antioxidative roles, cancer avoidance (Finley 2007), regulation of blood pressure (Damon et al., 2005) and glycemic index (Kwon et al. 2007), fighting parasites (Winkler et al. 2005), anti-aging (Tanış and Hekimoğlu 1999), skin burns (Bardaa et al. 2017) and intestinal microbiota (Avila-Nava, 2017) were some of the topics reported. They also contain fiber that regulate digestive biology. Seemingly, pumpkin seed should often be regular part of dietary allowance for better health.

3. TAXONOMY

Pumpkins generally belong to the genus *Cucurbita* of the family *Cucurbitaceae*. *Cucurbita pepo*, *C. maxima* and *C. moschata*, *C. argyrosperma*, *C. mixta* and *C. ficifolia* are named as pumpkins and are grown commercially in some countries. The first three species are the most important as their seeds, while *C. pepo* is the most common in Turkey, where the seeds of the other member of *Cucurbitaceae* family such as melon (*Cucumis melo*) and watermelon (*Citrullus lanatus*) are also used as cookies.

4. PRODUCTION

The FAO statistics on the amount of production of the seeds of *C. pepo* is not available. The data on seed production of *C. pepo* in Turkey is available provided by Turkish Statistical Institute (TUIK). The overall trend of production is rapid increase (Table 1). For example, the 2004 production was 10.500 tons in 159.000 da, while it was 42.000 tons of seeds of *C. pepo* in 628.000 da. The consumption of seeds of *C. pepo* is very popular as well as sunflower and some other cookies.

Table 1. Production of dried pumpkin seed (C. pepo) between 2005 and 2016 in Turkey according to Turkish Statistical Institute (TUIK).

Year	area-da	production-tons
2016	628.441	42.181
2013	515.808	35.586
2010	372.572	26.694
2007	269.158	31.262
2005	172.580	11.500

In general, the Central Anatolia is the main region for pumpkin seed production (Table 2). Irrigated land of pumpkin seed, despite lack of official data, is estimated to be about 20% (nearly 125.000

da). In 2004, 16 provinces were recorded to produce pumpkin seed, while they reached to 23 in 2013. The province of Kayseri produced about 40% of the total production followed by Nevşehir, Aksaray, Konya and Eskişehir.

Table 2. The regions producing pumpkin seed, area and amount of production in 2016 as reported by TUIK

<i>Region of Turkey</i>	<i>Area-Da</i>	<i>Production-tons</i>
<i>North-east</i>	<i>160</i>	<i>19</i>
<i>Central East</i>	<i>10</i>	<i>1</i>
<i>South-East</i>	<i>10</i>	<i>No data</i>
<i>West</i>	<i>7.888</i>	<i>735</i>
<i>Aegean</i>	<i>3.089</i>	<i>370</i>
<i>Eastern Marmara</i>	<i>20.606</i>	<i>2.066</i>
<i>Central West</i>	<i>45.645</i>	<i>5.031</i>
<i>Mediaterranean</i>	<i>220</i>	<i>22</i>
<i>Central</i>	<i>548.419</i>	<i>33.782</i>
<i>Western Blacksea</i>	<i>2.394</i>	<i>155</i>
<i>Total</i>	<i>628441</i>	<i>42181</i>

Pumpkin seeds are directly consumed as cookies and in food industry for making bread, cake, sausage, dressing oil, and pharmaceutical industry (Yanmaz, 2014).

In general, in Central Anatolia, the pumpkin seeds (*C. pepo*) are sown by machine that place fertilizer first, then 5 cm above it, inserts 3-4 seeds usually between 15-April and 15-May. Harvest takes place within in the beginning of September. The fruits are removed from the plant and leaved on the soil for 2-3 weeks for complete maturation. This provides easy removal of seeds from the fruits and more maturation resulting in higher quality seeds. During this period since fruits are prone to fungal and bacterial pathogen attack, low relative humidity is required. For extraction of seeds, the fruits were collected on a row by the workers using fork, then thrown into the machine specifically designed for this aim. After extraction of seeds, they are dried under open air conditions for 10 to 20 days regularly mixing for homogeneous drying. Usually extreme water loss from the seeds during this period causes lower germination ratio as our previous studies indicated (Coskun et al. 2016). Finally empty seeds are removed and the remaining intact seeds are graded based on sizes. Preference for sizes differs among the cities and people. Some prefer smaller size while the others pay more for larger seeds. There are usually two different types of pumpkin seeds; this-long and rounded-framed types. The preference also varies among the farmers and consumers. The farmers prefer thin-long types while the consumers prefer framed ones since the first is more yielding.

5. BOTTLENECKS

Since most of the pumpkin seed (87% of area and 80% of the production) is produced in Central Anatolia region, the bottlenecks observed in this region are discussed. Water availability generally is poor in the Central Anatolia. For example, annual precipitation in Kayseri, producing 40% of the total production, is 388 mm and their distribution during the pumpkin cultivation is as follows: January, 33.7 mm; February, 36.5 mm; March, 42.7; April, 52.4 mm; May, 52.4 mm; June, 40.9; July, 10.0 mm and August, 5.9 mm according to the Turkish State Meteorological Service (<https://mgm.gov.tr>). Under irrigation, yield per da (dried and elected) may reach up to 100-150 kg, while, under rain-fed conditions, it can be up to 50 kg/da (Menemencioglu et al., 2013). *C. pepo* plants complete life cycle enough to produce economical amount of seeds in acceptable quality and quantity. Despite lack of irrigated land statistics particularly on pumpkin seed, it is estimated as 20% irrigated and 80%rain-fed production. On the other hand percentage of irrigated land has been increasing due to completion of dam projects.

High altitude is another stress factor in Central Anatolia. Common growing areas range in elevations from 1000 to 2200 m from the sea level, which may create environmental stress due to extreme temperature differences during day and night. Our preliminary analysis indicated that correlation value (r) between elevation and seed yield was about 0.33. One reason may be poor quality and quantity of pollens produced under high elevation conditions.

Lack of suitable (hybrid and standard) cultivars possibly is an important reason of low yield (Menemencioglu et al., 2013). Although, in the world, there are F1 cultivars of *C. pepo*, the Turkish farmers use their own seeds produced from open-pollination. This creates heterogeneous population in the field for both plant and seed characteristics. In addition they usually have poor germination properties (Coskun et al. 2016). The heterogeneous populations are encouraged for organic farming systems since they may provide buffering effect in the case of pathogen/pest attack. Generally, in our previous surveys, germination ratios of seed used in this region is around 60% or low (Coskun et al. 2016).

Lack of appropriate cultivation practices such as fertilization and pruning is another factor for low yield (Menemencioglu et al., 2013). Usually the soils are poor (<1.0%) for organic matter, zinc and boron, have high pH of 7.5 to 8.5 in which many nutrients such as iron, phosphorus and zinc are not mostly usable. These soil properties of the Central Anatolia region may be main limiting factor for lower yield of seed pumpkin.

Inappropriate timing of sowing may be also important factor. Successful seed germination of *C. pepo* temperature highly depends on both air and soil temperature. Our previous studies indicated around 12°C, germination of *C. pepo* seeds usually fails while they have no problems around 20°C (Coskun et al., 2016). A quick driving during vegetative growing period among the seed pumpkin fields in the Central Anatolia region may show that about 20% of seed beds in a typical field is empty, meaning 3 to 4 seeds dropped in about 20% of seed beds fail d to germinate. Low soil temperature is one reason behind empty seed beds. The second reason may be low quality of seed used for sowing. In our previous study, the seeds collected from 30 different farmers indicated low germination ratios between 60 to 80%.

Main pests of seed pumpkin (*C. pepo*) are zucchini yellow mosaic virus spreaded by aphid and powdery mildew (Menemencioglu et al., 2013). The aphids are usually seen after young seedling period, which avoid early contamination allowing healthy plant growth in early stages. But later symptoms become clear in seed pumpkin fields. Thus late seeding is discouraged for seed pumpkins. There are no available resistant types and selections at the moment. Only solution is avoiding aphids by spraying chemicals. Powdery mildew is similarly becomes prominent in later

stages when air humidity drops and air temperature rise to 30-35°C after late July through August. This causes partial damage in seed pumpkins since the most of the growth is achieved by July.

6. CONCLUSION

Central Anatolia has some adverse conditions to plants, therefore number of agriculturally important plant species in this region is limited. Seed pumpkin has short vegetation period and, usually, can be harvested in between a 100-120 growing day or about 1200 growing degree days, which fits climatic conditions of Central Anatolia. Therefore its production showed a rapid increase, nearly four-fold increase only in 11 years between 2005 and 2016. It has contains very valuable nutrients and may have some beneficial health effects such as antioxidative, hypoglycemic, anticancer, antihypertensive, cardioprotective, antilipemic, gynoprotective, and anthelmintic properties. Their seeds do not contain any major anti-nutrients. Seed pumpkin cultivation has several bottlenecks. Dependency on rain, large difference between day and night temperatures, up to 20-25°C, lack of high yieldin cultivars (F1 or standart) are some of barries to higher yield. Yield is highly variable under rain-fed (30-50 kg/da) and irrigated conditions (over 100 kg/da). In addition it has several pests such as ZYMV and powdery mildew. Particularly it is almost difficult to find uninfected plant with ZYMV in a typical pumpkin field in Central Anatolia. Another drawback is, due to lower soil temperature in early spring that causes failure to seed germination, considerable portion of field up to 20% has no plant, which causes lowered seed yield. Breeding programs should consider these limitations to increase yield of pumpkin seed.

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