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The Role of Leader Countries in the Dry Fig Market of the World

Seval KURTOĞLU[1], Ahmet Semih UZUNDUMLU*[2], Duygu TOSUN[3]

[1]*Bayburt University, Demirozu Vocational Higher School, Bayburt, Türkiye*
[2]*Ataturk University, Department of Agricultural Economics, Erzurum, Türkiye*
[3] *Ataturk University, Department of Agricultural Economics, Erzurum, Türkiye*

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Abstract

This study aims to examine in terms of production, export, and price the leading countries dried fig market for 10-year periods, based on 1961-2020 years. Turkey, Egypt, Morocco, Algeria, Iran, Spain, and Syria are leader countries. 25.3 percent of fig production and 69.0 percent of dried fig exports have provided by Turkey in 2020. Outside of these countries, major dry fig exporter countries are Afghanistan, Iran, Belarus, Germany, Greece, Spain, the USA, and Syria. Saudi Arabia, Austria, the United Arab Emirates, Spain, Netherlands, Iran, and Italy were major fresh fig exporters in 2020. According to, dry fig exports, Hirschman Herfindahl Index (HHI) has increased from 3,300 to 4,100 from 1961-1970 to 2011-2020 periods. Also, the Concentration Ratio (CR5) decreased from 95.17 percent to 82.72 percent in the same period. According to this index dried fig markets are an oligopoly in structure and the major player in this market in Turkey. Because it is the largest manufacturer and exporter of dried figs in the market, and determines the world price. The ARIMA model will be used to forecast fig production and export quantity from 2021 to 2025. According to the findings of this study, it is forecasted that the competitive degree of Turkey's dry export market will increase from 2021 to 2025 periods. The result obtained from this study will help policymakers monitor the way dried figs marketing is conducted in Turkey.

1 INTRODUCTION

The fig (*Ficus carica*) is a deciduous tree from the family of Moraceae [1]. It has been cultivated since ancient times in the Mediterranean and is now widely grown throughout the temperate region of the world [2]. While the number of countries producing fig was 32 in 1961, it has risen to 51 in 2020 [3]. Figs are one of the earliest cultivated fruit trees and have more than 700 known species thus one of the oldest fruits recognized by mankind [4,5].

Dry figs contain relatively high amounts of crude fibers [6,7]. Dry figs also contain one of the highest concentrations of polyphenols among the commonly consumed fruits and beverages [8]. The *Ficus carica* is an important crop that is consumed as a part of meals or directly tables as the fresh or dried form in the market [9]. In recent years, the use of fruits such as figs, which are considered functional foods for people to lead healthier life has been increasing. Figs contain sugars, carbohydrates, minerals, and organic acids, as well as thiamine and riboflavin, which are rich sources of vitamins. In addition, fresh and dried figs are good sources of fiber and phenolic compounds, mainly proanthocyanidins, furanocoumarins, and phenolic acids demand for fresh figs is increasing due to the increasing awareness of consumers about the benefits of figs. Today, the fig is an important crop worldwide for dry and fresh consumption. It has fleshy and succulent pulp, besides being sweetened slightly. It is very appreciated for dessert [10]. The main fig-producing countries are Turkey, Egypt, Morocco, Algeria, Iran, Greece, Spain, Syrian, USA, and Albania. The five largest producers of fig are Turkey (25.8%), Egypt, (16.2%), Morocco (10.6%), Algeria (10.4%), and Iran (7.1%) in the 2011-2020 periods. The main fig importing countries are India, France, Germany, the USA, Italy, United Kingdom, Netherlands, Russian Federation, Saudi Arabia, and Canada in the 2011-2020 periods. These 10 countries account for 62.5 percent of the world's dried fig imports. Leader countries in exporting are Turkey, Afghanistan, Iran, Greece, Spain, Syrian, USA, Germany, Belarus, and Netherland. The five largest exporting of dry figs are Turkey (63.6%), Iran (7.4%), Afghanistan (4.9%), the USA (3.9%), and Spain (3.0%) in the 2011-2020 periods. Turkey has been supplying about 65% of

*asuzsemi@atauni.edu.tr

the world's dry fig exports [3]. 85-90% (60-70 thousand tons) of dried figs are exported and the rest (10-15 thousand tons) is consumed in the domestic market [11]. 30 percent of fig production in Turkey is fresh in the domestic market and 70% is consumed as dry in the foreign and domestic markets. The per capita dry fig consumptions are 308, 200, 152, 90, 83, and 78 g, and these countries are Iran, France, Germany, the United Kingdom, Italy, and Turkey, respectively. Generally, fresh consumption is two or three times this consumption [12].

60 years of data were used in this study. The results obtained from these data were estimated using ARIMA model tests. 5-year trend (2021-2025 years) of dry figs was estimated in Turkey and the world. Due to Turkey being the largest producer and exporter country, it naturally plays an important role in determining the world's dry fig prices. Turkish fresh and dry fig production quantity is very crucial for fresh and dry fig price in Turkey and the World at large. This study aims to estimate the world's dry fig exports from 2021 to 2025 using ARIMA model tests. Furthermore, this study examined the relationship between the world dry fig prices and dry fig export in Turkey.

2 MATERIAL AND METHOD

2.1 Materials

In the study, secondary data were mainly collected by the Food and Agricultural Organization (FAO), State Institute of Statistics of Prime Ministry Republic of Turkey (TURKSTAT), International Trade Centre (ITC), Aegean Dried Fruits and Products Exporters' Union (ADFPEU) Statistics, reports on fig over the past years in Turkey and other previous studies.

2.2. Methods

In the study, The Dry Fig Annual Reports, FAOSTAT, and ITC annual time series data were taken into consideration. HHI and CR were used to calculate the export concentration of dry figs in the world. ARIMA model tests were used to forecast the variables for the next five years (2021-2025); annual time series data containing, export variables of dry fig in the last 60 years (1961-2020). Excel was used to calculate the HH index and CR and ARIMA model estimates were obtained by SAS 9.2.

HHI and CR *HHI and CR*
In the study, the export concentration of dry figs in the world was defined by calculating HHI and Concentration Ratios (CR_1, CR_2, CR_3, CR_4, and CR_5) [13,14,15]. The calculation of HHI, HHI^{-1}, and CR_{1-5} for the largest five firms is shown below.

$$\mathbf{HHI} = {MS_1}^2 + {MS_2}^2 + {MS_3}^2 + {MS_4}^2 + {MS_5}^2 \quad (1)$$

$$\mathbf{HHI^{-1}} = 1/\,\mathrm{HHI} \quad (2)$$

$$\mathbf{CR_1} = MS_1 \quad (3)$$

$$\mathbf{CR_2} = MS_1 + MS_2 \quad (4)$$

$$\mathbf{CR_3} = MS_1 + MS_2 + MS_3 \quad (5)$$

$$\mathbf{CR_4} = MS_1 + MS_2 + MS_3 + MS_4 \quad (6)$$

$$\mathbf{CR_5} = MS_1 + MS_2 + MS_3 + MS_4 + MS_5 \quad (7)$$

MS_1= Percentage share of the country that ranks first in the world in production or export
MS_2= Percentage share of the country which ranks second in the world in production or export
MS_3= Percentage share of the country that ranks third in the world in production or export
MS_4= Percentage share of the country which ranks fourth in the world in production or export
MS_5= Percentage share of the country which ranks fifth in the world in production or export
The Market statue has been shown by HHI and CR in Table 1.

Table1. Market according to HHI and CR

Markets	**HHI**	**CR**
Perfect competition	0-99	< %1
Monopolistic Competition	100-1799	%1-49.9
Oligopoly	1800-9999	%50-99.9
Monopoly	10000	%100

Source: [16].

HHI and CR can have values from 0 to 10,000 and from 0 to 1 respectively. If there is only a single dry fig exporter country that has 100% of the market share, the HHI will be 10,000 and CR will be one. If there were a great

number of dry fig exporter countries with each country having a market share of almost 0% then the HHI and CR could be close to zero.

The Auto-Regressive Integrated Moving Average (ARIMA) models
ARIMA model is one of the most important time series models applied in financial market forecasting over the past three decades [17,18]. For more than half a century, ARIMA models have dominated many areas of time series forecasting [15]. This model has found a widespread application in many practical sciences [19].
ARIMA model function is represented by three terms (p, d, q), where p represents the number of autoregressive terms, d represents the number of nonseasonal differences and q represents the number of lagged forecast errors in the prediction equation. The three steps required to develop an ARIMA model are identification, estimation, and forecasting [15,20,21,22,23].

In the study, the p and q values, which obtained the BIC values determined by SCAN and ESACF in the SAS 9.4 program, were analyzed separately, and these criteria were determined the most according to the smallest SBC, SSE, MSE, MAE, MAPE, RMSE, DW values closest to 2 and the highest R^2 results. The p and q values that provide the most appropriate ARIMA model were accepted. In addition, HHI and CR are used in the competition of countries in terms of production and export [15 24].

The ARIMA forecasting equation for a stationary time series is a linear (i.e., regression-type) equation in which the predictors consist of lags of the dependent variable and/or lags of the forecast errors [25]. That is: The predicted value of Y = a constant and/or a weighted sum of one or more recent values of Y and/or a weighted sum of one or more recent values of the errors.

A no seasonal ARIMA model is classified as an ARIMA (p, d, q) model, where:
p is the number of autoregressive terms,
d is the number of no seasonal differences needed for stationary and
q is the number of lagged forecast errors in the prediction equation
First, let y denote the d^{th} difference of Y, which means [24,26].

If d=0: $y_t = Y_t$ (8)

If d=1: $y_t = Y_t - Y_{t-1}$ (9)

If d=2: $y_t = (Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2}) = Y_t - 2Y_{t-1} + Y_{t-2}$ (10)

All unvaried time series variables in this study are integrated in order (8), (9), and (10), after conducting appropriate unit root tests, indicating that the variable in question reaches a constant mean, variance, and the covariance between t and t+1 time after first differentiating the series. Once the stationary is met, we then use the ARIMA model to conduct a forecast. Several different ARIMA models were conducted to pick a model representing the series best [24,26].

3 RESULTS DISCUSSION

Fig production in the world

While there were 622 thousand hectares of fig production area in the world in 1961, this area decreased to 282 thousand hectares in 2020. About half of the production area in 1961 belonged to Portugal, and over the years, the fig production areas experienced significant decreases both in the world and in the countries, while the yield increased more than the decrease rate. The fig production area is 525,000 ha; about 48% of this area is in Portugal, about 12% in Italy, 8% in Spain, %8 in Turkey 6% in Algeria, %5 in Greece, %4 in Syria, and %4 in Tunisia in 1961-1970 periods. Also, Fig production area is 295,000 ha; about 20% of this area is in Morocco, 17% in Turkey, 14% in Algeria, %11 in Iran, %10 in Egypt, %6 in Tunisia, 5% in Spain, and 3% in Syria in 2011-2020 periods [3].

Leading countries in the fig production and their competitive situations are shown in the Table 2.

Table 2. Fig production competition of leader countries in 1961-2025 years

Years	HHI	HHI^{-1}	CR_1	CR_2	CR_3	CR_4	CR_5	Major Producer Countries	Number of Countries
1961-1970	0.11	9.52	18.24	33.60	48.66	60.30	71.22	Italy, Turkey, Portugal, Greece, Spain	32
1971-1980	0.08	12.79	19.28	38.56	51.25	62.67	70.52	Turkey, Greece, Italy, Spain, Algeria	32-37
1981-1990	0.12	8.30	31.55	63.10	73.99	80.26	85.59	Turkey, Greece, Morocco, Algeria, Spain	36-39
1991-2000	0.10	10.35	24.40	48.79	65.28	70.54	77.25	Turkey, Egypt, Greece, Iran, Spain	40-48
2001-2010	0.11	9.17	23.24	46.49	66.39	73.84	81.03	Turkey, Egypt, Morocco, Iran, Algeria	49-50
2011-2020	0.12	8.34	25.77	51.53	67.75	78.38	88.78	Turkey, Egypt, Morocco, Algeria, Iran	50-51
2021-2025*	0.14	7.36	27.08	44.22	55.91	65.87	75.67	Turkey, Egypt, Morocco, Iran, Algeria	53-54

Source: [3].
*Estimation was made with the ARIMA model.

There are fluctuations in fig production amounts in Turkey, Egypt, Morocco, and Iran but those countries have increased the fig rating of production whereas the rating of fig production has declined constantly in Greece and Italy such as some countries from 1961 to 2020. According to the HHI index, the market shows the feature of monopoly competition, while according to the concentration ratios, the fig production market shows the feature of the oligopoly market. While the number of producing countries was 32 countries in the 1961-1970 period, 51 countries produced this product in 2011-2020, with an average of 5 new countries producing this product every ten years. In 2021-2025, the number of producing countries is expected to be 53-54 countries. While Italy, Turkey, Portugal, Greece, and Spain were the leading countries in 1961-1970, Portugal until the 1970s, Italy until the 1980s, and Greece and Spain in the 2000s could find a place among the top 5 countries with their current production levels. Algeria in the 1970s, Morocco in the 1990s, and Egypt and Iran in the 2000s and later were among the top 5 countries with their production levels. Turkey, the leading country after 1970, has a production level of 18-32% of world production in general, while the second, third, fourth and fifth countries have percentages of 16-24, 13-20, 5-12 and 5-11.

Estimated annual average production quantity in leader 10 countries, other countries, world total, and world general average was listed in Table 3.

Tablo 3. As of 2021-2025, the leading countries and the annual fig production average estimates around the world

Periods / Variables	1. Turkey	2. Egypt	3. Morocco	4. Iran	5. Algeria	6. Spain	7. Syria	8. the USA	9. Albania	10. Greece	11. Others	World Total (1+...+11)	12. World General
a. Production Amount (thousand tons/year)	330	209	142	121	119	51	45	26	23	11	140	1217	1335
b. ARIMA Model Used	1,1,1	5,1,1	1,1,1	5,1,2	2,1,1	4,1,1	3,1,1	5,1,1	2,1,1	5,1,1	2,1,0	-	0,1,4

Not: 2021-2025 verileri için ARIMA modeli tahminleri kullanılmıştır.

Dry fig export in the world
Figs are usually consumed as fresh and dried. Dry figs are important commercial products for leader countries are Turkey, Afghanistan, Iran, Greece, Spain, Syrian, the USA, Germany, Belarus, and Netherland. While dry figs have been exported annually approximately 48 and 114 thousand tons, respectively in the world during 1961-1970 and 2011-2020.

Leading countries in the dry fig exporting and their competitive situations are shown in the Table 4.

Table 4. Amount of dry fig exporting of leader countries in 1961-2025 years

Years	HHI	HHI^{-1}	CR_1	CR_2	CR_3	CR_4	CR_5	Major Exporter Countries	Number of Countries
1961-1970	0.38	2.67	55.73	78.26	88.93	92.61	95.17	Turkey, Greece, Portugal, Italy, Algeria	16-31
1971-1980	0.45	2.25	63.20	83.66	88.82	91.35	93.85	Turkey, Greece, Syria, Portugal, USA	22-38
1981-1990	0.53	1.89	31.55	71.17	85.54	90.38	92.66	Turkey, Greece, Syria, USA, Italy	27-49
1991-2000	0.33	2.99	55.94	65.91	73.04	79.02	84.12	Turkey, Greece, Iran, Syria, USA	34-74
2001-2010	0.33	3.03	56.16	65.00	68.29	73.42	78.53	Turkey, Iran, Greece, Syria, USA	47-84
2011-2020	0.41	2.41	63.57	70.97	75.84	79.76	82.72	Turkey, Iran, Afghanistan, USA, Spain	57-91
2021-2025*	0.53	1.87	72.62	79.87	82.78	85.24	87.60	Turkey, Afghanistan, Syria, Spain, Germany	64-97

Source: [3].
*Estimation was made with the ARIMA model.

There is an increase of slightly more than 2 times worldwide, dry fig exporting between 1961-1970 and 2011-2020 periods. According to the HHI index and the concentration ratios, the market shows the feature of the oligopoly market. HHI^{-1} index shows that the number of main exports of dry fig is about 2.7 in 1961-2070 and 2.4 which of meaning that the rating of main export countries has changed little. CR_1 has increased from 0.56 to 0.64 between the 1961-1970 and 2011-2020 periods.

This means that the most important exporting country is Turkey and it has increased its market share. CR_2 decreased from 0.78 to 0.71 in the same period. The second country in the 2000s was Greece, after which was Iran. Change in CR_3 decreased from 0.89 to 0.76 in the same periods. It means that the most important 3rd country has decreased dry fig market share. During these periods, there was a constant change in the place of 3rd countries such as Portugal, Syria, Iran, Greece, and Afghanistan. CR_4 decreased from 0.93 to 0.80 in the same period. It means that the most important 4th country has increased in 0.5% market share. CR_5 decreased from 0.95 to 0.83 in the same period. It means that the most important 5th country has increased by 2% its market share. The most important exporting countries are Turkey, Greece, Germany, Portugal, the USA, Algeria, Syrian Arabia, France, Germany, Iran, Afghanistan, Argentina, and Morocco. While the number of exporting countries was among 16-31 countries in the 1961-1970 period, 57-91 countries exported this product in 2011-2020, with an average of eight new countries exporting this product every ten years. The number of exporting countries is expected to be between 61-95 countries in the 2021-2025 periods. Turkey, Iran, the USA, Afghanistan, and Spain have increased the dry fig rating of exporting whereas the rating of dry fig export has declined constantly in Greece, Portugal, Italy, Algeria, and Syria such as some countries from 1961 to 2020. The market shares of the leading countries while Turkey, Greece, Portugal, Italy, and Algeria are 55.7%, 22.5%, 9.3%, 3.7%, and 2.6% in dry fig export, respectively in the 1961-1970 period, Turkey, Iran, Afghanistan, USA, Spain are 63.4%, 7.4%, 4.9%, 3.9% and 3% in the 2011-2020 period.

Considering Tables 2 and 3, the most striking feature is that the number of countries exporting dried figs is higher than the number of producing countries over the years, which brings to mind the derivative demand situation. Turkey does a large part of dry fig exporting to European Union countries. Countries, where Turkey's most dry figs are exported, include Germany (17.2%), France (13.0%), the USA (%8.3), United Kingdom (4.9%), Russia (4.8%), Netherlands (4.4%), Italy (4.4%), Switzerland (3.2%), China (2.3%) and Belarus (2.0%) according to the average of 2011-2020 periods. Turkey also exports to 104 countries in the same period, and the share of the 10 countries to which it exports the most in total exports is 64.5%. Also, European Union countries constitute about 61.8% of the total dry fig exports of Turkey. Because Turkey has been exporting an average of 45 thousand tons of dry fig for an average of 10 years. Especially in European Union countries like France, Germany, and Italy, a large part of dry fig imports from Turkey are exported to other countries. The study of statistics related to the imports in three countries; France, Germany, the Netherland, and Italy showed that the four main demanders have each purchased about 40% of Turkey's dry fig on average from 2011 to 2020.

Leading countries in the value of dry fig exporting and their competitive situations are shown in Table 5.

Table 5. Value of dry fig exporting of leader countries in 1961-2025 years

Years	HHI	HHI^{-1}	CR_1	CR_2	CR_3	CR_4	CR_5	Major Exporter Countries	Number of Countries
1961-1970	0.32	3.10	51.75	70.75	81.84	88.45	93.10	Turkey, Greece, Algeria, Portugal, USA	16-31
1971-1980	0.46	2.17	64.41	85.15	88.95	92.02	93.73	Turkey, Greece, USA, Portugal, Italy	22-38
1981-1990	0.49	2.02	68.41	82.50	88.67	92.48	93.52	Turkey, Greece, Syria, USA, Italy	27-49
1991-2000	0.40	2.53	61.27	72.68	79.61	82.94	85.74	Turkey, Greece, USA, Syria, Iran	34-74
2001-2010	0.35	2.84	58.43	65.05	70.51	75.56	79.13	Turkey, Iran, Greece, Syria, USA	47-84
2011-2020	0.38	2.60	60.48	71.92	76.37	80.71	83.83	Turkey, Afghanistan, USA, Iran, Germany	57-91
2021-2025*	0.47	2.14	67.26	78.42	82.11	85.06	86.93	Turkey, Afghanistan, Germany, Syria, Spain	64-97

Source: [3].
*Estimation was made with the ARIMA model.

If you pay attention, the HHI and concentration ratios in table 4 and 5 are close to each other, and some differences are noticeable in the rankings of the top five countries in terms of leading countries, and especially in most of the years, the two countries of the European Union are among the top five countries in terms of export amount and income by creating derivative demand of European Union countries. has taken place.

Dry fig average exporting price in the world

Table 6. As of 2021-2025, dry fig export quantity and value and unit export price forecasts for leading countries and around the world

Periods / Variables	Turkey	Afghanistan	Germany	Greece	USA	Spain	Austria	Netherlands	France	Syria	Italy	World General	World Total
a. Export Amount (thousand tons)	90.2	9.0	2.9	1.6	2.7	3.1	0.5	1.3	0.8	3.6	0.3	134.1	124.2
ARIMA Model Used	5,1,2	5,1,1	3,1,4	3,1,4	1,1,1	1,1,0	2,1,1	2,1,1	2,1,2	2,1,1	3,1,1		4,1,0
b. Export Value (million $)	300.5	49.9	16.5	13.2	6.4	8.4	2.1	6.6	4.8	5.7	2.6	496.0	446.8
ARIMA Model Used	0,1,4	4,1,1	4,1,0	1,1,0	2,10	1,1,0	3,1,1	3,1,3	4,1,4	0,1,1	5,1,2		5,1,4
c. Export Price ($/kg) (b/a)	3.3	5.5	5.7	8.3	2.4	2.7	4.2	5.1	6.0	1.6	8.7	3.7	3.6

Note: ARIMA model estimates are used for 2021-2025 data.
The data of 1977-2000 for Austria and 1967-2000 for Afghanistan are taken into account.

Exporting price of dry fig was obtained by dividing by the exported quantity of export income of dry fig. Dry fig unit prices in the world ranged from $0.21 to $0.64 and the world average is $0.24, while Turkey's average is $0.23 from 1961-1970 [3]. Sometimes dry fig prices rise and fall sometimes throughout the world at a time. Therefore, there were fluctuations in prices. The dry fig price in the world and Turkey has increased about 20 times in 60 years. Turkey is in the first place by forming approximately 50-75% of the world's dried fig exports. For this reason, Turkey's export price is generally close to the world export price. Even though dry fig prices have been below the world price in Syria, the USA, Spain, and Turkey, above the world price in Italy, Greece, France, Germany, Netherlands, and Afghanistan. The reason of applied higher prices in these countries, they take dry figs from Turkey; they provide the market benefits such as place, time, shapes, ownership, and prestige, and export dry fig to other countries. Turkey's most dry figs are exported including Germany (17.2%), France (13.0%), the USA (%8.3), the Netherlands (4.4%), and Italy (4.4%) [3]. In other words, this shows that countries with dried figs from Turkey market the product in different markets at higher prices. Because the market is not a monopoly, there may be a resale situation. According to [27], fig color has a principal positive influence on fig prices, on the contrary fig's hull, splotch, overripe and unripe have a positive influence on fig prices. If producers obtain suitable quality products to the standards of the world this will increase export potential. There are two most important factors affecting prices, one is supplied and the other is demand. Supply and demand for dry fig will be approximately 124-134 thousand tons in the 2021-2025 periods. If Turkey doesn't submit more than 20% of this demand in the market, dry fig prices will rise.

This is caused by an excessive increase in prices in 1971-1980 and 2001-2010 because the supply failed to meet dry fig's demand. [28], said that awareness of farmers in figs marketing is reflected in fluctuations in the prices. Therefore, producers should explore the most suitable drying conditions for marketing [29]. If we consider these statements as true, when Turkey fig producers come together for joint action they will fix the price in their favor in the world market.

4 CONCLUSION

There are approximately 10 countries that export dry figs in economic terms, and 60-70% of the world's dry figs exports are provided by Turkey. In that case, Turkey is undisputed number one in the world's dry fig exports. The results show that the dry fig market will have oligopoly market features after 5 years, too. Especially Turkey have a huge effect in determining the price of dry figs in the market in recent years. As understood from the estimated future in 5 years, the impact on Turkey's dry figs market will increase and Turkey will predominate about 70% of the market. Germany and France, the USA, Netherlands, and Italy such as countries create derivative demand in the dry fig, and also as they are increasing marketing benefits of production, sell to them at higher prices. Derivative demand in the dry figs is about 20-30%. If Turkey acts that such a monopoly videlicet, Turkey can how much reduce resale opportunities, and the world and Turkey's prices will so increase. Also, dry figs of Turkey are primarily marketed to member countries of the European Union. Export of dry fig from Turkey has been made to about 100 countries in the last 5 years. In considering the over 200 countries in the world, and many countries like Ghana, China, Iraq, Paraguay, and Chile that do not know firms that market dry fig, there is a need to advertise and provide information in these countries, for the promotion of this product. It is concluded that dry fig producers

are informed about the dry fig market. By providing technological efficiency and increasing the demand for this product, the price of dry figs and the export revenue of Turkey will increase. For dry fig export value is very important for Turkey, it will provide additionally increased prosperity as indirect.

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