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Analysis of Saudi demand for imported honey using an Almost Ideal Demand System (AIDS)

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ABSTRACT

This study aims to analyze Saudi demand for natural honey imported from Yemen, Pakistan, Australia, Argentina, Mexico, and Germany, which contribute around 73.7% of the value of natural honey imports during the period of study (1991–2017). Marshallian elasticities estimation using AIDS model shows all own-price elasticities were negative and significant except for own-price elasticity associated with demand for natural honey imported from Pakistan. Natural honey imported from Yemen has own-price inelastic demand. In addition, the results of cross-price elasticities show a relationship between different products of imported natural honey and the estimated values of expenditure elasticities. According to these study results, it is important to encourage the domestic production of honey to meet the increase in the demand of the natural honey. The future studies could examine whether the domestic natural honey might be close substitute of any of these imported natural honey. In addition, we recommend increasing sources of import natural honey, especially if a country might be closer substitute for others.

1. Introduction

In Saudi Arabia, the demand for imported natural honey has increased as result of many factors such as the increase in population and income. We can observe that imports of natural honey increased from around 2.2 thousand tons in 1991 to 6.4 thousand tons in 2000, which means the imports of this product increase of 4.2 thousand tons over 10 years (General Authority for Statistics, 1991–2017). Imports reached more than 21.3 thousand tons in 2014, which clearly reflects the increase in demand from Saudi consumers. The other reason for the increase in imports is the fact that production by local honey projects in Saudi Arabia could not match the increase in domestic consumption during the study period (1991–2017). According to data from the Ministry of Environment, Water, and Agriculture (2018), total domestic production in 2017 amounted to 2.5 thousand tons, while total imports reached about 16.5 thousand tons in the same year, which represents only about 15 percent of the supply volume in the Saudi market. The importance of imports to meet the domestic demand for natural honey is, therefore, clear.

Saudi Arabia is dependent on several countries for imports of natural honey. The most prominent countries during the study period were Yemen, Pakistan, India, Australia, United States, Argentina, Mexico, Germany, Turkey, and Spain. The relative importance of imports from these countries changed depending on production conditions and other factors affecting foreign trade. Between 1992 and 1994, imports from Turkey accounted for between 35 and 50 percent of total imports of natural honey. Recently, imports from a few countries such as Pakistan and Mexico have accounted for around 25 percent of the total imports (The General Authority for Statistics, 1991-2017).

Most research on honey focuses on the contribution of honey to nutrition and human health. Some research has focused on the economic aspects of honey such as consumer behavior regarding demand, prices, and competition. Economic research on honey focuses on the effects of several factors on demand and consumer preferences such as importance of the source of honey, wax content, proportion of sugar, packaging, color, taste, aroma, brand name, and certification and their impact on willingness to pay (Ghorbani and Khajehroshanaee, 2009; Cosmina et al., 2016; Ismaiel et al., 2014; Zulail et al., 2014; Wu et al., 2015; Brščić et al., 2017; Ribeiro et al., 2018).

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In addition, honey suppliers' competition behavior provides an interesting area of study to understand economic behavior related to honey. Wang and Wang (2006) studied Chinese exports of honey to Japan. They used linear approximate almost ideal demand system models (LA-AIDS) to estimate the income and price elasticities observed in competition between Argentinian and Chinese honey imports. The demand system model is commonly used to describe an economic phenomenon regarding agricultural and food products; its results illustrate price and income elasticities and compare different alternatives. Such a model is used to examine demand for fruit juice imports in the United States (He and Huo, 2011), and the relationship between citrus products, which include oranges, tangerines, and lemons (Alzoom, 2000), and the competitive relationships between sources of orange imports (Alzoom, 2000). It is also used to examine demand for rice (Ruwis, 2004) and sheep meat for Saudi Arabia (Ruwis and Alderiny, 2008; Ruwis et al., 2007). Even though, there is a lack of econometric studies that focus on the optimal demand of Saudi consumers regarding imported natural honey. There is a need to study and analyze the demand structure for imported natural honey, which may contribute to the adoption of appropriate economic decisions in the field of improvement and expansion of domestic production and are also applicable in the field of trade exchange.

The main objective of this research is to analyze Saudi demand for natural honey imported from Yemen, Pakistan, Australia, Argentina, Mexico, and Germany. The study seeks to achieve a number of other objectives that include computing own-price, cross-price, and expenditure or income elasticities to show the effect of the relative changes in prices and total expenditure on the relative changes in the quantities demanded, and using elasticities for prediction of the quantities demanded. The results of this study expected to show the competitive situation among origin countries and examine whether these countries represent acceptable alternatives for Saudi consumers.

2. Research methodology

The demand was estimated according to total expenditure on imported natural honey. Import sources include 10 countries, and the six most important countries were selected. The following sections introduce the empirical model of the Almost Ideal Demand System (AIDS); the restrictions on its parameters, which satisfies the conditions of the demand functions, prices elasticities, and expenditure; and the method of estimation.

2.1. Empirical AIDS model

Assuming a linear form of an Engle curve, the Almost Ideal Demand System (AIDS) model introduced by Deton and Muelbauer (1980) can be applied to demand for natural honey imported from the aforementioned six countries. Eq. (1) shows budget expenditure on honey imported from country i

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} Ln(p_j) + \beta_i [Ln(X) - Ln(a(P)],$$
$$n = 6, \quad i = 1,2,3,4,5,6 \tag{1}$$

where $Ln(a(P))$ is the translog price index defined as

$$Ln(a(P)) = \alpha_0 + \sum_{i=1}^{n} \alpha_i Ln(p_i) + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} Ln(p_i) Ln(p_j) \tag{2}$$

where w_i refers to the budget share of honey imported from country i, p_j is price of honey imported from country j, X is total expenditure on honey imports, and $\alpha_0, \alpha_1, \gamma_{ij}$ *and* β_i are parameters to be estimated.

2.2. Demand function constraints

Economic theory imposes the following restrictions on the parameters of the budget share Eq. (1).

(i) The "adding-up" condition ensures that the expenditure shares always sum up to one, $\sum_{i=1}^{n} w_i = 1$. This condition is fulfilled if

$$\sum_{i=1}^{n} \alpha_i = 1; \quad \sum_{i=1}^{n} \beta_i = 1; \quad \sum_{i=1}^{n} \gamma_{ij} = 0 \forall j \tag{3}$$

(ii) The "homogeneity" condition guarantees that there is no "money illusion," that is, if all prices and income change at the same rate, the imported quantities do not change. It is fulfilled if

$$\sum_{j=1}^{n} \gamma_{ij} = 0 \forall i \tag{4}$$

(iii) The "symmetry" condition follows from applying Shepard's Lemma to the expenditure function related to the AIDS model (1). Symmetric changes in compensated demand functions can be imposed by setting

$$\gamma_{ij} = \gamma_{ji} \forall i,j \tag{5}$$

(iv) The "Negativity" condition means that Slutsky's substitution matrix, which includes own and cross elasticities, must be negative semidefinite.

2.3. Demand elasticities

Let η_i^E be the expenditure elasticity of natural honey imported from country i and η_{ij}^p be the price elasticity of natural honey imported from country j in the ith equation. According to Alston et al. (1994), based on (1) and (2), the expenditure and price elasticities of the AIDS model are obtained as follows.

(i) The expenditure elasticity is

$$\eta_i^E = 1 + \frac{\beta_i}{w_i}, \quad i = 1,2,\cdots,n \tag{6}$$

which expresses the responsiveness of the quantity of natural honey imported from country i to relative change in total expenditures on imports of natural honey.

(ii) Marshallian price elasticity is

$$\eta_{ij}^p = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\alpha_j \beta_i}{w_i} - \frac{\beta_i}{w_i} \sum_{k=1}^{n} \gamma_{kj} Ln(p_k), \tag{7}$$

$$\delta_{ij} = \begin{cases} 1 if i = j \\ 0 otherwise \end{cases}, \quad i,j = 1,2,\cdots,n$$

which expresses the responsiveness of the quantity of natural honey imported from country i to relative changes in the price of natural honey imported from country j. If $i = j$ it is possible to obtain the own-price elasticities, η_{ii}^p, while if $i \neq j$ cross-price elasticity, η_{ij}^p can be obtained.

Under assuming $\alpha_0 = 0$ in Eq. (2) and providing observations on dependent variable w_i as well independent variables $Ln(p_i), i = 1,2,3,4,5,6$ and $Ln[X/a(P)]$, parameters α_i, β_i, *and* γ_{ij}

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in Eq. (1) can be estimated. From the parameter estimates, all elasticities η_i^E and η_{ij}^P are computed based on Eqs. (6) and (7).

2.4. Parameters estimations

When we substitute the value of $Ln(a(p))$ in the right-hand side of Eq. (1), budget share w_i becomes nonlinear in regression coefficients and can be rewritten as

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} Ln(p_j) + \beta_i \left[w_i - \sum_{i=1}^{n} \alpha_i Ln(p_i) - \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} Ln(p_i) Ln(p_j) \right] + \varepsilon,$$

$$i, j = 1, 2, \cdots, n; n = 6 \quad (8)$$

where ε is the error term. After taking model constraints into account, the number of equations in the AIDS model becomes $(n - 1 = 5)$ and there are 32 coefficients in this study, which can be estimated using the Nonlinear Least Squares (*NLS*) method with a Seemingly Unrelated Regression (*SUR*) technique for analyzing a system of multiple equations. The properties of (*NLS*) estimates are consistent, and their distribution is close to normal when the sample size becomes sufficiently large. (Greene, 2003).

Statistical Analysis System (SAS) software (2001) can be used to obtain the results of (NLS) estimates, as well as the results of statistical hypotheses tests that achieve the objectives of the research.

2.5. Data

To achieve the research objectives, the study relied on time series data from 1991 to 2017, obtained from the General Authority for Statistics in Saudi Arabia. This series includes data on the amounts q_i and values x_i of natural honey imported from Yemen, Pakistan, Australia, Argentina, Mexico, and Germany, which contribute around 73.7% of the value of natural honey imports during the period. The prices data $p_i = x_i/q_i$ were calculated, and all data are presented in Appendix A.

Table 1 includes the mean values and standard deviations of budget share from each country, w_i, $i = 1, 2, 3, 4, 5, 6$, price per kg of natural honey imported from each country p_i, and total expenditure on natural honey imported from the countries under study (X).

From Table 1, we note that natural honey imported from Yemen accounts for around 21.6% of total Saudi expenditure on natural honey imported from the countries under study, imports from Pakistan account for around 19.9%, Australia around 14.2%, Argentina 8.6%, Mexico around 15.9%, and Germany around 19.8%. Average price per kilo lies between the lower bound (8.65 SR) honey from Mexico, and the upper bound (126.41 SR) honey from Yemen. The average of Saudi expenditure on imported natural honey from the countries under study is about SR 93 million during the period 1991–2017.

Table 1
Mean and standard deviation for the variables under study.

Variables under study	Mean	Standard deviation
Yemeni Honey Imports' budget share (w1)	0.216	0.148
Pakistani Honey Imports' budget share (w2)	0.199	0.070
Australian Honey Imports' budget share (w3)	0.142	0.107
Argentinian Honey Imports' budget share (w4)	0.086	0.042
Mexican Honey Imports' budget share (w5)	0.159	0.085
German Honey Imports' budget share (w6)	0.198	0.093
Price of Yemeni Honey Imports (p1)	126.41	124.58
Price of Pakistani Honey Imports (p2)	13.84	6.27
Price of Australian Honey Imports (p3)	9.63	2.01
Price of Argentinian Honey Imports (p4)	8.71	3.32
Price of Mexican Honey Imports (p5)	8.65	3.26
Price of German Honey Imports (p6)	25.99	14.58
Total expenditure on Honey Imports (SR)	93,440,688	62,655,496

Source: Computed from data in Annex 1.

3. Results and discussion

Results of (*NLS*) estimates: In this study, the Saudi Arabian demand system for imported natural honey consists of six equations representing the expenditure shares of imports from six countries: Yemen (w_1), Pakistan (w_2), Australia (w_3), Argentina (w_4), Mexico (w_5), and Germany (w_6). Since the sum of shares is $\Sigma w_i = 1$, and under the condition of addition, the number of system equations can be reduced to five. The coefficients of these equations were estimated using the *NLS* method and the results are summarized in Table 2.

The coefficient estimates of the AIDS model (8) are presented in the form of price and expenditure elasticities. The expenditure share of natural honey imports from Yemen (w_1) responds positively to an increase in its own price as well the price of imports from Australia, but it responds negatively to change in the price of imports from each of the other countries.

The expenditure share of imports from Pakistan (w_2) responds positively to an increase in its own price as well the price of imports from both Mexico and Germany, but it responds negatively to change in the price of imports from both Australia and Argentina.

The expenditure share of imports from Australia (w_3) responds negatively to an increase in its own price, but it responds positively to an increase in the price of imports from Argentina, Mexico, and Germany.

The expenditure share of imports from Argentina (w_4) responds positively to an increase in its own price as well the price of imports from Mexico, but it responds negatively to an increase in the price of imports from Germany.

The expenditure share of imports from Mexico (w_5) responds negatively to an increase in its own price as well an increase in the price of imports from Germany.

The expenditure share of imports from Germany (w_6) responds positively to an increase in its own price.

Testing demand constraints: The linear restrictions on the parameters of the budget share equations, their estimations, t-test statistics, and p-value = $pr > |t|$ for testing these restrictions are presented in Table 3.

Note that the adding-up condition is automatically satisfied by the demand model in the budget-share form and it can be verified at the same time by testing the null hypotheses [H_0:$\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5 + \alpha_6 = 1$]. We demonstrate that the p-value related to testing of this restriction {$pr > |t| = 0.109$} is greater than the 5% significance level; the null hypothesis is accepted and the empirical demand model satisfies the adding- up condition.

The conditions of homogeneity represented by six null hypotheses, [H_0: $\gamma_{i1+}\ \gamma_{i2+}\ \gamma_{i3+}\ \gamma_{i4+}\ \gamma_{i5+}\ \gamma_{i6} = 0$, $i = 1, 2, 3, 4, 5, 6$], and all p-values,{$pr > |t| = 0.113, 0.689, 0.088, 0.592, 0.766, 0.105$}, related to testing these restrictions are greater than the 5% significance level; all null hypotheses are accepted and indicate that the empirical demand model satisfies homogeneity conditions.

The symmetry conditions represented by 15 null hypotheses, [H_0: $\gamma_{ij} = \gamma_{ji}$, $i, j = 1, 2, 3, 4, 5, 6$, $i \neq j$], and all p-values related to testing these restrictions are greater than the 5% significance level; all null hypotheses are accepted and indicate that the empirical demand model satisfies symmetry conditions (Table 3).

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Table 2
Results of *NLS* estimates for the parameters of equation systems (8).

Expenditure share (w_i)	Log_e price of natural honey imported from country $Ln(p_i)$						Total expenditure $Ln(X/P)$	Intercept α_i
	Yemen Ln (p_1)	Pakistan Ln (p_2)	Australia Ln (p_3)	Argentina Ln (p_4)	Mexico Ln (p_5)	Germany Ln (p_6)		
Yemen	0.037 (0.63)	−0.065 (−1.95)*	0.185 (1.59)	−0.021 (−1.27)	−0.090 (−1.16)	−0.045 (−1.18)	0.055 (1.3)	−0.740 (−1.07)
Pakistan		0.150 (3.02)***	−0.090 (−1.14)	−0.019 (−0.78)	0.004 (0.05)	0.021 (0.5)	−0.002 (−0.08)	0.306 (0.72)
Australia			−0.469 (−2.66)**	0.019 (0.32)	0.283 (2.17)**	0.072 (0.66)	−0.144 (−5.71)***	2.176 (5.66)***
Argentina				0.001 (0.03)	0.038 (0.58)	−0.017 (−0.67)	0.005 (0.35)	0.066 (0.27)
Mexico					−0.194 (−1.2)	−0.039 (−0.45)	0.092 (2.83)***	−1.187 (−2.24)**
Germany						0.009 (0.14)	−0.007 (−0.18)	0.380 (0.65)

Note: computed t values are in parentheses under the estimated coefficients.
* The coefficient is significant at 10% significance level.
** The coefficient is significant at 5% significance level.
*** The coefficient is significant at 1% significance level.

Table 3
Results of restrictions estimation and hypothesis tests.

Restrictions	Null hypotheses (Linear restriction)	Estimate	Std. Err	t Value	$Pr > \|t\|$
Adding up	$\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5 + \alpha_6 = 1$	4.285	2.663	1.610	0.109
Homogeneity	$\gamma_{11+}\ \gamma_{12+}\ \gamma_{13+}\ \gamma_{14+}\ \gamma_{15+}\ \gamma_{16} = 0$	21.637	13.571	1.590	0.113
	$\gamma_{21+}\ \gamma_{22+}\ \gamma_{23+}\ \gamma_{24+}\ \gamma_{25+}\ \gamma_{26} = 0$	5.850	14.123	0.410	0.689
	$\gamma_{31+}\ \gamma_{32+}\ \gamma_{33+}\ \gamma_{34+}\ \gamma_{35+}\ \gamma_{36} = 0$	36.542	21.405	1.710*	0.088
	$\gamma_{41+}\ \gamma_{42+}\ \gamma_{43+}\ \gamma_{44+}\ \gamma_{45+}\ \gamma_{46} = 0$	13.816	24.967	0.550	0.592
	$\gamma_{51+}\ \gamma_{52+}\ \gamma_{53+}\ \gamma_{54+}\ \gamma_{55+}\ \gamma_{56} = 0$	3.683	11.962	0.310	0.766
	$\gamma_{61+}\ \gamma_{62+}\ \gamma_{63+}\ \gamma_{64+}\ \gamma_{65+}\ \gamma_{66} = 0$	13.628	8.375	1.630	0.105
Symmetry	$\gamma_{12} = \gamma_{21}$	−10.331	11.089	−0.930	0.364
	$\gamma_{13} = \gamma_{31}$	−2.165	7.259	−0.300	0.773
	$\gamma_{14} = \gamma_{41}$	10.097	11.189	0.900	0.379
	$\gamma_{15} = \gamma_{51}$	−2.540	10.348	−0.250	0.813
	$\gamma_{16} = \gamma_{61}$	−1.049	5.021	−0.210	0.840
	$\gamma_{23} = \gamma_{32}$	14.531	11.990	1.210	0.234
	$\gamma_{24} = \gamma_{42}$	29.247	18.301	1.600	0.112
	$\gamma_{25} = \gamma_{52}$	10.604	13.519	0.780	0.446
	$\gamma_{26} = \gamma_{62}$	5.221	4.367	1.200	0.241
	$\gamma_{34} = \gamma_{43}$	14.883	15.313	0.970	0.343
	$\gamma_{35} = \gamma_{53}$	−7.777	10.437	−0.750	0.469
	$\gamma_{36} = \gamma_{63}$	3.949	3.432	1.150	0.259
	$\gamma_{45} = \gamma_{54}$	−8.478	9.329	−0.910	0.376
	$\gamma_{46} = \gamma_{64}$	0.989	3.571	0.280	0.789
	$\gamma_{56} = \gamma_{65}$	4.023	3.154	1.280	0.209

* Null hypotheses is rejected at 10% significance level.

Marshallian and Expenditure Elasticities: Coefficient estimates related to the budget share equations (γ_{ij}, β_i) in Table 2, the averages of expenditure shares, $w_1 = 0.2157$, $w_2 = 0.1995$, $w_3 = 0.1419$, $w_4 = 0.0861$, $w_5 = 0.15921$, and $w_6 = 0.1976$ in Table 1, and the computed averages of price logarithms $lnp_1 = 4.353$, $lnp_2 = 2.556$, $lnp_3 = 2.242$, $lnp_4 = 2.0924$, $lnp_5 = 2.0855$, $lnp_6 = 3.0857$ were used to compute Marshallian and expenditure elasticities. The results are summarized in Table 4.

From the estimates of Marshallian and expenditure elasticities (Table 4), we note that all own-price elasticities were negative, which means the increase in the price of any product would lead to a decrease in quantity demand of the same product, which is consistent with economic theory, and all are significant at the 5% level except for own-price elasticity associated with demand for natural honey imported from Pakistan. Natural honey imported from Yemen has own-price inelastic demand (−0.648), which means 10% increases in price of this product will decrease the purchase of the same product by less than 10%. At the same time, the demand for natural honey imported from both Argentina and Germany has own-price elasticity of −0.984 and −0.945, respectively, which is close to unitary elasticity. Natural honey imported from both Australia and Mexico has own-price elastic demand of −1.710 and −1.416, respectively, which these could be interpreted as a 10% increase in price will lead to a drop in quantity demanded of more than 10%.

Next, the cross-price elasticity measures the responsiveness of the demand for one honey product to a change in the price of another honey product from a different source. According the

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Table 4
Average Marshallian and expenditure elasticities.

	Yemen	Pakistan	Australia	Argentina	Mexico	Germany	Expenditure
Yemen	−0.648 (−4.45)***	−0.362 (−3.03)***	0.209 (2.05)*	−0.098 (−1.73)*	−0.066 (−0.52)	−0.289 (−1.79)*	1.255 (6.4)***
Pakistan	−0.334 (−2.76)**	−0.245 (−1.05)	−0.425 (−2.47)**	−0.097 (−0.79)	0.004 (0.02)	0.108 (0.49)	0.989 (7.21)***
Australia	0.591 (4.53)***	−0.397 (−1.65)	−1.710 (−3.83)***	0.126 (0.52)	0.586 (1.49)	0.820 (2.63)**	−0.015 (−0.09)
Argentina	−0.205 (−1.58)	−0.239 (−0.87)	0.055 (0.14)	−0.984 (−2.15)**	0.524 (0.93)	−0.215 (−0.71)	1.064 (5.8)***
Mexico	−0.160 (−1.07)	−0.113 (−0.44)	0.296 (0.91)	0.239 (0.82)	−1.416 (−2.61)**	−0.426 (−1.32)	1.580 (7.71)***
Germany	−0.253 (−1.7)	0.113 (0.56)	0.450 (2.17)**	−0.085 (−0.67)	−0.246 (−0.92)	−0.945 (−2.78)**	0.967 (5.12)***

Note: Computed *t* values are in parentheses under the estimated elasticities.
* The elasticity is significant at 10% significance level.
** The elasticity is significant at 5% significance level.
*** The elasticity is significant at 1% significance level.

result of cross-elasticity, the products are either complements (a negative cross-price elasticity) or substitutes (a positive cross-price elasticity). Because we are dealing with the same product from different sources, we assume all relationships of cross-price elasticity have a positive sign. The results indicate that natural honey imported from Yemen has a substitutability relationship with that imported from Australia and it is statistically significant. The demand for natural honey imported from Yemen is inelastic to changes in the price of that imported from Australia and increases by 2.09% if the price of Australian imports increases by 10%. Natural honey imported from Australia has a statistically significant substitutability relationship with that imported from Yemen, Mexico, and Germany, such that the demand Australian imports is inelastic to change in the price of natural honey imported from these three countries. We find that this demand increases by 5.91%, 5.86%, and 8.2%, respectively, if the price of imports from Yemen, Mexico and Germany increase by 10%. Natural honey imported from Germany has a statistically significant substitutability relationship with that imported from Australia, where the demand for natural honey imported from Germany is inelastic to change in the price of that imported from Australia and increases by 4.5% if the price of Australian imports increases by 10%. Other cross-price price elasticities have negative values and are therefore inconsistent with economic theory.

From the estimated values of expenditure elasticities and their *p*-values, we find that all estimates are positive and statistically significant except for expenditure elasticity associated with demand for natural honeyimported from Australia. The estimates indicate that demand for natural honey imports from Yemen, Argentina, and Mexico is elastic to expenditure on natural honey imports, and increases by 12.55%, 10.64%, and 15.8%, respectively, when the amount allocated for spending on imports from the countries under study increases by 10%, which we could identify them as luxuries good. Similarly, natural honey imported from Pakistan and Germany is inelastic to expenditure on imports (normal and necessary goods), and demand increases by 9.67% and 9.89%, respectively, when the amount allocated for spending on natural honey imported from the countries under study increases by 10%. Overall, it is expected that demand of natural honey imports from Yemen, Pakistan, Argentina, Mexico, and Germany will an increase when income (expenditure) increases in tandem with the overall economic growth of the country.

4. Conclusion

This study aims to analyze Saudi demand for natural honey imported from Yemen, Pakistan, Australia, Argentina, Mexico, and Germany, which contribute around 73.7% of the value of natural honey imports during the period of study (1991–2017). Marshallian elasticities estimation using AIDS model shows all own-price elasticities were negative and significant except for own-price elasticity associated with demand for natural honey imported from Pakistan. Natural honey imported from Yemen has own-price inelastic demand. In addition, the results of cross-price elasticities indicate that natural honey imported from Yemen has a substitutability relationship with that imported from Australia, whereas the demand for natural honey imported from Yemen is inelastic to changes in the price of that imported from Australia. The natural honey imported from Australia has a statistically significant substitutability relationship with that imported from Yemen, Mexico, and Germany, and natural honey imported from Germany has a statistically significant substitutability relationship with that imported from Australia. The estimated values of expenditure elasticities indicate that demand for imports from Yemen, Argentina, and Mexico is elastic to expenditure on natural honey imports, while the natural honey imported from Pakistan and Germany is inelastic to expenditure on imports. According to these study results, it is important to encourage the domestic production of honey to meet the increase in the demand of the natural honey. The future studies could examine whether the domestic natural honey might be close substitute of any of these imported natural honey. In addition, we recommend increasing sources of import natural honey, especially if a country might be closer substitute for others such natural honey of India could be close substitute to natural honey of Pakistan.

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Appendix A

See Table 1a.

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Table 1a
Values and quantities of natural honey imports (Saudi Riyal) from several countries between 1992 and 2017.

Years	Yemen		Pakistan		Australia		Argentine		Mexico		Germany	
	Values (R. S) X_1	Quantity (kg) q_1	Values (R. S) X_2	Quantity (kg) q_2	Values (R. S) X_3	Quantity (kg) q_3	Values (R. S) X_4	Quantity (kg) q_4	Values (R. S) X_5	Quantity (kg) q_5	Values (R. S) X_6	Quantity (kg) q_6
1991	2,169,865	5283	3,049,015	179,326	5,087,249	524,785	430,152	51,910	518,520	83,793	4,802,834	536,671
1992	1,956,345	5199	189,446	13,013	6,196,432	498,586	795,366	107,025	760,228	155,021	5,176,247	426,640
1993	5,491,754	20,647	2,008,113	65,137	3,433,736	279,719	109,104	14,883	539,385	112,891	1,118,203	91,561
1994	5,215,390	15,024	4,068,568	132,790	3,856,181	345,929	284,285	57,472	339,122	80,736	1,282,424	139,043
1995	6,256,033	17,060	6,821,214	244,683	5,377,753	606,358	1,674,828	342,854	4,536,674	879,267	7,904,151	821,962
1996	3,247,248	14,282	9,232,898	492,208	10,569,219	1,177,403	3,345,089	498,962	5,508,361	852,735	5,015,049	238,463
1997	9,239,257	46,996	7,204,520	444,480	13,919,895	1,400,423	2,248,598	300,412	4,376,631	575,429	5,640,001	319,973
1998	5,062,304	42,054	6,604,218	471,737	9,836,748	1,263,850	4,108,548	687,817	10,125,528	1,501,807	7,519,083	515,632
1999	5,715,728	65,691	5,799,470	424,062	5,819,877	800,578	2,321,580	468,086	3,693,480	655,649	7,358,367	684,319
2000	4,496,591	47,689	8,742,740	643,014	6,473,688	1,043,682	2,954,535	630,619	7,154,016	1,562,887	8,569,912	883,536
2001	45,672,031	250,105	11,942,951	921,594	4,878,798	826,915	3,061,440	724,659	6,910,432	1,338,373	7,121,415	870,758
2002	35,494,637	382,663	6,221,683	532,309	5,261,876	616,527	1,297,013	228,013	2,324,452	384,286	7,411,804	381,321
2003	47,403,873	443,885	17,411,344	1,712,606	10,038,521	1,258,537	16,730,495	1,636,560	22,420,430	2,103,372	6,661,806	318,875
2004	42,414,156	537,881	23,952,925	2,395,624	18,122,618	2,378,418	15,029,072	1,549,144	18,952,902	1,842,251	4,241,686	240,327
2005	28,264,834	459,846	30,076,683	3,011,834	11,648,134	1,522,641	4,336,879	726,016	10,197,313	1,474,648	9,294,725	335,539
2006	15,896,723	421,660	31,558,973	3,139,643	10,737,866	1,592,936	10,279,628	1,742,155	25,076,516	3,067,576	13,271,969	466,412
2007	19,372,134	537,650	19,350,730	1,891,916	3,274,572	270,157	9,075,642	1,273,131	14,301,060	1,972,277	17,530,280	544,467
2008	23,269,903	569,826	28,161,137	2,743,736	6,873,396	547,458	16,367,798	1,410,196	34,113,344	3,140,077	22,864,755	630,567
2009	26,753,672	680,103	30,132,800	2,974,010	11,976,468	1,283,088	14,701,381	1,261,779	38,523,730	3,267,635	27,075,796	736,211
2010	25,984,980	695,602	16,037,207	1,582,983	7,212,616	663,786	17,524,210	1,427,209	43,307,226	3,546,717	31,662,366	890,264
2011	18,870,177	527,386	29,136,632	2,964,841	12,046,925	1,063,112	16,427,128	1,292,461	29,180,096	2,291,127	37,661,356	729,092
2012	17,653,560	486,458	38,312,354	3,672,286	12,195,229	988,442	18,065,345	1,568,683	35,230,076	2,998,869	50,062,510	1,038,757
2013	20,601,495	583,765	37,899,696	3,665,987	9,159,966	863,333	30,297,490	2,317,546	32,749,976	2,695,579	55,974,177	1,352,234
2014	28,698,376	795,131	40,126,239	4,051,682	9,146,443	895,132	29,458,798	2,004,609	65,225,006	4,564,598	72,875,227	1,942,959
2015	6,416,482	180,056	32,746,985	3,235,454	7,586,618	684,119	16,683,017	1,083,881	47,833,014	3,399,996	35,508,358	1,067,845
2016	4,475,092	908,081	36,003,292	3,526,782	4,820,713	442,920	14,726,482	1,599,408	8,681,168	732,737	27,106,084	523,428
2017	26,588,015	1,169,991	30,973,297	3,071,467	6,605,803	686,761	13,771,400	1,210,259	23,872,225	2,138,648	61,028,662	1,245,926

Source: General Authority for Statistics (2018).

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