

MARKET ANALYSIS OF FENNEL SEED

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Executive Summary

This paper investigates the current and future trends of the Australian and international fennel market. It provides a baseline assessment of the global industry based on currently available information and identifies opportunities for future research.

The market data available for fennel is limited and is often presented in a larger group of spices including juniper berries, anise seeds, badian, caraway, coriander and fennel (as whole seed, not ground or crushed). It is not possible to separate the individual spices from this grouped data so in these instances the overarching trends have been assessed. Throughout this report juniper berries, anise seeds, badian, caraway, coriander and fennel will be referred to as the 'group of spices.'

Fennel is a hardy, biennial or perennial herb with yellow flowers and feathery leaves (Singh, 2017). Fennel produces aromatic dried fruits, which are commonly used as a spice in cooking. The flower and seeds are produced in terminal compound umbels and the dry fruits are 4-10mm long.

India is the world's largest fennel producing country with Syria, Egypt, Turkey, Germany, Spain and Pakistan also making significant contributions to global production. India and Egypt are significant exporters of fennel. Interestingly, for the group of spices including juniper berries and anise seeds, badian, caraway or fennel, India also imported the highest amount of these spices, followed by Germany. Other major importers include United States of America (USA), Turkey, United Kingdom (UK), United Arab Emirates (UAE), Brazil and Malaysia. The annual growth in the import market is 8.9% (ITC, 2019, UN Com Trade, 2019). The reason for this growth is unknown but it has been suggested it may be due to population growth or increased purchasing power of middle-class consumers.

Australia's domestic market for fennel and other similar spices is entirely supplied through imports. In 2018, Australia imported about 568tonnes of the spice group in question, worth about US\$1.37million. The majority of imported spices in Australia are produced in India and China (UN Com Trade, 2019).

There is evidence of continuous growth in the quantity of imported spices, which suggests there is an increasing demand for fennel and similar spices in Australia. Calculations made by CQUniversity using the available data and trend analysis suggest that in 2025 the demand for fennel and similar spices in Australia will exceed 2,000 tonnes per year.





RESEARCH WITH IMPACT

The unit trade price of fennel and other spices was volatile over the last few years. In 2018, the price was US\$ 2,408/tonne. Given the unit value and the size of the market, it is likely that a local industry in Australia could initially target the domestic market before scaling up for international markets.

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Introduction

Fennel (*Foeniculum vulgare Mill.*) is a small herb belonging to the *Apiaceae* family and the order *Apiales* (Malhotra, 2012). Fennel is a hardy, biennial or perennial herb with yellow flowers and feathery leaves (Singh, 2017). Fennel produces aromatic dried fruits, which are commonly used as a spice in cooking. In addition to the seed, fennel leaves and essential oil are used as a spice for flavouring while the bulb of fennel is consumed as a vegetable.

Fennel has an ancient history of being used as a medicinal herb in the Mediterranean region and India. Historical records indicated that ancient Egyptians used fennel as medicinal herb for Pharaohs (Guarrera and Savo, 2013). In the Hershey papyrus, fennel was mentioned as a gift for stomach ailments (Guarrera and Savo, 2013).

The fennel plant has hairy, feathery and soft foliage which can grow up to 2m tall. The thread-like leaves grow up to 40cm long and 0.5mm wide. The flower and seeds are produced in terminal compound umbels and the dry fruits are 4-10mm long. The dry fruit of fennel is generally known as fennel seeds and it contains several vitamins and minerals (Table 1). Based on appearance and composition, fennel is classified in several categories including wild fennel, bitter fennel, sweet fennel and culinary florence fennel (Bagchi and Srivastava, 2003).

Table 1. Chemical composition of fennel seeds

Content	g/100 g	Vitamins	mg/100 g	Content	mg/100 g
Moisture	8.8	Vitamin B ₁	0.41	Calcium	49
Protein	15.8	Vitamin B ₂	0.35	Potassium	414
Fat	14.9	Vitamin C	12	Phosphorus	50
Carbohydrate	36.6	Vitamin A	135 IU	Sodium	29
Fibre	15.7	Niacin	6	Magnesium	23
Energy value:	1440 kJ				

Sources: Malhotra, 2012, Javed et al., 2020, Abubacker, 2011

Fennel is considered as an indigenous Mediterranean plant but is now cultivated in many parts of the world on dry soils near the coast or river banks (Rather et al., 2016). Well-drained and calcareous soils in a sunny situation are the most suitable conditions for fennel production (Bhattacharya, 2016). Key fennel producing countries are India, Egypt, Turkey, Syria and Iran. While the actual production data for fennel are not available for many countries, it is documented that India produced about 150,000tonnes of fennel in 2018 (NHB, 2019).

Scope and limitations of the study

This report presents preliminary market analysis of fennel seeds, which include current production and international trade of this spice. The report is based on the data and literature available through secondary sources including the databases of the Food and Agriculture Organization (FAO), World Trade Organization(WTO), United Nations International Trade Statistics Database (UN ComTrade) and the World Bank.

Since 2012, the commodity code of fennel seeds has been changed and fennel was grouped with anise, badian, caraway and juniper. Only a few countries, including India and Turkey, recorded the production of fennel separately. Therefore readers of this report need to be careful about the use of this information.

This paper also includes an indicative trading price of the group of spices from available data, which might not be the same for fennel. We have not provided a detailed value chain analysis, but some description of value-added products of fennel.

Included is an overview of Australian fennel market and scopes the potential for a future fennel industry in Australia. This baseline information has been collected from secondary sources and is provided to create a greater understanding of the current production and future demand for fennel in domestic and international markets.

Analysis of the production practices, methods, and agronomic factors affecting seed quality will be provided in subsequent reports of this CRCNA Project (A.2.1819045) based on the field varietal trials being undertaken as part of this project.

Global fennel production and value

Global fennel production data showing each of the countries producing this commodity is not available. Based on the available information, India is believed to be the world’s largest fennel producing country. The area under fennel production in India is estimated at 90,000 hectares, yielding 149,000tonnes in 2017-18 (NHB, 2017). In 2016-17 India produced about 153,000tonnes of fennel. Syria, Egypt, Turkey, Germany, Spain, Pakistan are the other significant fennel producing countries.

A Turkish government agriculture statistics website published production data and production area. According to these data, India produced significantly more fennel than Turkey for the period 2012-2018 (Figure 1).

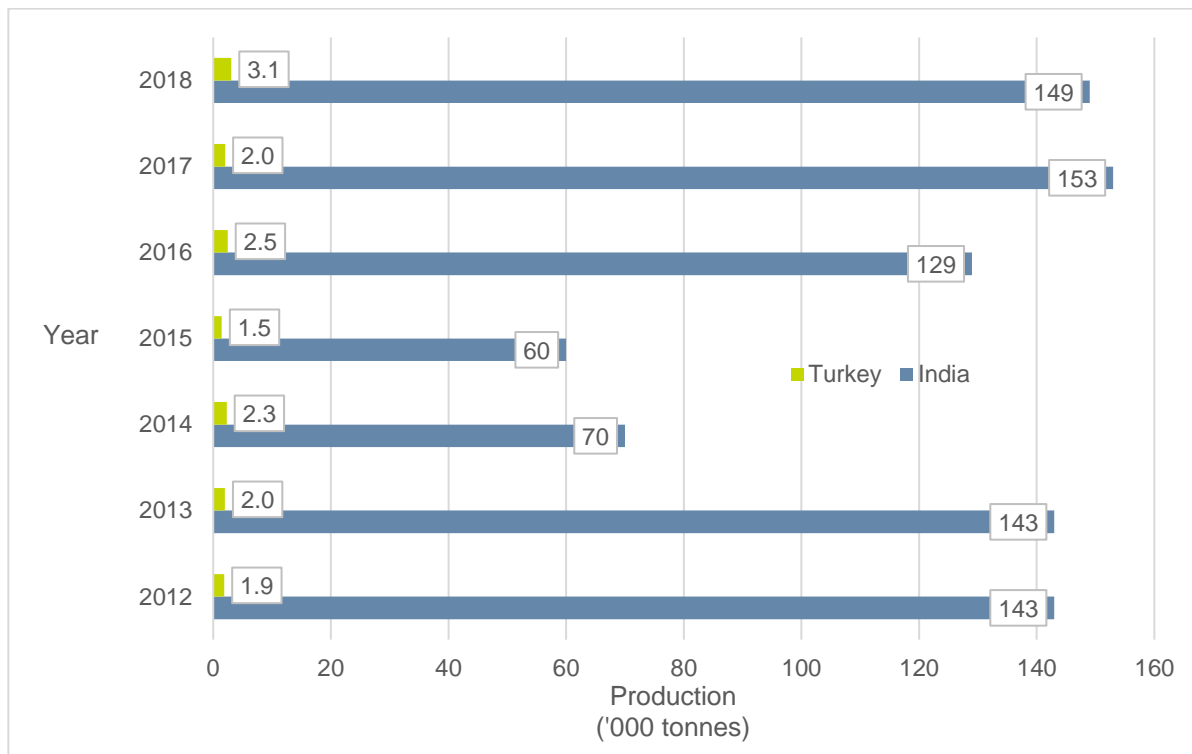


Figure 1: Annual production of fennel in India and Turkey (Data Source: NHB, 2019, TurkStat, 2019)

A comparison of fennel yields from India and Turkey indicate an average yield of fennel per hectare as slightly more in India than Turkey (Table 2).

Table 2: Production area and yield of fennel in India and Turkey over the period of 2012-2018.

Year	India		Turkey	
	Area (thousand ha)	Yield (kg/ha)	Area (thousand ha)	Yield (kg/ha)
2012	100	1,430	1.58	1,180
2013	100	1,430	1.38	1,440
2014	54	1,296	1.58	1,444
2015	39	1,538	1.55	942
2016	76	1,697	1.75	1,408
2017	91	1,681	1.65	1,224
2018	90	1,656	2.34	1,311
Average yield		1,540		1,280

Source: NHB, 2019, TurkStat, 2019

The FAO grouped fennel with anise (*Pimpinella anisum*), badian (*Illicium verum*) and coriander (*Coriandrum sativum*) to produce an annual production data set (FAO, 2019). In 2017, India, Mexico and Iran were the three largest producers of these four spices by volume (Table 3). These data are difficult to decipher to allocate the proportion for individual crops from the pooled data, as coriander is very widely used spice compared to anise, badian and fennel. This makes a prediction of the production volume for each of the spices very challenging and it is risky to extract the exact quantities of production of fennel from these data.

However, in an attempt to extrapolate this data, the known production volume of fennel in India (Figure 1) was 153,000t in 2017, compared to the 646,000t combined for the four spices (FAO 2019) (Table 3). Assuming other countries produce the same proportion of fennel to the other three spices, it is possible to extrapolate that approximately 24% of the production volumes reported in Table 3 can be attributed to fennel production. Further research is required to identify the exact volume of each of these spices.

Table 3. Combined production of anise, badian, fennel, coriander in 2017

Rank	Country	Volume ('000 tonnes)
1	India	646.0
2	Mexico	132.6
3	Iran	64.8
4	China	55.0
5	Russian Federation	50.2
6	Syria	46.7
7	Turkey	32.7
8	Egypt	26.9
9	Morocco	24.5
10	Bulgaria	23.7
11	Others	94.3
	World Total	1,197.4

Source: FAO, 2019

Fennel exporting countries

China and India are the leading spice exporters by volume and value, for the group of spices (juniper, anise, badian, caraway and fennel) (Table 4). India's government statistics indicate that in 2017 India exported about 37,000tonnes of fennel (NHB, 2019).

Data from UN Com Trade and International Trade Centre (ITC) indicates that China exported about 14,200 tonnes of 'whole spice seeds', including juniper berries, anise, badian, caraway and fennel, which was worth approximately US\$49million in 2018 (ITC, 2019 & UN ComTrade, 2019). The same source indicated that of this trade value, badian spice accounted for US\$ 43.7million. This indicates that China's export value of fennel is relatively small compared to other countries.

There was a decline of about 24% in the international trade of this group of spices from India between 2017 to 2018 but global trade value increased by 1.6% during the same period. The data source also indicated that data for some countries including Syria and Vietnam were not available and hence approximate data was presented in the list (ITC, 2019).

Table 4. Major fennel (includes the full group of spices: juniper, anise, badian, caraway or fennel - whole unprocessed seeds only) exporting countries, with volume exported and value of export in 2017 and 2018.

Rank	2017			2018		
	Country	Volume ('000 tonnes)	Value (USD million)	Country	Volume ('000 tonnes)	Value (USD million)
1	China	9.4	27.5	China	14.2	49.0
2	India	37.5	43.1	India	25.0	32.9
3	Egypt	5.2	14.3	Egypt	6.7	23.4
4	Vietnam	7.8	24.3	Vietnam	Not available	22.3
5	Syria	7.0	18.5	Syria	Not available	16.5
6	Turkey	1.9	6.9	Turkey	2.6	10.2
7	Germany	1.6	8.8	Germany	1.5	8.0
8	Spain	1.7	5.1	Spain	2.4	6.5
9	Netherlands	1.5	5.8	Netherlands	1.0	3.6
10	Others	14.8	47.5	Others	Not available	32.6
	World Total	88.5	201.8	World Total	Not available	205.1

Source: ITC, 2019 & UN ComTrade, 2019

India

India exports fennel (and the other four spices in the grouping) to more than 110 countries, with the three major market destinations being Vietnam, USA and Malaysia (Figure 2). The unit price of fennel based on the trade value available in the UN Comtrade database indicated that the highest unit prices among the top 10 export destinations was in Canada (US\$ 2,219/tonne), followed by the United Kingdom (US\$ 2,197/tonne). Interestingly, among the countries which import more than 100 tonnes of these spices each year, Australia is paying the highest unit price at US\$ 2,504/tonne.

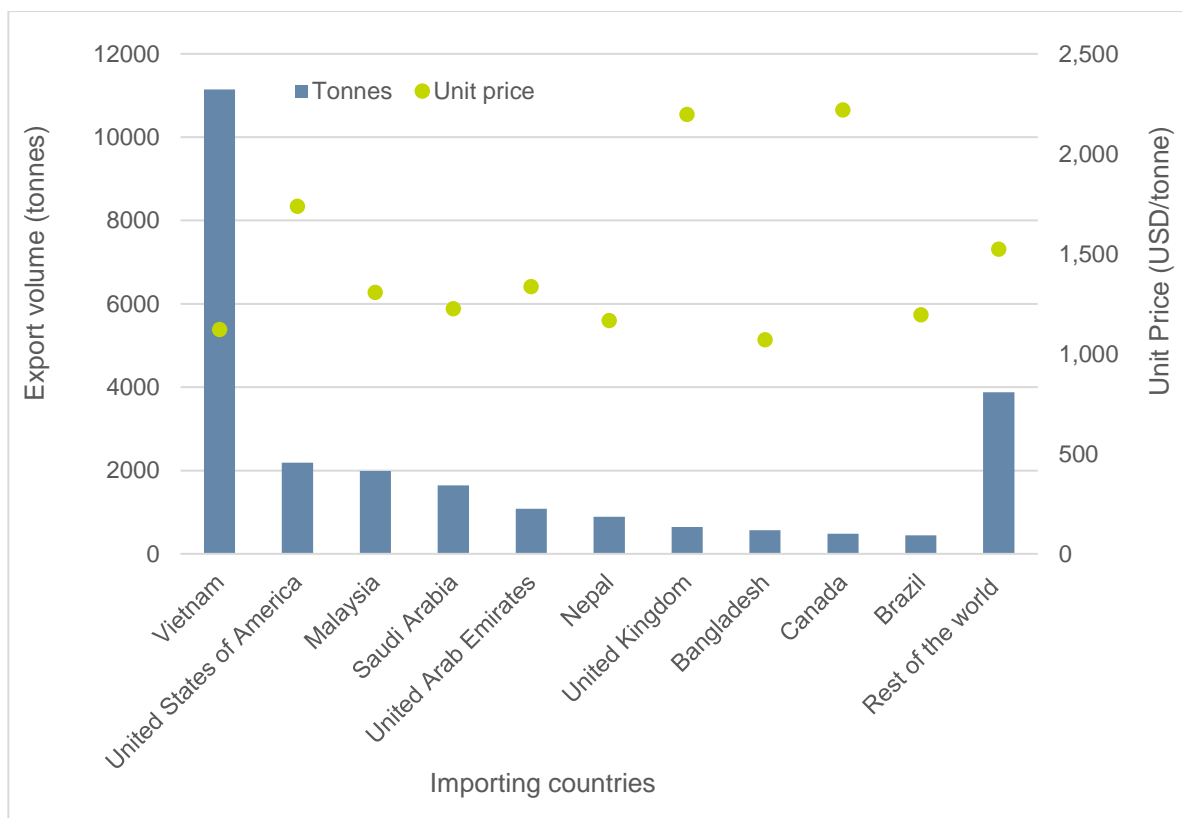


Figure 2. Top 10 export destination of Indian spices (juniper berries and seeds of anise, badian, caraway or fennel as whole seed). Data source: ITC, 2019.

The average trade value of spices (juniper berries and anise seed, badian, caraway or fennel as whole seed) from India is US\$ 1,320/tonne, compared to the trade value in the top importing country of Vietnam of US\$ 1,121/t (Calculated from total trading value, Source: ITC, 2019).

Egypt

In 2018, Egypt exported the selected group of spices to more than 55 countries, with Vietnam the main importer followed by Algeria (Figure 3). The total value of the exported spice group from Egypt in 2018 was over UD\$ 23M, which is about 64% higher than 2017.

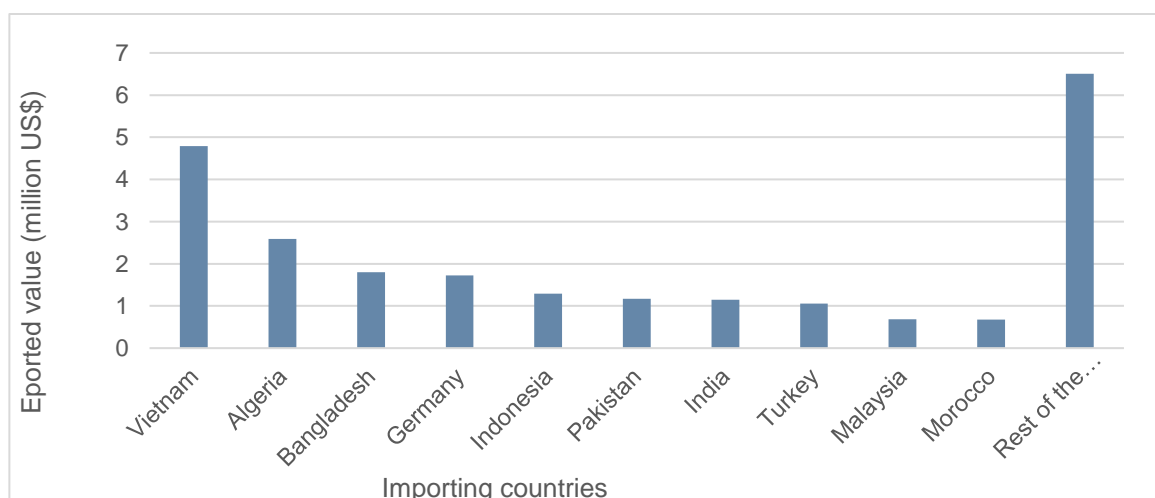


Figure 3. Top export destination of Egyptian spices (juniper berries and anise seeds, badian, caraway or fennel, neither crushed nor ground). Data source: ITC, 2019, UN Com Trade, 2019.

The average trading price of Egyptian spices is US\$ 3,504/t, which is higher than the trading price of the same group of Indian spices (calculated from total trading value, Source: ITC, 2019). Since the price of individual spice is not available, this variation of price may not be indicative for fennel seeds.

Fennel importing countries

The data presented in this section is again for the group of spices (juniper, anise, badian, caraway and fennel). India imported the highest amount of these spices followed by Germany (Table 5). Other major importers include USA, Turkey, UK, UAE, Brazil and Malaysia. Country specific import quantity is available in UN databank but not for all countries.

Table 5. Major fennel (including juniper berries and anise seeds, badian, caraway or fennel) importing countries.

Rank	2016 (source: www.trademap.org)		2018 (Source: ComTrade)	
	Country	Value ('000 USD)	Country	Value ('000 USD)
1	India	34,706	India	45,045
2	Germany	29,781	Germany	33,043
3	United States of America	21,743	United States of America	21,744
4	Algeria	8,410	Turkey	6,587
5	United Kingdom	6,267	United Kingdom	6,393
6	Netherlands	4,808	Brazil	5,022
7	Turkey	4,759	Netherlands	4,599
8	Brazil	4,020	Malaysia	4,477
9	Austria	3,901	United Arab Emirates	4,224
10	Italy	3,324	Saudi Arabia	4,160
11	Other	75,593	Other	79,659
	World Total	197,312	World Total	214,953

India imported about 14,300 tonnes of these spices in 2018, while Germany and USA imported 12,950 tonnes and 8,760 tonnes respectively for the same period. The annual growth in the total global import market is 8.9%.

The average import price of the selected group of spices was US\$ 2,402/tonnes in 2017. However, import value of fennel differed from one country to another, as well as the variation of price based on the reporting organisations.

An interesting feature of the global fennel trade is the role of 'middle man countries' like Vietnam, which is the leading importer of both Indian and Egyptian spices, but then re-exports these spices to different markets.

India

India is the world's largest importer of the group of spices in focus. In 2018, India imported over 14,000 tonnes of spices, which was 44% higher than the previous year (Figure 4). The major share, about 58%, was sourced from Vietnam, while India also imported a significant amount of spices from Afghanistan, Egypt and Finland (Figure 5).

The trend line of the imported volume of spices indicates that by 2025 the demand will be 22,000 tonnes if there assuming no changes in the consumption pattern. The trading price for one tonne of imported spice was about US\$3,120 in the year 2018 (ITC, 2019), which is much higher than other countries because of the high demand for spice in India.

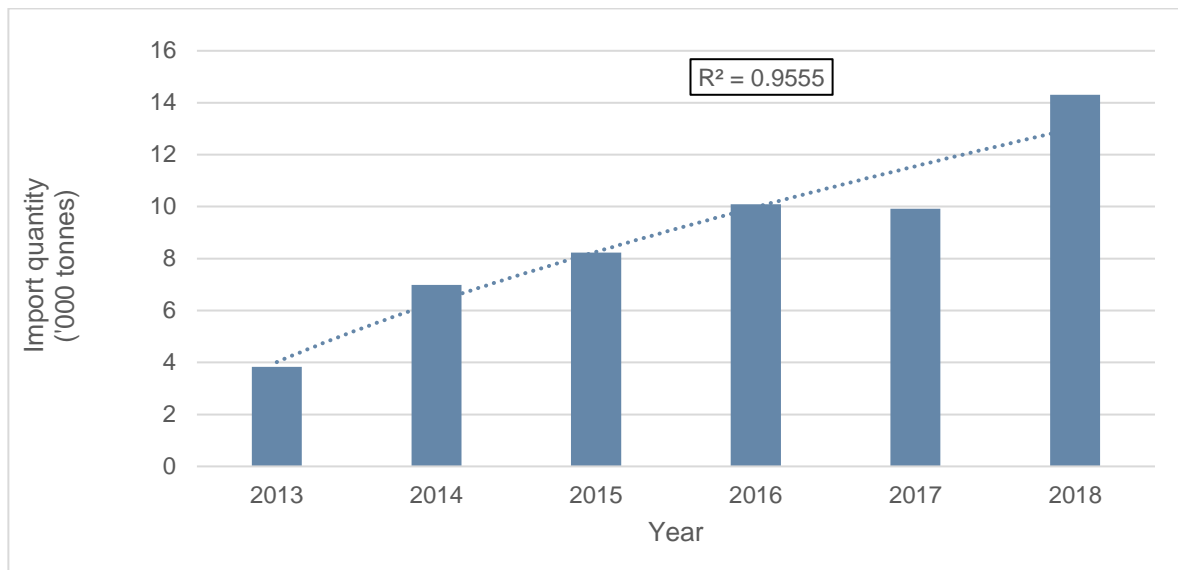


Figure 4. Quantity of spices (juniper berries and anise seed, badian, caraway or fennel, as whole seed) imported by India. (Data source: UN ComTrade, 2019)

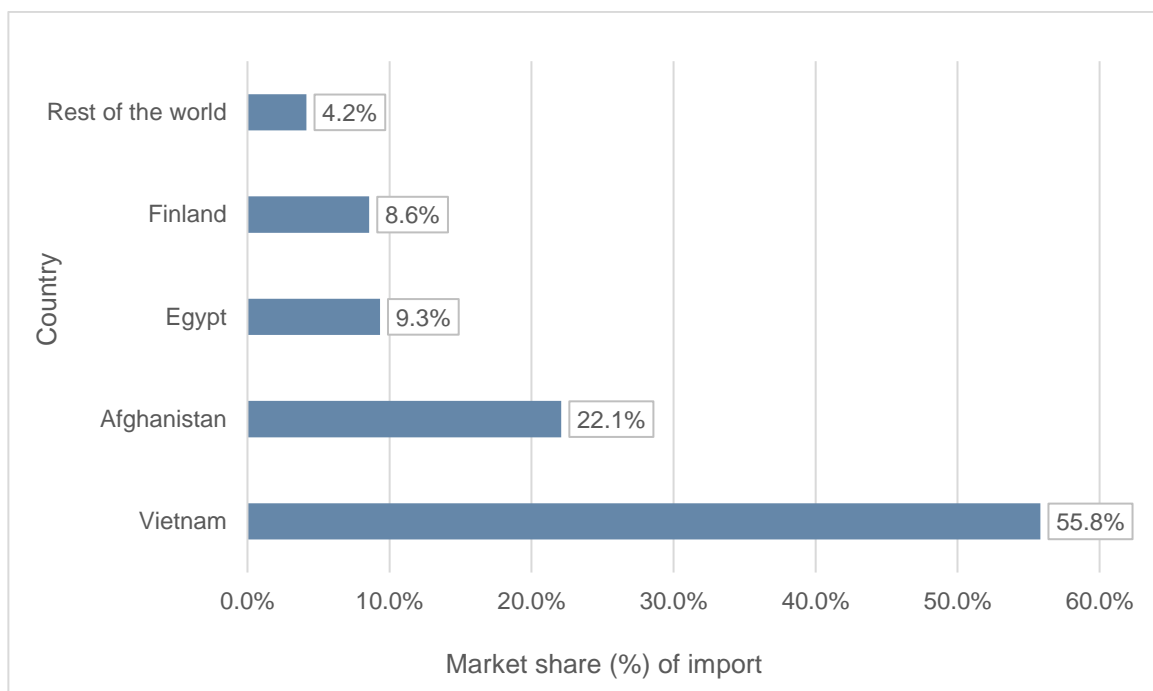


Figure 5. Origin of imported spices (juniper berries and anise seeds, badian, caraway or fennel, as whole seed) in India (Data source: ITC, 2019).

Germany

In 2018, Germany imported about 13,000 tonnes of spices mainly from Egypt, China and other European countries (Figure 6). From 2017 to 2018 the trade value of imported spices increased by 11%.

Over the last six years, the spice importing trend in Germany exhibits steady growth in volumes (Figure 7). With the current trend, it is expected that the demand for spice in Germany will reach 23,000 tonnes by the year 2025. In 2018, Germany spent about US\$ 2,550/tonnes on imported spices.

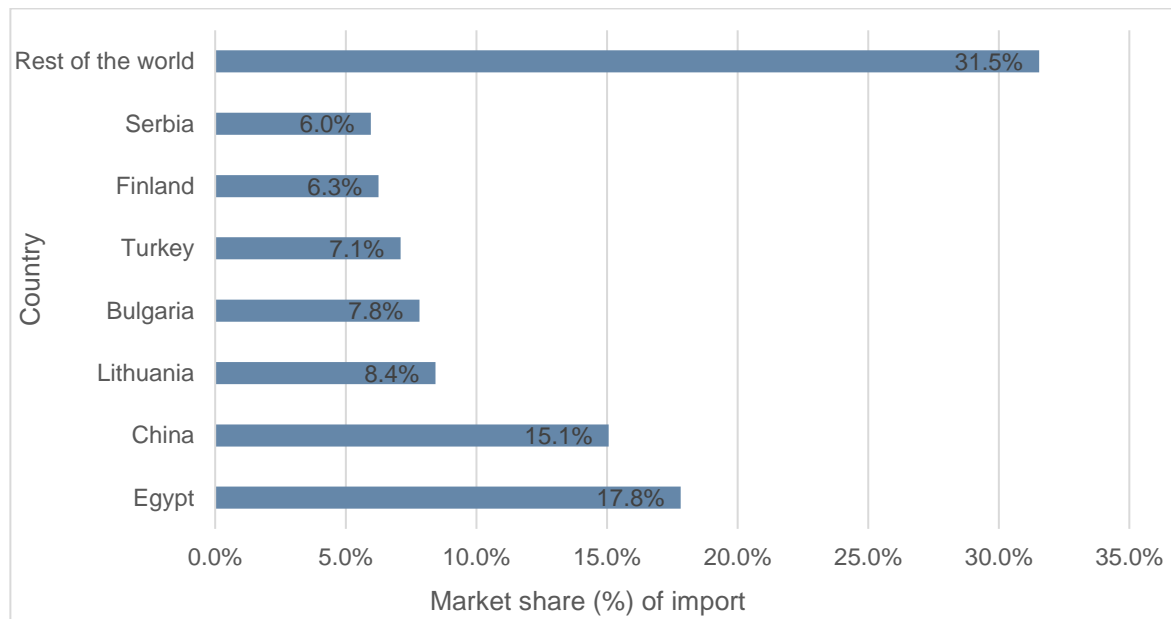


Figure 6. Origin of imported spice (juniper berries and seeds of anise, badian, caraway or fennel, neither crushed nor ground) in Germany (Data source: ITC, 2019).

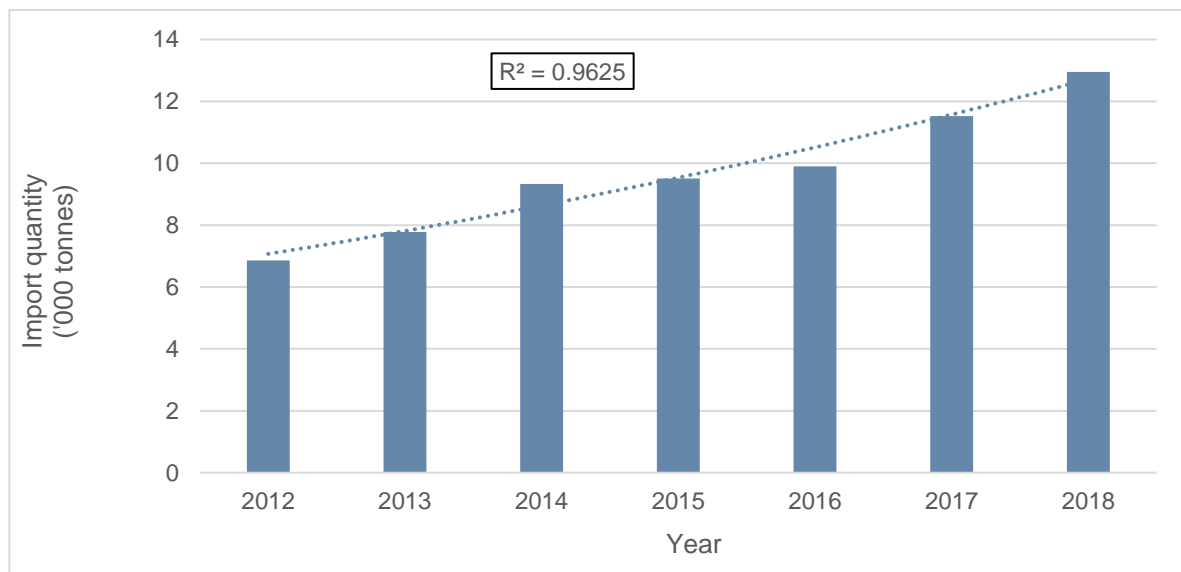


Figure 7. Quantity of imported fennel and other spices in Germany (Data source: UN ComTrade, 2019).

USA

The USA is the third-largest importer of this group of spices in the world, importing US\$ 21million worth in 2018. The import quantity over the last few years fluctuated but it is estimated that it will reach 10,000 tonnes in 2025 (Figure 8).

Egypt and India are the main spice exporters to the USA and hold about 60% of market share (Figure 9). In 2018, the USA spent about US\$ 2,480/tonnes of spice.

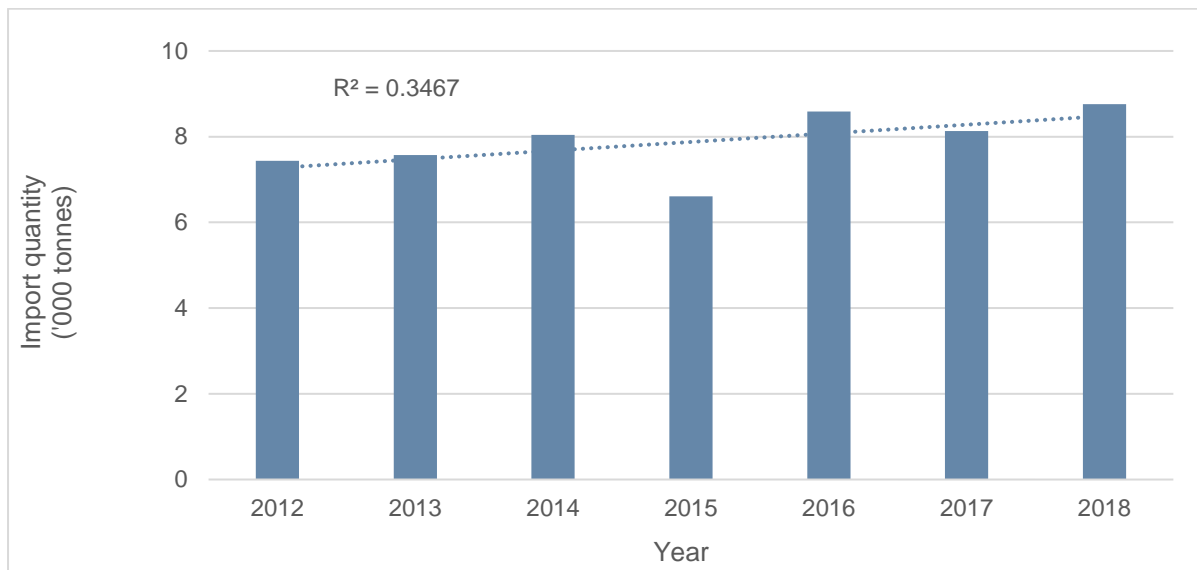


Figure 8. Fennel and other spices importing trend in USA. (Data source: UN ComTrade, 2019).

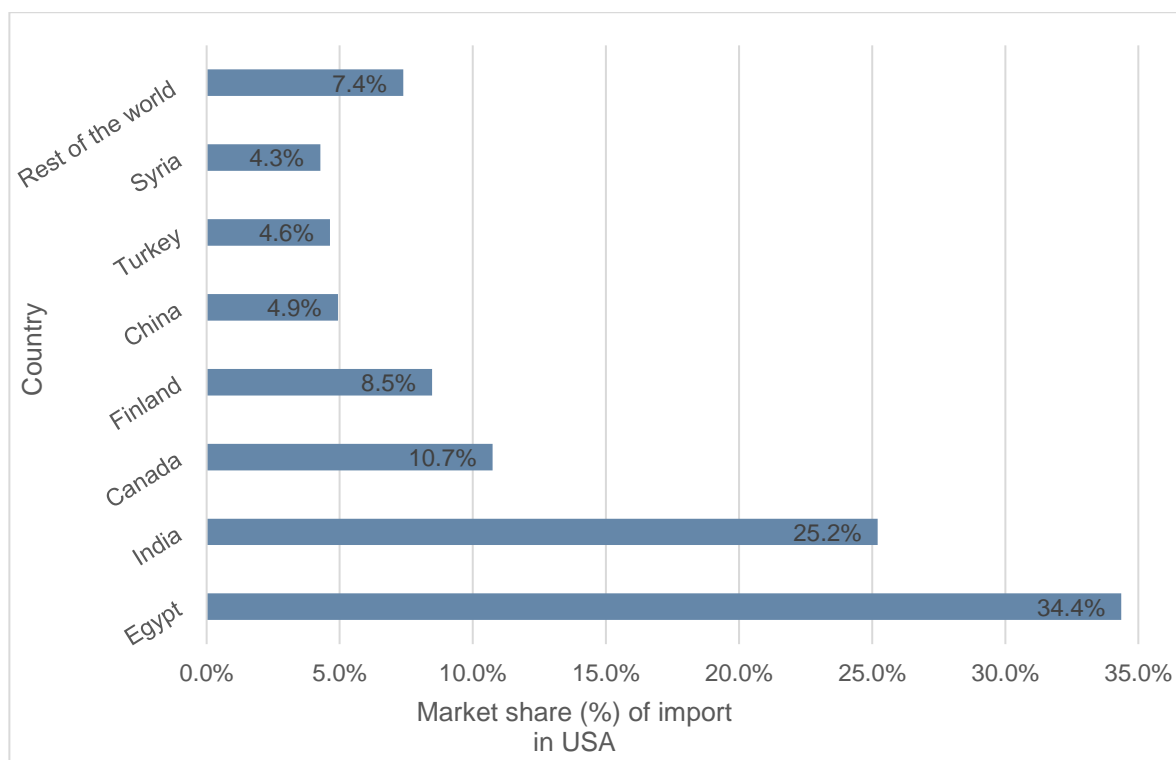


Figure 9. Origin of imported fennel and other spices in USA markets (Data source: ITC, 2019).

Australian fennel market

Australia's domestic market for fennel and other similar spices is entirely supplied through imports. In 2018, Australia imported about 568 tonnes of the spice group in focus worth about US\$ 1.37million. The majority of imported spices in Australia are from India and China (Figure 10).

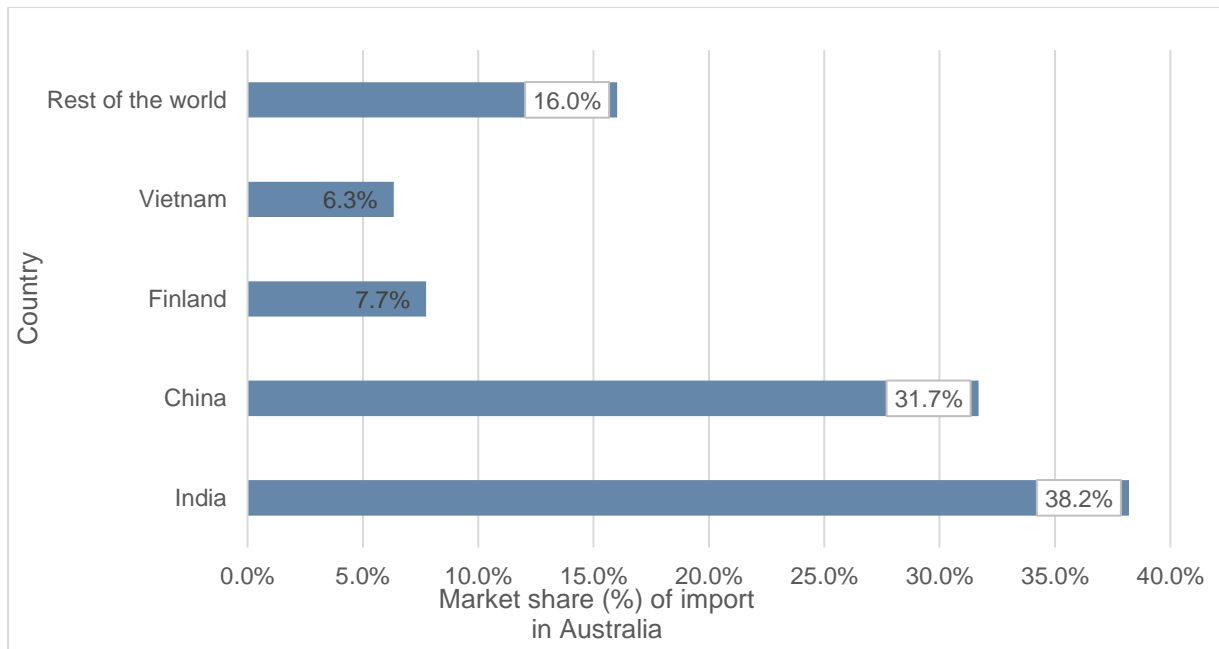


Figure 10. Countries supplying Australia import fennel and other spices (Data source: ITC, 2019).

The limited available data indicates a continuous growth in the quantity of imported spices, which suggests there is an increasing demand for fennel and similar spices in Australia. The trend line (Figure 11) indicates that by 2025 the demand for fennel and similar spices in Australia will exceed 2,000 tonnes/year.

The unit trade price of fennel and other spices was volatile over the last few years. However, in 2018, the price was US\$ 2,408/tonne. Given the unit value and the size of the market, it is likely that a local industry in Australia could initially target the domestic market before scaling up for international markets.

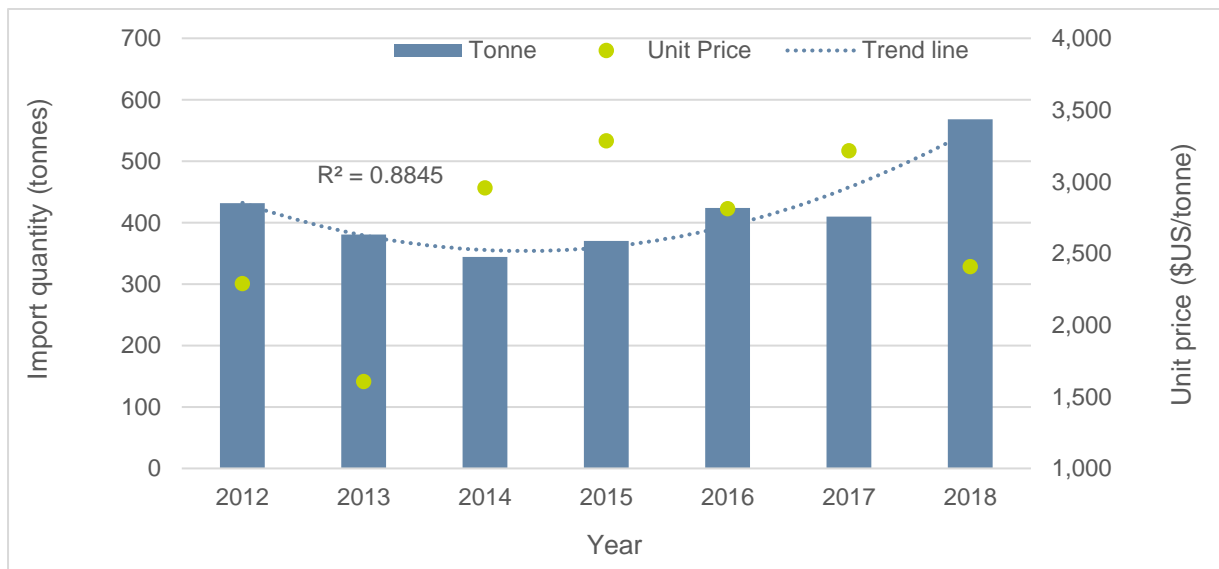


Figure 11. Trend of fennel and spices trade in Australia (Data source: ITC, 019, UN ComTrade, 2019).

Value-added fennel products

Fennel seeds are known for their pleasant flavour and sugar-coated fennel is used as a breath freshener (Malhotra, 2012). They are a popular spice in Asian and European cuisine and they are often included in specific spice blends including Indian *panch phoron* and Chinese five-spice powder. The seeds are commonly used in soups, German and Italian bread, Italian sausages, and in fish and seafood dishes (Shelef, 2003).

Fennel oil, ground fennel and fennel seed tea are the most common value-added products of fennel.

Apart from usage as a spice, fennel has traditionally been used for health benefits including aiding the digestive system. In ancient times, fennel leaves were considered to improve eyesight, assist in losing weight and relieve stomach pains. Fennel juice syrup is also used for chronic coughs.

Research has shown fennel to have benefits over and above nutrition and flavour enhancing. These include assisting in managing blood pressure to reducing symptoms of asthma. The literature also indicates fennel as having positive impact in antibacterial, antifungal and anti-inflammatory treatments (Shabbara et al., 2018, Rather et al., 2016, Arora, 2018).

Other parts of the fennel plant can also be utilised. The leaves of the fennel plant are also used for garnishes and salad dressing. Fennel bulb is a popular vegetable in Italy and in some other countries (Shelef, 2003), but it should be noted that different varieties are used for bulb production than seed production. Fennel pollen is usually hand collected from wild or planted fennel – it doesn't taste like fennel seed or anise, so it adds a different flavour to food. Essential oils can be extracted from seeds, green and dry biomass (Saxena, et al 2018), which could bring new economic opportunities for fennel producers for value adding after seed harvest. The vast array of applications of fennel in value-added products warrants further and more detailed investigation of value-adding opportunities for the Australian fennel industry.

The United Nations Economic Commission for Europe (UNECE) has published Standard FFV-16 detailing the marketing and commercial quality control of fennel, which sets out the details for grading of produce into different classes for market. The details of the UNECE standard can be found at https://www.unece.org/fileadmin/DAM/trade/agr/standard/standard/fresh/FFV-Std/English/16_Fennel.pdf

Conclusion

Use of fennel and similar spices in cooking and in pharmacology have increased during the last decade. The demand for fennel is predicted to continue to increase due to increasing population, changing food consumption behaviour and increasing demand for value-added products such as oil and powder.

Australia has the potential to enter into the commercial production of fennel by first targeting the domestic market, which has a current value of around US\$1.4million. A more accurate assessment of potential market value for domestic crops will depend on the quality of the fennel seeds. This needs to be ascertained through trial production before production is assessed on a commercial scale.

The current CRCNA 'Spicing up the North' project is designed to provide scientific information about fennel varietal performance and environmental suitability, which will go some way to addressing these questions. The project will also assess the gross margins of fennel production in Australian conditions during the verification and commercialisation phases.

Further research will be required to consolidate on this establishment phase and address questions including:

- A detailed supply and value chain analysis to investigate factors including logistics (storage, segregation, transport etc), product processing infrastructure, consumer preference and the viability of value-added products.
- Business, agronomy and environmental risks and uncertainties to grow fennel at commercial scale in Australia.

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**Queensland
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**Department of
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References

- Abubacker, A.T.N., 2011, Export Value of Fennel, October 2011, Facts for You, pp. 21-22.
- Arora, S., 2018, 9 Health Benefits of Fennel Seeds, Available at: <https://food.ndtv.com/food-drinks/unveiling-the-health-benefits-of-fennel-seeds-1287281>.
- Bagchi, G.D., Srivastava, G.N., 2003, in Spices and Flavouring (Flavouring) Crops: Fruits and Seeds, in Encyclopedia of Food Sciences and Nutrition, eds, Caballero, B., Trugo, L.C., Finglas. P.M., Academic Press, San Diego, Ca, pp. 5465-5477.
- Bhattacharya, S., 2016, Cultivation of Essential Oils, in Essential Oils in Food Preservation, Flavor and Safety, ed., Preedy, V.R., Academic Press, London, UK. pp. 19-29.
- Dilip Singh, D., 2017, On-farm assessment of technological innovation of fennel (*Foeniculum vulgare Mill*) cultivation, International Journal of Current Microbiology and Applied Sciences, Vol. 6 (7), pp. 1504-1509.
- Guarrera, P.M., Savo, P., 2013. Perceived health properties of wild and cultivated food plants in local and popular traditions of Italy: a review. Journal of Ethnopharmacology, Vol. 146 (3), pp. 659–680.
- ITC, 2019, International trade centre, Trade map, Available at: <https://www.trademap.org/Index.aspx>
- Javed, R., Hanif, M.A., Ayub, M.A., Rehman, R., 2020, Fennel (Chapter 9), in Medicinal Plants of South Asia: Novel sources for drug discovery, eds. Hanif, M.A., Nawaz, H., Khan, M.M., Elsevier, Amsterdam, Netherlands, pp. 241-256.
- Malhotra, S.K., 2012, Fennel and fennel seed, Handbook of herbs and spices, Ed. Peter, K.V., Woodhead Publishing Limited, Cambridge, UK, pp 275-302.
- NHB, 2017, National Horticulture Board, India, Horticultural Statistics at a Glance, available at: [http://nhb.gov.in/statistics/Publication/Horticulture%20At%20a%20Glance%202017%20for%20net%20Uplod%20\(2\).pdf](http://nhb.gov.in/statistics/Publication/Horticulture%20At%20a%20Glance%202017%20for%20net%20Uplod%20(2).pdf).
- NHB, 2019, National Horticulture Board, India, publications, available at: <http://nhb.gov.in/Statistics.aspx?enc=i3aXhtkJwc/n3rCHOr1FVp4BttTNWILSQ8DhVptPrAbUppswYCodsFDUK1EY4Ru6yxB1yyjqgJ6NwxLqpANwXQ==>.
- Rather, M.A., Dar, B.A. Sofi, S.N., Bhat, B.A., Qurishi, M.A., 2016, *Foeniculum vulgare*: A comprehensive review of its traditional use, phytochemistry, pharmacology and safety, Arabian journal of Chemistry, Vol. 9 (2), pp. S1574-S1583.
- Saxena, S. N., Agarwal, D., John, S., Dubey, P. N. and Lal G., 2018. Analysis of fennel (*Foeniculum vulgare*) essential oil extracted from green leaves, seed and dry straw. International J Seed Spices, 8(1):60-64.
- Shabbara, M.H.M., Karima, A.M., Yousria, A.E.A., Ahmed, E.A.E., 2018, Comparative analytical economic study of the high yield varieties production of *Foeniculum vulgare* Mill. (Fennel) between Arabic Republic of Egypt and India, Middle East Journal of Agriculture Research, Vol: 07 (4), pp. 1514-1520.
- Shelef, L.A., 2003, Herbs of the Umbelliferae, in Encyclopedia of Food Sciences and Nutrition, eds, Caballero, B., Trugo, L.C., Finglas. P.M., Academic Press, San Diego, CA, pp. 3090-3098.
- TurkStat, 2019, Turkish Statistical Institute, <http://www.turkstat.gov.tr/PreTabloArama.do>
- UN ComTrade, 2019, Comtrade Database, availabel at: <https://comtrade.un.org/data/>