

Trend Analysis and Competitive Positioning of Iranian Licorice in the Global Market: A Structural and Policy-Oriented Examination

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Article Info	ABSTRACT
Article Type Original Article Article History Received: 07 March 2025 Accepted: 26 August 2025 © 2012 Iranian Society of Medicinal Plants. All rights reserved. *Corresponding author Isaleh@ut.ac.ir 	As Iran seeks to diversify its economy beyond oil dependency, the strategic role of agricultural exports, particularly medicinal plants such as licorice, has gained prominence. This study conducts a comprehensive evaluation of Iran's competitive standing in the global licorice trade by employing Revealed Comparative Advantage (RCA) and Revealed Symmetric Comparative Advantage (RSCA) indices, alongside market structure (MS) analysis using the Concentration Ratio (CR) and Herfindahl-Hirschman Index (HHI). Utilizing data from the International Trade Center (ITC) for the period 2003–2022, findings reveal that while Iran possesses a notable comparative advantage in licorice exports, it remains highly susceptible to global market volatility and domestic structural inefficiencies. MS analysis indicates that licorice exports are predominantly controlled by a few key players, with 62–79% of total trade concentrated in Turkmenistan, China, France, and the UAE. Despite Iran's potential, its 7.38% average market share is hindered by insufficient processing infrastructure, inconsistent trade policies, and limited global market integration. To strengthen its competitive position, Iran must implement strategic initiatives, including market diversification, value-added processing through advanced extraction techniques, compliance with international certification standards, and enhanced governmental and financial support mechanisms for exporters. These measures will be instrumental in reinforcing Iran's foothold in the global licorice market and ensuring long-term sustainability in its export strategy. Keywords: Licorice, Comparative Advantage, Market Structure, Herfindahl-Hirschman Index, Trade Policy

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INTRODUCTION

The increasing global demand for plant-based medicines has underscored the significance of medicinal plants in both traditional and modern healthcare [1, 2]. Among these, licorice (*Glycyrrhiza Tourn. ex L.*) has been extensively used in traditional Chinese and Ayurvedic medicine due to its anti-inflammatory, antimicrobial, and immunomodulatory properties [3-5]. Licorice's primary bioactive compound, glycyrrhizin, is 50 times sweeter than sucrose and serves as a key ingredient in pharmaceuticals and the food industry [6, 7]. However, excessive consumption poses potential health risks, including hypertension and metabolic disorders [8]. Despite its extensive applications, Iran's licorice export sector faces challenges related to unstable production, limited processing infrastructure, and market volatility.

Iran is among the top 20 countries in the world in terms of medicinal plant production, due to its rich biodiversity and varied climatic zones. Although Iran hosts significant potential, its export performance remains modest, highlighting a gap in translating production capacity or diversity into global market prominence [9]. The cultivation of medicinal plants offers economic advantages, as it requires lower production costs and yields early returns compared to other agricultural sectors [10]. Understanding these structural weaknesses is crucial for developing targeted strategies to enhance Iran's competitiveness in the global licorice market.

Comparative advantage plays a pivotal role in shaping global trade, particularly in agricultural exports [11]. The commercialization of medicinal plants has proven to be a significant driver of economic

sustainability in developing contexts. For instance, a recent study in South Africa demonstrates that engaging indigenous knowledge holders in commercial value chains led to a 3.60% increase in net returns and a 1.42% rise in per-capita total expenditure, underscoring the potential of non-oil exports in supporting rural livelihoods and reducing reliance on volatile resource revenues [12]. However, achieving sustainable economic growth through agricultural exports necessitates a strategic approach to trade policies, market access, and production efficiencies [13]. A well-defined export strategy can increase Iran's market share, generate foreign exchange earnings, and improve employment opportunities.

This study aims to analyze Iran's competitive position in the global licorice trade by examining export trends, market structure (MS), and comparative advantage using key trade indices such as the Revealed Comparative Advantage (RCA) and the Herfindahl-Hirschman Index (HHI). A recent international analysis of global licorice-extract trade employs a similar methodological framework, utilizing market share (MS), trade competitiveness (TC), and Revealed Symmetric Comparative Advantage (RSCA), and highlights how competition is shaped by three core advantages: consumer market access, processing technology, and resource endowment, with China playing a pivotal role in influencing global dynamics [14].

To gain a deeper understanding of the MS and formulate more effective competitive strategies, a review of previous research on comparative advantages and market structures in agricultural

exports is presented in Table 1. These studies analyze the export potential of various Iranian agricultural products, including pistachios, dates, tomato paste, saffron, and medicinal plants. The methodologies range from the HHI and RCA to numerical taxonomy and market continuity indices. A common theme among

these studies is Iran's fluctuating comparative advantage, highlighting the challenges of market instability, trade policy limitations, and reliance on a few dominant markets. The insights derived from these studies serve as a foundation for evaluating Iran's position in the global licorice trade.

Table 1 Summary of Previous Research on MS and RCA in Iranian Agricultural Exports

Product	Methods	Study Period	Findings	References
Medicinal Plants	RCA, RSCA, HHI	2008-2018	Iran has a strong comparative advantage in medicinal plant exports but faces instability.	[15]
Agricultural Products	RCA	2001-2017	Iran's comparative advantage in agricultural products has increased over time, especially in nuts and fruits.	[16]
Dates	RCA, Spearman Rank Correlation	1989–2005	Iran's RCA declined while those of the UAE, Tunisia, and Pakistan rose. The export policy was significant.	[17]
Pistachio	MS, RCA, RSCA	2012–2018	The global pistachio market was dominated by the USA, Iran, Hong Kong, and China. Iran maintained a strong comparative advantage in exports to key markets such as China, Russia, and Turkey.	[18]
Fresh and Processed Fruits & Vegetables	RCA, RSCA, NRCA, Spearman Rank Correlation	2010–2020	India showed comparative advantage in fresh fruits/vegetables (HS 07) but lost ground in processed products (HS 08).	[19]
Fresh Grapes	RCA, HHI, Market Concentration Analysis	2013–2022	Peru maintained a strong RCA and moderate HHI, supported by diversified export destinations.	[20]
Saffron	TOPSIS, XSI, MSI, HHI, MS, RCA, RSCA	2003-2022	The saffron MS shifted between oligopolies and dominant firm structures; recommended market expansion to China, the UAE, Spain, and Germany.	[21]

These studies highlight the dynamic nature of Iran's agricultural export sector, emphasizing the need for strategic policy interventions. The findings indicate that Iran's comparative advantage in many agricultural markets is often unstable, requiring improved infrastructure, policy consistency, and diversification to enhance long-term sustainability. This review serves as a critical reference for understanding Iran's position in the licorice export market and developing effective trade strategies.

While previous studies have extensively examined the comparative advantages and market structures of Iran's major agricultural exports, including pistachios, saffron, and medicinal plants, the licorice sector remains largely underexplored. Despite its significant economic potential, Iran's licorice trade has not been analyzed through robust quantitative methodologies, leaving a critical gap in the literature. Existing research primarily focuses on well-established export commodities with extensive trade networks, overlooking niche yet valuable markets like licorice. This study addresses this shortfall by applying advanced trade indices such as RCA, RSCA, and HHI to assess Iran's competitive position in the global licorice market. By filling this research gap, our findings provide new insights for policymakers and industry stakeholders to optimize trade strategies and enhance Iran's presence in high-value agricultural exports.

MATERIALS AND METHODS

According to established international trade frameworks, sustainable export growth necessitates a strategic blend of comparative and competitive advantages, a dual approach that identifies economic potential and operational capability [22]. For market structure analysis, this study draws on Concentration Ratios (CR_n) and the Herfindahl–Hirschman Index (HHI), widely used metrics in competition economics. CR_4 indicates top-firm dominance when exceeding 60%, while HHI quantifies overall market concentration accounting for share distribution among all firms.

Revealed Comparative Advantage

The RCA index quantifies a country's specialization in a specific export commodity. It is calculated using equation 1 [23]:

$$RCA_{ij} = \frac{\frac{x_{ij}}{\sum_i x_{ij}}}{\frac{\sum_j x_{ij}}{\sum_i \sum_j x_{ij}}} \quad (1)$$

Where x_{ij} is the export value of commodity i by country j , $\sum_i x_{ij}$ is the total export value of the country being studied, $\sum_j x_{ij}$ is the total export value of the specific commodity worldwide, and $\sum_i \sum_j x_{ij}$ is the total global trade value [24]. RCA values: $0 < RCA < 1$ indicate no comparative advantage, $RCA > 1$ suggests the presence of comparative advantage and export specialization. Given the asymmetry issue in RCA values, many researchers prefer the Symmetric Revealed Comparative Advantage (RSCA) index, as in equation 2:

$$RSCA_{ij} = \frac{RCA_{ij} - 1}{RCA_{ij} + 1} \quad (2)$$

RSCA values range from -1 to +1, where negative values indicate a lack of advantage, and positive values indicate a comparative advantage [25].

Market Structure Analysis

MS defines the level of competition and concentration within an industry. It is assessed through seller concentration, buyer concentration, entry barriers, and product differentiation. This study utilizes CR and the HHI to classify market structures [26].

Concentration Ratios

This index indicates that the production of medicinal plants is concentrated in a few countries and can also show the types of market structures between perfect competition and monopoly. The index can be defined as in equation 3:

$$CR_n = S_1 + S_2 + \dots + S_n = \sum_{i=1}^n S_i \quad (3)$$

Where S_i represents the market share of firm i , and CR_n denotes the CR of the n largest firms. This index helps determine whether a market tends toward perfect competition or monopoly.

Herfindahl-Hirschman Index

To address CR_n 's limitations, the HHI provides a more comprehensive measure of market concentration. It is computed as: as in equation 4:

$$HHI = S_1^2 + S_2^2 + \dots + S_k^2 = \sum_{i=1}^k S_i^2 \quad (4)$$

Where S_i represents the market share of firm i in percentage terms. The HHI index: Approaches zero for highly competitive markets, Nears one for highly concentrated, monopolistic markets [27].

If there are countless firms with equal relative sizes in the market, the HHI will be very small; if there are a few producers with unequal shares in the market, the Herfindahl index will be close to one. The Herfindahl index is a statistic that indicates high market

competition if it approaches zero, and high market concentration and monopoly if it approaches one. Its advantage is that it considers the market shares of all firms and, conversely, indicates the type of market (number of firms with equal shares). The selection of these two indices is because they are the best indicators for measuring competition and monopoly levels. Determining MS with the combination of the CR and the HHI is illustrated in Table 2 [28]. The closer CR_1 approaches 100, the less competitive the market; the closer the HHI approaches zero, the more competitive the market [29]. According to Table 2, the HHI index ranges between zero and one. If it approaches zero, the product market moves towards competitiveness (less concentration); if it approaches one, the market moves towards monopoly (more concentration).

Table 2 Types of MS Based on CR_n and HHI Indices

Main Feature Market	HHI	CR_n %	Market Type
More than 50 competing firms exist without any single firm holding a significant market share.	$HHI \rightarrow 0$	$CR_1 \rightarrow 10$	Perfect Competition
No competing firm holds more than 10% of the market share.	$(1/HHI) \rightarrow 10$	$CR_1 < 10$	Monopolistic Competition
Four firms collectively hold a monopoly of up to 40% of the market.	$6 < (1/HHI) \leq 10$	$CR_4 < 40$	Loose Oligopoly
Firms collectively hold at least 60% of the market share.	$3 < (1/HHI) \leq 6$	$CR_4 > 60$	Tight Oligopoly
One firm monopolizes more than 50% of the market.	$1 < (1/HHI) \leq 3$	$CR_1 \geq 50$	Dominant-firm market
One firm monopolizes the entire market.	$HHI \rightarrow 1$	$CR_1 \rightarrow 100$	Perfect Monopoly

Source: [28]

Data Collection and Computational Methods

The empirical analysis in this study relies solely on international trade statistics for licorice products under HS code 130212 (Licorice extracts). Data on the quantity and value of exports and imports were collected from the International Trade Centre (ITC, Trade Map) for the period 2003–2022. These ITC data, harmonized from UN Comtrade submissions, served as the exclusive basis for all calculations. Specifically, we used them to compute:

- Revealed Comparative Advantage (RCA) and Revealed Symmetric Comparative Advantage (RSCA) indices to assess Iran's competitiveness;
- Market Structure indices, including the n -firm Concentration Ratios (CR_1 , CR_4) and the Herfindahl–Hirschman Index (HHI), are used to examine global and country-level market concentration.
- All computations were performed in Microsoft Excel. Since the indices are share-based measures, no additional deflation or adjustment was required.

RESULTS

Trends in Iran's Licorice Exports

Licorice exports play a vital role in Iran's agricultural trade, reflecting both the country's production capacity and global demand dynamics. As shown in (Fig. 1), Export Volume illustrates the volume of Iran's licorice exports from 2003 to 2022, which has undergone considerable fluctuations over the period. Despite these variations, the overall trend indicates a gradual increase in exports. The fluctuations, characterized by sharp rises and declines in different years, are largely influenced by factors such as changes in production levels, climatic conditions, and international trade policies. For instance, significant declines in export volume are observed in 2010 and 2022, whereas the peak occurred in 2017, reaching over 10,000 tons. These findings highlight the strong dependence of Iran's licorice export market on both domestic and global dynamics.

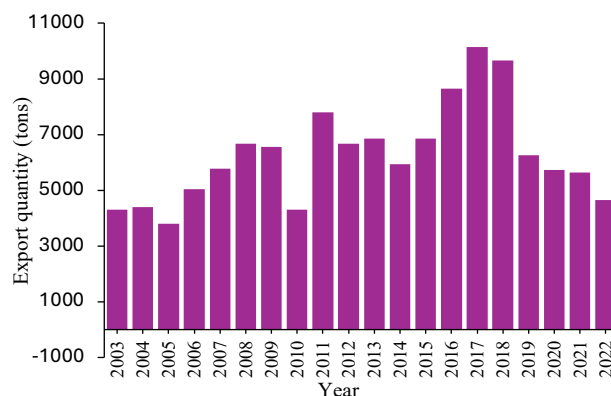


Fig. 1 Trend of Iran's Licorice Export Volume (2003–2022) [30].

Export Value illustrates the dollar value of Iran's licorice exports from 2003 to 2022, which follows an irregular pattern with considerable fluctuations as shown in (Fig 2). These variations, reflecting the influence of multiple factors such as global prices, market accessibility, and competition, reveal two prominent peaks: the first between 2008 and 2012, and the second during 2016 and 2017, when export values exceeded 40 million USD. In contrast, export values sharply declined to below 15 million USD during 2003–2005 and again from 2019 onwards. Such rises and falls underscore the highly volatile nature of the global licorice market for Iran; nevertheless, the country has remained an important player in this sector.

presents the trade performance of Iranian licorice with its principal importing partners, calculated from the average values for the years 2003–2022. Iran has established strong and stable trade relations with key countries such as Germany, the United Arab Emirates, China, France, and the Netherlands. These countries, accounting for a substantial share of Iran's licorice exports, play a pivotal role in maintaining market stability. At the same time, the figure also reflects smaller-scale trade relations with other countries, underlining the importance of diversifying export markets to reduce reliance on a limited number of dominant buyers and to enhance resilience against global trade policy fluctuations. Such a

strategic approach provides Iran with the capacity to consolidate and strengthen its position in the international licorice market (Fig. 3).

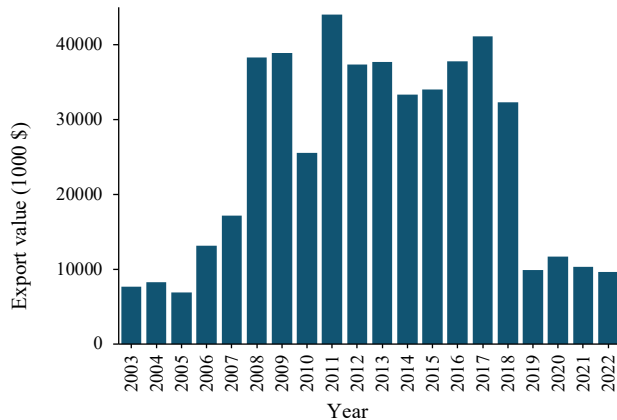


Fig. 2 Trends in the Export Value of Iran's Licorice (2003–2022) [30].

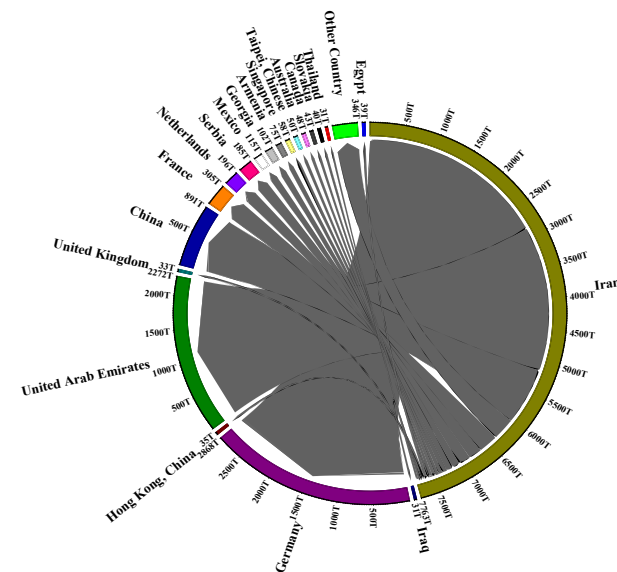


Fig. 3 Average trade performance of Iranian licorice with major importing partners (2003–2022) [30].

Table 3 provides a focused analysis of the global licorice export market under tariff code 130212 from 2003 to 2022. The data indicate a persistent Tight Oligopoly, where a few dominant exporters exert control. The HHI declined from 0.23 to 0.17 over this period, signaling reduced market concentration and increased competition. This shift suggests a more balanced distribution of export influence among key players, reducing dependency on a single exporter. The CR_1 index, which reflects the market share of the leading exporter, fell from 0.38 in 2003 to 0.21 in 2022, while the CR_4 index, representing the top four exporters, dropped from 0.82 to 0.79. These trends underscore the gradual diversification of the licorice export market, mitigating monopolistic influences and encouraging broader participation from emerging suppliers. Iran, Turkmenistan, the UAE, and Uzbekistan have risen as major competitors alongside traditional leaders such as the USA, China, and France. These structural changes highlight the need for strategic trade policies. To strengthen global competitiveness, exporters must invest in advanced processing, expand their market reach, and enhance value-added production. By leveraging these strategies, licorice-exporting nations can ensure sustainable growth and greater market resilience against economic fluctuations.

Table 4 provides a comprehensive assessment of Iran's licorice export MS, which exhibited significant fluctuations between a tight oligopoly and a Dominant-firm market from 2003 to 2022. Throughout this period, the top four competitors maintained control over 85% of the market, signifying a monopolistic trend that limited competition. The highest concentration was recorded in 2014 when the top four importers accounted for 99% of Iran's licorice exports, slightly reducing to 98% in 2022. This dominance illustrates Iran's dependency on a few key trade partners, exposing its export sector to heightened risks associated with external economic shifts and policy changes. Additionally, the number of countries importing Iranian licorice declined from 15 in 2003 to just 10 in 2022, further emphasizing market contraction.

This reduction in market diversification has created vulnerabilities, limiting Iran's ability to negotiate favorable trade terms and adjust to global demand fluctuations. With a significant portion of its exports concentrated among a small group of buyers, Iran faces challenges in stabilizing revenue streams and sustaining export growth in the long term.

Table 3 Export MS of Medicinal Plants with Tariff Code 130212 of World

Year	CR ₁	CR ₄	HHI	1/HHI	Active business competitors	MS
2003	0.38	0.82	0.23	4.44	USA, China, France, Israel	Tight Oligopoly
2004	0.38	0.82	0.22	4.6	USA, China, France, Israel	Tight Oligopoly
2005	0.36	0.76	0.20	5.04	USA, China, France, Israel	Tight Oligopoly
2006	0.35	0.78	0.20	4.92	USA, China, France, Israel	Tight Oligopoly
2007	0.25	0.74	0.17	6.06	USA, China, France, Turkmenistan	Tight Oligopoly
2008	0.22	0.68	0.14	7.16	Iran, USA, China, Turkmenistan	Tight Oligopoly
2009	0.27	0.76	0.17	5.82	USA, China, Turkmenistan, France	Tight Oligopoly
2010	0.25	0.73	0.16	6.29	USA, Iran, China, France	Tight Oligopoly
2011	0.26	0.70	0.15	6.74	Iran, USA, China, France	Tight Oligopoly
2012	0.21	0.65	0.13	7.57	USA, Iran, UAE, China	Tight Oligopoly
2013	0.27	0.68	0.16	6.35	China, USA, Turkmenistan, UAE	Tight Oligopoly
2014	0.22	0.64	0.14	7.16	USA, Germany, China, Turkmenistan	Tight Oligopoly
2015	0.18	0.64	0.13	7.87	Turkmenistan, Germany, China, USA	Tight Oligopoly
2016	0.31	0.67	0.16	6.18	Iran, France, China, Turkmenistan	Tight Oligopoly
2017	0.30	0.62	0.15	6.82	Iran, Turkmenistan, UAE, Uzbekistan	Tight Oligopoly
2018	0.26	0.68	0.15	6.82	Turkmenistan, UAE, Uzbekistan, France	Tight Oligopoly
2019	0.21	0.60	0.12	8.1	Uzbekistan, UAE, Turkmenistan, France	Tight Oligopoly
2020	0.22	0.72	0.15	6.59	Turkmenistan, China, France, Germany	Tight Oligopoly
2021	0.31	0.73	0.17	5.95	Uzbekistan, France, Turkmenistan, Germany	Tight Oligopoly
2022	0.21	0.79	0.17	5.82	Turkmenistan, China, France, UAE	Tight Oligopoly

Source: Research Findings

To mitigate these risks, Iran must adopt proactive measures to diversify its export destinations, enhance value-added processing, and strengthen its presence in emerging markets. Strategic investments in production efficiency, branding, and international trade agreements will be crucial in reducing market dependency

and improving Iran's standing in the global licorice trade. Without such reforms, the country's licorice export sector will remain susceptible to monopolistic pressures and external market uncertainties, undermining its long-term economic potential.

Table 4 Export MS of Medicinal Plants with Tariff Code 130212 of Iran

Year	CR ₁	CR ₄	HHI	1/HHI	Active business competitors	MS
2003	0.70	0.92	0.50	1.99	Germany, China, UAE, Canada	Dominant-firm market
2004	0.59	0.85	0.38	2.66	Germany, France, China, Mexico	Dominant-firm market
2005	0.56	0.90	0.36	2.76	Germany, China, France, Netherlands	Dominant-firm market
2006	0.47	0.89	0.32	3.09	Germany, China, France, Singapore	Tight Oligopoly
2007	0.40	0.88	0.32	3.16	Germany, China, France, Singapore	Perfect monopoly
2008	0.51	0.94	0.38	2.62	China, Germany, France, UAE	Dominant-firm market
2009	0.43	0.97	0.37	2.71	China, Germany, France, Netherlands	Tight Oligopoly
2010	0.65	0.95	0.48	2.10	Germany, UAE, France, Netherlands	Dominant-firm market
2011	0.55	0.97	0.45	2.21	UAE, Germany, China, Netherlands	Dominant-firm market
2012	0.54	0.97	0.44	2.30	UAE, Germany, Netherlands, China	Dominant-firm market
2013	0.47	0.98	0.43	2.32	Germany, UAE, China, Netherlands	Tight Oligopoly
2014	0.44	0.99	0.39	2.59	Germany, UAE, Netherlands, China	Perfect monopoly
2015	0.46	0.98	0.40	2.50	UAE, Germany, China, Netherlands	Tight Oligopoly
2016	0.59	0.99	0.48	2.08	UAE, Germany, Netherlands, Thailand	Dominant-firm market
2017	0.52	0.97	0.43	2.31	UAE, Germany, Netherlands, UK	Dominant-firm market
2018	0.54	0.99	0.46	2.19	UAE, Germany, Netherlands, Georgia	Dominant-firm market
2019	0.53	0.97	0.42	2.37	Germany, UAE, Netherlands, Georgia	Dominant-firm market
2020	0.59	0.98	0.47	2.14	Germany, UAE, Netherlands, Australia	Dominant-firm market
2021	0.56	0.99	0.46	2.18	Germany, UAE, Netherlands, Australia	Dominant-firm market
2022	0.60	0.98	0.46	2.18	Germany, UAE, Serbia, Netherlands	Dominant-firm market

Source: Research Findings

Fig. 4 illustrates the shifts in the market share of importing countries for licorice extracts (tariff code 130212) across two distinct time periods: 2003-2012 and 2013-2022. The data reveal significant structural transformations in the global trade dynamics of this product. Notably, the share of the United Arab Emirates (UAE) surged by an impressive 191%, positioning it as a dominant importer in the latter period. Similarly, the Netherlands experienced a substantial 69% increase in its share, reinforcing its role as a key player in the licorice extracts market.

Conversely, traditional importers such as Germany, China, and France witnessed declines in their market shares. Germany's share diminished by 2%, while China saw a drastic 93% contraction, and France experienced a complete exit from the import market, with a 100% decline. These shifts indicate a realignment of global demand, potentially influenced by changes in trade policies, supply chain logistics, and market preferences. The observed trends suggest that emerging markets, particularly in the Middle East, have capitalized on new trade opportunities, while established European importers have faced declining influence. This evolving MS underscores the necessity for Iranian exporters to reassess their strategic trade partnerships and explore diversification to enhance market stability and reduce dependency on a limited number of buyers. The significant growth of certain markets, such as the UAE, highlights the increasing importance of regional trade hubs in shaping the global licorice extracts supply chain.

Figure 5 illustrates the fluctuations in Iran's comparative advantage in licorice extract exports over the period from 2003 to 2022. Despite periodic variations, Iran has consistently maintained a strong export position, as evidenced by a RCA index greater than one and a positive symmetric RCA. The persistence of an RCA index above one underscores Iran's sustained comparative advantage in this sector, reinforcing its role as a key global supplier of licorice extracts. Nevertheless, despite Iran's established standing in licorice extracts production and export, there remains

significant room for strategic enhancements. To solidify and expand its market share, Iran must adopt more targeted and effective trade policies, focusing on identifying optimal export destinations and refining market penetration strategies. Given the competitive landscape, Iranian exporters must navigate dynamic global trade conditions while mitigating risks posed by rival suppliers. Furthermore, the trajectory of the RCA index over recent years indicates an overall strengthening of Iran's comparative advantage in licorice extract exports. This upward trend highlights the potential for further growth, provided that the country implements well-structured policies aimed at market diversification and value addition. By capitalizing on its natural endowments and leveraging strategic trade initiatives, Iran can enhance its long-term position in the global licorice extracts export market.

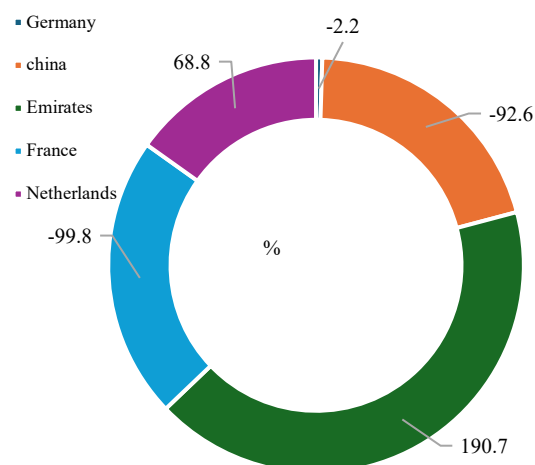


Fig. 4 Changes in the Share of Importing Countries for Licorice extracts in the Two Time Periods 2003-2012 and 2013-2022.

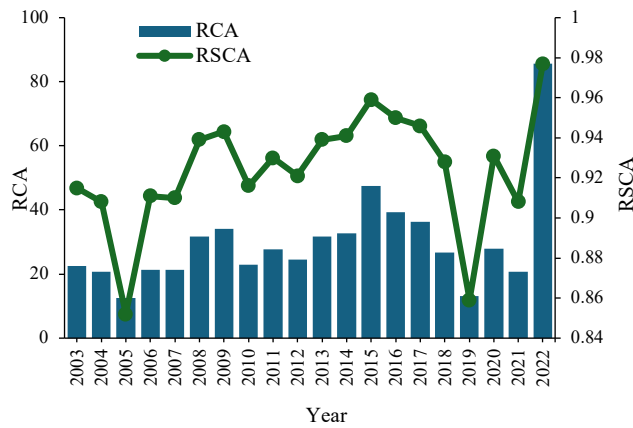


Fig. 5 Comparative Advantage in Licorice extracts Exports (RCA Index) from 2003 to 2022

The analysis of Iran’s relative advantage in licorice extracts exports across key destination markets from 2003 to 2023 reveals significant structural shifts and evolving trade dynamics. As shown in Table 5, the United Arab Emirates consistently emerges as Iran’s most dominant export market, with a remarkably high variation coefficient, indicating volatile but substantial trade engagement. While Germany maintains a steady position as a key importer, its relative advantage index exhibits more stability compared to other destinations. Notably, China and France display highly inconsistent import patterns, with their relative advantage indices fluctuating near zero in multiple years, signaling weak or sporadic market penetration. The Netherlands, although not among the largest importers, demonstrates relatively moderate and consistent engagement with Iranian licorice exports, suggesting a potential avenue for expansion. The dramatic peak in Iran’s relative advantage index for the UAE in 2010 underscores the concentration of trade flows, emphasizing the risks associated with over-reliance on a few dominant markets.

Table 5 Relative Advantage Index of Iran’s Licorice extracts Exports to Selected Destination Markets (2003-2023)

Year	Germany	Emirates	China	France	Netherlands
2003	19.79	49.38	0.41	0.13	0.61
2004	0.55	9.78	0.69	0.69	0.04
2005	3.19	52.81	3.04	2.28	0.53
2006	2.69	4.76	4.05	1.23	0.57
2007	2.51	44.65	4.74	0.87	0.56
2008	2.51	6.80	5.16	1.33	0.21
2009	3.10	0.73	3.50	2.48	0.12
2010	3.62	226.48	0.31	0.83	0.37
2011	2.24	20.90	0.21	0.28	0.19
2012	2.11	8.50	0.09	0.00	0.40
2013	2.30	10.89	0.20	0.00	0.46
2014	2.13	12.31	0.42	0.02	1.02
2015	2.37	9.93	0.51	0.00	0.46
2016	2.52	6.27	0.00	0.07	0.45
2017	2.86	2.76	0.03	0.00	0.80
2018	3.37	3.90	0.04	0.00	0.71
2019	4.08	10.52	0.00	0.03	2.35
2020	4.84	3.94	0.04	0.01	0.66
2021	3.73	14.07	0.02	0.01	0.82
2022	5.81	17.59	0.03	0.01	1.00
2023	3.85	5.87	0.02	0.00	0.92
Average	3.82	24.90	1.12	0.49	0.63
Maximum	19.79	226.48	5.16	2.48	2.35
Minimum	0.55	0.73	0.00	0.00	0.04
Coefficient of variation	1.00	1.95	1.57	1.56	0.76

Source: Research Findings

DISCUSSION

This study set out to examine Iran’s comparative advantage and market structure in the global licorice extracts trade. Our findings show that Iran maintains a revealed comparative advantage ($RCA > 1$; $RSCA > 0$ in most years), yet this advantage has been unstable, with noticeable fluctuations over time. The volatility stems primarily from misalignment between production capacity and trade policy, compounded by recurrent droughts and limited processing capacity.

The market-structure analysis (CR_n and HHI) confirmed that the international licorice extracts market is oligopolistic, dominated by a few suppliers such as Turkmenistan, China, France, and the UAE. While Iran occasionally ranked among the top exporters, its share has declined in recent years due to intensified competition, weak institutional support, and the absence of large-scale extraction industries.

These results are broadly consistent with earlier research on Iran’s agricultural and medicinal plant exports. For example, studies on saffron, dates, and pistachio exports reported similar instability in RCA and high destination concentration, exposing exporters to demand shocks and policy shifts. Comparable analyses of tomato paste and medicinal herbs likewise highlighted underinvestment in processing and certification as barriers to sustained competitiveness. Our findings reinforce these patterns, extending them to licorice, which, despite being a niche product, shares the structural challenges of Iran’s broader agri-export sector.

At the same time, the results add nuance by documenting the global trend toward reduced concentration (HHI and CR_4 decreasing over 2003–2022), suggesting opportunities for mid-tier exporters like Iran to consolidate their presence if supply- and policy-side barriers are addressed.

Study Limitations and Future Research Directions

This study, while providing valuable insights into Iran’s comparative advantage and market structure in licorice exports, faced several limitations. The reliance on ITC trade data at the HS 6-digit level may have introduced aggregation bias, while informal and unrecorded trade flows were not captured. Moreover, the absence of firm-level, province-level, and cost data restricted the analysis to international trade outcomes, and ecological variables such as overharvesting, water use, and climate stressors were only discussed qualitatively due to limited long-term datasets. Future research should therefore employ disaggregated firm and regional data, apply econometric models to examine determinants of competitiveness, and integrate sustainability indicators into the analysis. Comparative studies across other medicinal plants, along with an assessment of the role of certifications, branding, and value-added processing in shaping export prices and market diversification, would also deepen understanding and guide more effective policy interventions.

CONCLUSION

This study assessed Iran’s position in the global licorice extracts market using RCA , $RSCA$, CR_n , and HHI indices over the period 2003–2022. The research questions asked whether Iran possesses a sustained comparative advantage, what structural characteristics define the licorice market, and which policy levers can strengthen competitiveness. The findings confirm that Iran holds a significant but unstable comparative advantage, and that the global licorice market is characterized by a tight oligopoly dominated by a few key exporters.

Policy implications are clear. Iran's unstable performance underscores the need for a coherent, long-term trade strategy that aligns production, processing, and export policies. Specific recommendations include:

- **Value-added processing:** Encourage investments in extraction and standardization facilities to shift exports from raw root to higher-value derivatives.
- **Market diversification:** Reduce overreliance on a handful of destinations by building new trade ties in Europe, East Asia, and the MENA region.
- **Standards and certifications:** Promote compliance with international quality benchmarks (e.g., GMP, ISO, pharmacopeial standards) to secure entry into regulated markets.
- **Capacity building:** Establish training programs for farmers and exporters in sustainable cultivation, harvesting, and marketing techniques.
- **Sustainability:** Address environmental pressures by incentivizing cultivation, regulating wild harvesting, and adopting water-efficient technologies.
- **Policy stability:** Ensure continuity and transparency in export regulations and financial support to minimize uncertainty for private actors.

By implementing these strategies, Iran can stabilize its comparative advantage, improve its export share, and strengthen resilience against external shocks. At the same time, integrating ecological sustainability and value addition into the licorice industry would elevate Iran's broader medicinal plant sector, positioning the country not only as a traditional supplier but also as a modern global hub for herbal products.

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Conflict of Interest

The authors declare that they have no conflict of interest regarding the publication of this paper.

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