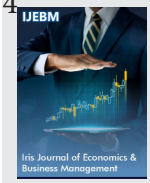

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Review Article

Natural and Artificial Dyes in Spinning and Carpet Industry: Substitution and Effects. Examples from the Ottoman Empire during the 19th century

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Abstract

The aim of this paper is to explore the transition in the use of dyes in spinning and carpet industry, from natural to imported artificial ones, and the effects on the whole grid of the craft activity of the particular industry, in selected areas of the East in the 19th century up to the early 20th century.

Keywords: Natural dyes; artificial dyes; spinning industry; carpet industry; ottoman empire; crafts

Introduction

The development of the spinning and carpet-making industries was deeply intertwined with the use of dyes. Historically, local, natural dyes were utilized across workshops and artisan crafts to color yarns and carpets. These dyes were derived from a variety of natural sources such as plant roots, leaves, flowers, and fruits, as well as from animals and minerals [1-3]. One such notable plant was millet[1] (*grana giala, graine-jaune or djehri* | Gr: κεχρί or τζεχρί), known for producing vivid yellow and green shades [4,5]. Another prominent dye source was rubia[1](Gr: ερυθρόδανον or ριζάρι or αλιτζάρι), commonly referred to as madder (Rubia Tinctorum), which was cultivated extensively in Western Asia Minor from the early 18th century. Its exports through the port of Smyrna to European markets were significant [6].

Madder's red dye was extracted from the plant's roots, a process that sustained numerous dyeing workshops, particularly in towns of Eastern Thessaly like Ambelakia, Tyrnavos, and Tsaritsani [7]. Throughout the 19th century, the dyeing industry expanded its color palette by importing additional natural dyes from overseas. This included Indian indigo, which provided a deep blue, and cochineal carmine, producing bright red shades. By 1835, the Ottoman Empire imported substantial amounts of these dyes - records show imports of 2,750 lbs. of cochineal and 100,000 lbs. of indigo [8]. While natural dyes were praised for their rich, long-lasting colors and were highly sought after for oriental yarns and carpets, they were expensive due to the labor required for harvesting and processing. The high cost of natural dyes, combined with rising wages, particularly for female workers along the western coast of Asia Minor, drove up the prices of yarn and carpets by as much as 50% around 1870. Consequently, the escalating costs had a significant impact on the export market for these products.

Shift to Synthetic Dyes

During the 19th century, the market landscape of the spinning and carpet industries began to change significantly due to the introduction of synthetic dyes. Unlike natural dyes, which were

labor-intensive to produce, synthetic dyes were much more affordable. Although they initially lacked the durability of natural dyes, their lower cost and ability to create colors that were previously unattainable by natural methods made them appealing. European manufacturers and consumers, in particular, favored these artificial colors for their brightness and diversity, driving a shift in the dyeing practices across Eastern markets.

Synthetic dyes, such as aniline and artificial alizarin, started gaining traction in workshops and dyeing facilities [3,9,10]. They offered economic advantages for both producers and consumers, particularly when compared to natural dyes that required more effort to cultivate, harvest, and process. The ability to synthesize a broader spectrum of colors aligned with European tastes and demands, accelerating the adoption of these dyes throughout the Ottoman Empire. By 1820, and especially after 1850, the production of synthetic alizarin - which was 36 times more color-efficient than its natural counterpart - became widespread, dominating the dyeing processes for yarns [11-13].

This growing dominance of synthetic dyes marked a pivotal point for the region's dyeing industry. European companies, such as Bayer and BASF (Badische Anilin-und Soda-Fabrik), played a critical role in this transition, not only by exporting synthetic dyes but also by sending representatives to train local workers in Asia Minor on how to use the dyes effectively. By the early 20th century, synthetic dyes had nearly replaced natural dyes in the production of yarns and carpets, although there was still some parallel use of both types in the interim.

Economic and Industrial Impact

The introduction of synthetic dyes led to considerable upheavals in regions heavily reliant on natural dye production. Thessaly's previously flourishing workshops in Tyrnavos, Ambelakia, Agia, and Tsaritsani - known for their expertise in natural dyeing - began to decline. The competitive pricing of imported synthetic pigments played a major role in this downturn. By the mid-19th century, only a few dye-works remained in operation in these towns, which had once housed dozens of dyeing facilities during their peak. French archaeologist and traveler Heuzey, who visited Thessaly in 1858, noted that only two to three dye works in Tyrnavos still used madder, while another one or two utilized indigo and other imported pigments [14].

Similarly, the thriving cooperative of Ambelakia, which had previously led the region's cotton manufacturing and dyeing industries, began to decline in the early 1800s. This decline culminated around 1820, exacerbated by the influx of British yarn, which further undercut local prices [15]. In Asia Minor, dyeing centers also faced significant disruption. Although some crafts survived by continuing to use locally sourced natural dyes, such as in Demirci, other regions like Uşak and Gördes saw a marked reduction in carpet production as they struggled to compete with synthetic dyes [16]. In certain towns, such as Kula, the shift from natural to synthetic dyes had profound consequences not only for the local industry but also for the social fabric of the community. Kula had experienced considerable prosperity during the late 18th and early 19th centuries due to its flourishing wool-dyeing trade. However, the introduction of synthetic dyes contributed to the decline of this once-thriving industry, prompting many residents to leave the town in search of better opportunities elsewhere [17].

Social Implications

One of the groups most affected by the transition to synthetic dyes was the labor force, particularly women employed in the cultivation and processing of natural dyes. As synthetic dyes became more widely used, demand for labor-intensive natural dyes decreased, leading to a reduction in the incomes of those who had previously relied on this work. At the same time, changes in agricultural production further contributed to economic hardships for these workers. The replacement of natural dyes with synthetic alternatives not only altered the economic landscape but also impacted the social dynamics of many communities. In areas where the economy was heavily dependent on the production and trade of natural dyes, such as Eastern Thessaly, the shift to synthetic dyes brought widespread economic challenges. Entire villages that had once thrived on the dye trade saw their populations decline as people migrated to other areas or industries in search of new livelihoods.

Attempts to Support Local Industry

Recognizing the challenges posed by imports, the Ottoman government made efforts during the 1840s and 1850s to support domestic dye production[2,3]. The government sought to reduce the Empire's dependence on imported dyes by exploring local sources of mineral dyes and encouraging the production of indigo. However, these efforts yielded limited success. Despite attempts to bolster the local crafts, imported synthetic dyes continued to dominate the market, driven by their lower cost and greater color range.

[1] In the Foreign Office archives it is noted as "yellow berries".

[2] BBA (Başbakanlık Osmanlı Arşivi) Dah 5253 (1261/1845); MV 1460 (1262/1846)

[3] BBA MV 14224 (1271/1855)

[4] Trakakis (1920) reports that the woollen yarns suitable for carpets were produced in the company's privately-owned factory/woollen-mill (in Beyköy initially, in Halkapınar (Chalka-Bounar) during the 1st World War), and then were sent to the also company's privately-owned dye-works in Mortakya (Kahramanlar), a suburb of Smyrna, where they were washed and dyed.

One notable example of the changing industry landscape was the activity of the "*Oriental Carpet Manufacturers Ltd.*", a company that played a key role in shaping the new industrial framework in western Asia Minor. With modern facilities in Smyrna and surrounding areas, the company established a supply chain that controlled the entire production process - from manufacturing and dyeing yarns in its steam-powered dye works to distributing these products to carpet manufacturers throughout the region[4]. The influence of such companies signaled a new era in the spinning and carpet industries, further accelerating the decline of traditional dyeing practices.

Conclusion of Industrial Changes

By the late 19th century, the exports of natural dyes[5] from ports such as Smyrna[6] had diminished significantly. The cultivation of madder, once a crucial crop in western Asia Minor, had fallen into disuse, and its exports numbers declined sharply after 1869, when synthetic alizarin became widely available [18-65]. While some consumers remained loyal to natural dyes due to their rich colors and traditional associations, the competitive pricing and versatility of synthetic dyes made them the dominant choice in both Eastern and Western markets. The shift to synthetic dyes caused profound changes in the spinning and carpet industries, with significant economic and social repercussions for regions that had relied on natural dye production. In some areas, local crafts experienced a complete decline, while in others, the introduction of synthetic dyes offered new opportunities for modernization and economic growth. Nonetheless, the transition was not without challenges, as it disrupted traditional industries and altered the livelihoods of countless individuals across the Ottoman Empire.

The Decline of Natural Dye Exports

The decline in natural dyes exports from the port of Smyrna during the late 19th century was a clear indicator of the broader industrial transition taking place. The introduction of synthetic dyes, particularly alizarin, signaled a rapid reduction in the demand for natural dyes such as madder, which had previously been a staple in the region's economy. Table 1 and Figure 1 provide a detailed look at the exports data from Smyrna between 1865 and 1892, as noted in the British consular correspondence from Smyrna[7] reflecting this decline.

In 1865, a substantial volume of 14,966 bales of natural dyes were exported, with a total value of £317,293. However, by 1892, this figure had dropped significantly, with only 9,258 bales exported. The trend is evident in both the quantity of dyes exported and their total value, which saw a steep drop from the mid-1870s onwards. This period of decline coincides with the rise of synthetic alizarin production in Europe and its subsequent introduction into Ottoman markets [18-65]. As synthetic dyes became more widely available and accepted, the demand for traditional natural dyes plummeted. The initial skepticism surrounding the indelibility of synthetic dyes gave way to widespread adoption as manufacturers and consumers alike began to appreciate their affordability and ability to produce a wider range of colors. Figure 1 illustrates this downward trend in natural dye exports, highlighting how quickly the market for these products shrank.

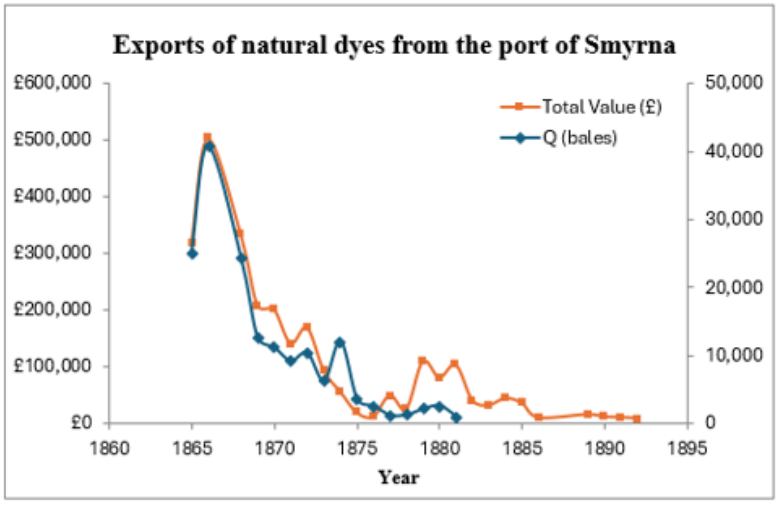

Figure 1: Exports of natural dyes from the port of Smyrna (Source: Great Britain, 1867-1893).

[5] i.e. madder (roots) and djehri (yellow berries)

[6] A significant port regarding the exports of natural dyes.

[7] After 1881, no data about the quantities are provided.

Table 1: Exports of natural dyes from the port of Smyrna, 1865-1892 (Source: Great Britain, 1867-1893).

Year	Q (bales)	Total Value (£)
1865	14,966	£317,293
1866	20,724	£502,899
1868	24,370	£332,225
1869	12,640	£208,340
1870	11,210	£201,750
1871	9,210	£141,200
1872	10,400	£169,200
1873	6,236	£93,540
1874	12,084	£56,200
1875	3,589[8]	£19,070
1876	2,596	£11,682
1877	1,248	£49,610
1878	1,295	£25,350
1879	2,189	£109,450
1880	2,625	£80,880
1881	1,032	£103,200
1882		£40,568
1883		£32,525
1884		£44,396
1885		£35,610
1886		£10,388
1889		£16,015
1890		£11,610
1891		£10,935
1892		£9,258

8 = Since the European demand is very low, cultivations of natural dyes (mainly of madder roots) are gradually abandoned.

Consumer Preferences and Market Dynamics

Consumer preferences played a key role in shaping the fate of natural dyes during this period. Before 1873, demand for madder and other natural dyes was relatively elastic, meaning that small fluctuations in price could result in significant changes in the quantity demanded. This is reflected in the data from the port of Smyrna, where demand for madder remained relatively stable despite some price fluctuations. However, between 1873 and 1876, there was a sharp drop in both the price and demand for natural dyes, signaling the height of the substitution effect as synthetic dyes flooded the market.

By the mid-1870s, the demand for madder had become virtually perfectly elastic, with small changes in price having a dramatic impact on demand. This period marked the peak of the synthetic dye revolution, as more consumers shifted towards cheaper, synthetic alternatives. Following this initial phase of rapid substitution, demand for natural dyes became inelastic after 1876. While a small segment of consumers continued to purchase natural dyes due to personal preferences or skepticism about synthetic alternatives, the overall market for these products had largely disappeared by the end of the 19th century.

Several factors contributed to this shift in consumer behavior. First, the development of new synthetic dyes allowed for the creation of colors that were previously unattainable with natural dyes, appealing to a broader range of tastes and preferences. Second, the economic prosperity of the "*Belle Époque*" period in Europe and the United States enabled consumers to pay higher prices for goods, including textiles dyed with synthetic pigments. Lastly, the initial concerns about the quality and durability of synthetic dyes were gradually alleviated as technological advancements improved their performance.

The Role of European Chemical Companies

The success of synthetic dyes in displacing natural dyes was largely due to the efforts of European chemical companies,

particularly in Germany. Major firms such as Bayer and BASF were at the forefront of synthetic dye production and played a pivotal role in promoting these products throughout the Ottoman Empire. By sending representatives to train local workers and demonstrate the proper use of synthetic dyes, these companies ensured that the transition from natural to synthetic dyes was as smooth as possible. BASF's introduction of artificial alizarin in the mid-19th century had a particularly profound impact on the dyeing industry. As a synthetic version of the red dye extracted from madder, artificial alizarin offered a cheaper and more efficient alternative that quickly gained popularity among manufacturers. Its introduction effectively marked the end of the madder trade in Western Asia Minor, as reflected in the sharp decline in madder exports from Smyrna during this period [18-65]. The influence of European chemical companies extended beyond the production of dyes. These firms also established dyeing facilities in key regions of the Ottoman Empire, including Smyrna and its surrounding areas. By controlling both the production and distribution of synthetic dyes, these companies were able to dominate the entire supply chain, further marginalizing traditional dyeing workshops and consolidating their hold on the market.

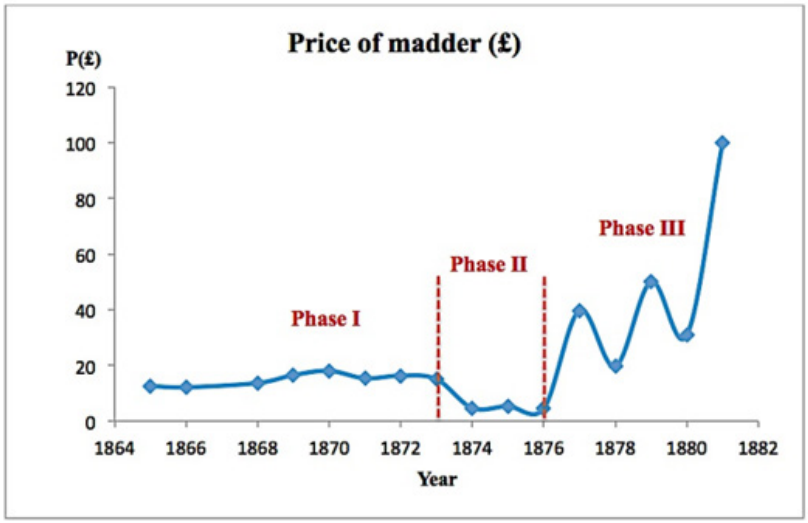

Figure 2: Price of madder (Source: Great Britain, 1867-1883).

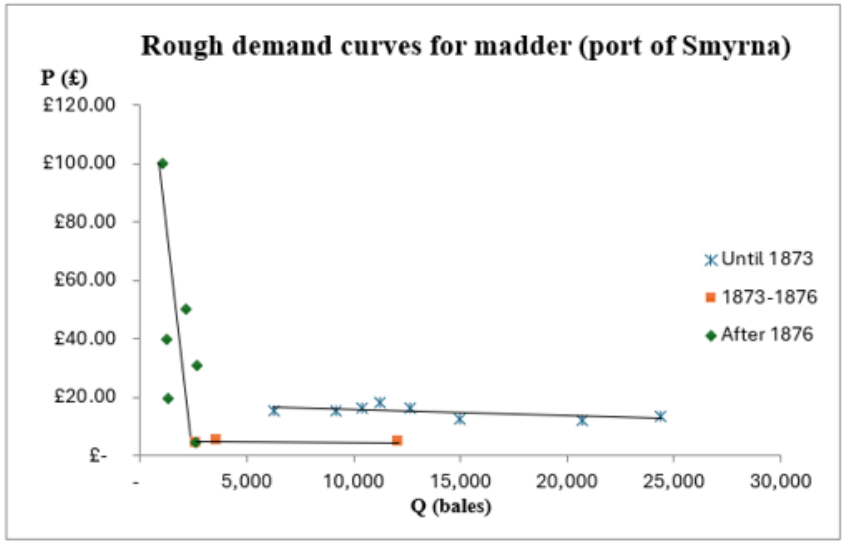

Figure 3: Rough demand curves for madder (based on exports from the port of Smyrna) (Source: Great Britain, 1867-1893).

Local Efforts to Preserve Traditional Industries

Despite the overwhelming success of synthetic dyes, there were efforts within the Ottoman Empire to preserve traditional industries that relied on natural dyes. In some regions, local artisans and manufacturers continued to use natural dyes alongside synthetic ones, particularly in cases where the natural dyes were seen as superior in terms of quality or cultural significance. For example, in the town of Demirci, locally produced natural dyes remained in use for dyeing wool yarns, helping to sustain the local craft industry in the face of growing competition from synthetic alternatives [66].

However, these efforts were often not enough to prevent the decline of natural dye production. In towns like Kula, where the art of dyeing wool with natural pigments had flourished in previous centuries, the introduction of synthetic dyes contributed to the eventual collapse of the local industry. Many of Kula's residents were forced to migrate to other areas in search of work as the demand for natural dyes dried up and the town's economy deteriorated [17]. The Ottoman government also attempted to intervene by implementing policies aimed at reducing the Empire's reliance on imported synthetic dyes. Throughout the 1840s and 1850s, the government encouraged the exploration of domestic sources of mineral dyes and supported efforts to produce indigo within the Empire. These initiatives, however, were largely unsuccessful, and the flood of cheaper synthetic dyes from Europe continued unabated [.

Conclusion

The transition from natural to synthetic dyes in the spinning and carpet industries was a major turning point that brought about significant economic, social, and industrial changes. The introduction of synthetic dyes in the mid-19th century transformed the dyeing industry, offering cheaper, more efficient alternatives to traditional natural dyes. This shift had profound implications for regions that had long relied on the production of natural dyes, particularly in Eastern Thessaly and Asia Minor, where many traditional dyeing workshops were forced to close. Despite efforts to preserve traditional dyeing methods and support domestic production, the widespread adoption of synthetic dyes by both consumers and manufacturers ultimately led to the decline of natural dyes. The success of European chemical companies, particularly in promoting and distributing synthetic dyes, further accelerated this process, reshaping the entire industry and altering the livelihoods of countless workers. Today, the legacy of this industrial shift is evident in the modern textile industry, where synthetic dyes continue to dominate. While the use of natural dyes has seen a resurgence in recent years, particularly in niche markets that value sustainable and artisanal products, the impact of the synthetic dye revolution on the global textile trade cannot be overstated.

Acknowledgement

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