YAŞAR UNIVERSITY

GRADUATE SCHOOL

MASTER IN ART THESIS

LEATHER BEYOND TRADITION:

VEGAN AND SYNTHETIC PERSPECTIVES

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MA IN ART AND DESIGN

BORNOVA / İZMİR
MAY 2024

JURY APPROVAL PAGE

We certify that, as the jury, we have read this thesis and that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts.

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ABSTRACT

LEATHER BEYOND TRADITION: VEGAN AND SYNTHETIC PERSPECTIVES

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May 2024

This study aims to provide a general overview of leather, vegan (plant-based leather) leather, and synthetic leather, comparing the advantages and disadvantages of each material. The study will begin by addressing the history and production of leather, followed by an examination of synthetic leather and vegan leather. Research will then compare the durability, aesthetic appeal, and environmental impact of each material, examining the same product from three material types, and will conclude with a summary of key points and future considerations.

Keywords: leather, synthetic leather, leather alternative, vegan leather, veganism, sustainable, fashion

ÖZ

GELENEĞİN ÖTESİNDE DERİ: VEGAN VE SENTETİK PERSPEKTİFLER

Savaş, Belis
Yüksek Lisans, Sanat ve Tasarım
Danışman: Dr. Öğr. Üyesi Mehmet Kahyaoğlu
Mayıs 2024

Bu çalışma, deri, vegan deri (bitkisel deri) ve suni deriye genel bir bakış sunmayı ve her bir malzemenin avantaj ve dezavantajlarını karşılaştırmayı amaçlamaktadır. Bu çalışma derinin tarihçesi ve üretimi ele alınarak başlayacak, ardından suni deri ve bitkisel deri ele alınacaktır. Araştırma daha sonra her malzemenin dayanıklılığını, estetik çekiciliğini ve çevresel etkisini karşılaştıracak, aynı ürünü üç malzeme türünden inceleyecek, kilit noktaların ve gelecekteki düşüncelerin özeti ile sona erecektir.

Anahtar Kelimeler: deri, sentetik deri, alternatif deri, vegan deri, veganizm, sürdürülebilirlik, moda

ACKNOWLEDGEMENTS

I am deeply grateful to my esteemed thesis advisor, Assist. Prof. (PhD) Mehmet Kahyaoğlu, for his guidance, motivation, and sharing of knowledge and experience throughout the completion of this study. I would also like to thank Canan Erdönmez for her invaluable support and the knowledge and experience she shared during my research. Her guidance was essential, and without her help, completing this study would not have been feasible.

I extend my deepest gratitude to my parents for their unwavering support and patience throughout my studies. Their presence and encouragement have been a great source of strength in overcoming the challenges I faced.

I would also like to thank Erkan Zandar for his contributions in providing the sources needed used in this thesis. His information and sources were foundational to this work. Special thanks to Mısra Artkıy, Erdinç Artkıy, and Artkıy Deri for their support during the production phase of the bags. Their assistance and contributions were crucial to the success of this project.

I am profoundly grateful to my dear uncle, Süleyman Tahiroğlu, for his constant support throughout this process. His support and guidance played a significant role in my academic and personal development.

Finally, I extend my heartfelt thanks to everyone who supported me, shared their knowledge and experience, and showed patience and understanding throughout this journey.

Thank you all.

Belis Savaş

İzmir, 2024

TEXT OF OATH

I declare and honestly confirm that my study, titled “LEATHER BEYOND TRADITION: VEGAN AND SYNTHETIC PERSPECTIVES” and presented as a Master in Art and Design Thesis, has been written without applying any assistance inconsistent with scientific ethics and traditions. I declare, to the best of my knowledge and belief, that all content and ideas drawn directly or indirectly from external sources are indicated in the text and listed in the list of references.

Belis Savaş

Date

TABLE OF CONTENTS

LIST OF FIGURES

ABBREVIATIONS

PVC Polyvinyl Chloride

PU Polyurethane

BC Before Christ

UK United Kingdom

PETA People for the Ethical Treatment of Animals

1. CHAPTER: INTRODUCTION

Human beings have processed the skin of animals whose meat, milk and wool they have utilized since the day they came into existence and have used leather as the main material in many items used in daily life. Throughout human history, from the most primitive settlements to the present day, leather has been the basic raw material of various product groups such as belts, whips, armor, arrow bags, quivers, shields, tents, harnesses, pouches, overalls as well as daily use products such as clothes, shoes, belts, headdresses (Erdönmez, n.d.). Leather dates to ancient civilizations where it was used for many purposes from clothing to shoes and accessories. Wall paintings depicting bison hunters with animal skins in the Altamira cave in Spain show that the history of leather and leather products dates to the Paleolithic period (Yelmen, 1985). In ancient Egypt, leather was used to make products such as sandals, shoes and decorative accessories. In ancient Rome, leather was used to make armor as well as a wide variety of products such as belts, wallets and even books (Yamauchi and Wilson, 2016). Leather production was industrialized over time with the development of new techniques and technologies that allowed for the mass production of leather products. Particularly in the 18th and 19th centuries, the leather industry boomed with the rise of the British Empire and the expansion of global trade. This period saw the development of new methods for tanning and finishing leather in different styles and colors. Leather has become a valuable recycled material used in many areas, from footwear and clothing to leather goods and furniture. The production of these products utilizes the skins of small and large cattle, which are subjected to mechanical and chemical reactions to transform them from inert to durable, high value-added products. In addition, the skins of exotic animals such as snakes and rhinos are processed in similar ways to produce a variety of products. However, the trade in the skins of these exotic animals is generally considered unsustainable in terms of wildlife conservation.

Today, many people are becoming more aware of issues such as sustainability, animal rights, water consumption and environmental factors. This increased awareness is further enhanced by the rise of sustainability movements and a greater media focus on

these issues. People's demand for environmentally friendly products is increasing. While price and quality factors affected the production of products in the past, today producers are faced with ecological concerns (Erol, Pamuk, & Aydın, 2018). In the 20th century, mechanization and increasing variety of raw materials increased the speed of production and encouraged the consumption trend (Berber & Keskin, 2021). However, today, factors such as the decrease in animal resources and the increase in water consumption have led people to seek more ecological and sustainable alternatives without harming nature and living things. With this increase in awareness, the concept of "veganism" has become more popular and in this context, an alternative to traditional leather has emerged: Vegan (pland-based) leather. Vegan leather is a material made to mimic the look and feel of animal skin but is made entirely from non-animal materials. It is produced using a variety of natural ingredients, including PU, PVC and plant-based materials such as cork, pineapple, cactus, grapes and apples. Vegan leather has been favored in the fashion industry as an alternative to animal leather and is used in a wide range of products, from clothing and footwear to handbags and accessories. Unlike traditional leather, the production of vegan leather does not involve the use of animal resources and the chemicals required for the processing of animal skins. Therefore, it is typically a more environmentally friendly option than traditional leather. Several factors contribute to the fact that vegan leather requires less energy and chemicals to produce. Vegan leather is usually made from plant-based materials, which requires less processing and chemical use compared to animal leather. While many chemicals are used in the leather industry to process animal leather, these chemicals are not needed in the production of vegan leather. A lot of water and energy is used to process animal leather and preserve the processed leather. However, in the production of vegan leather, water consumption is generally lower and energy requirements are lower. The concept of vegan leather has emerged as an alternative to the leather industry and is presented as an environmental and ethical option. However, there is controversy about calling vegan leather "leather". Some argue that although vegan leather looks and feels like real leather, it should not be considered in the same category as real leather because it is made from non-animal sourced materials. These debates about the naming of vegan leather will be explored and evaluated in more detail. In the following sections of this study, the different views on the name and definition of vegan leather will be discussed and the causes and consequences of these

debates will be discussed in detail. In this way, a broader perspective on how vegan leather should be approached will be presented.

This research aims to compare the history, types, technical characteristics, production processes and main differences between leather, artificial leather and vegan leather. In addition to theoretical comparisons, it aims to provide a comprehensive analysis by observing practical aspects of the same product such as the production, cost and durability of different types of leather. By identifying the advantages and disadvantages of vegan leather, the results of the research will shed light on the process of branding and marketing this product. It has a special focus area to examine in detail the rising popularity of vegan leather as an alternative to traditional leather and artificial leather and its eco-friendly features. In the first part of the research, the history of leather will be introduced and the evolution of the leather industry from past to present will be discussed. Emphasizing the importance and uses of leather in human history, it will examine how leather is traditionally produced and used. Then, it will focus on the historical processes of artificial leather and vegan leather. By focusing on the emergence, development and commercial uses of artificial leather and vegan leather, it will be explained how and why these alternatives were developed. The process of artificial leather and vegan leather gaining popularity and their effects on the industry will be emphasized. In the following sections of the research, leather, artificial leather and vegan leather will be compared with each other. In this comparison, the advantages and disadvantages of leather, artificial leather and vegan leather will be evaluated by considering factors such as material properties, production processes, environmental impacts, durability and usage areas. This evaluation will provide an important perspective to understand the potential industrial and consumer impacts of each material.

2. CHAPTER: AS OLD AS HUMAN HISTORY: LEATHER

Leather is a material that has been shaped, processed and gained its present value in the process of human evolution (Coşkun, 2018). Scientists working in the fields of anthropology and ethnography offer important scientific studies on the origins and evolution of the human species. These studies deepen our understanding of when and how human beings emerged. Estimating the period in which the first humans lived is a complex process, but there are many findings that are widely accepted in the scientific community. For example, the skull found on the island of Java and identified as belonging to a hominid that lived about five hundred thousand years ago is considered an important finding that illuminates the history of human evolution. It has also been suggested that another skull discovered near Beijing in China is much older and may belong to a hominid that lived about one million years ago (Yelmen, 2005). Skin is a material as old as the existence of humanity, and human survival is thought to be largely dependent on the presence of this material (Rines, 2020). Since its existence, mankind has not only consumed the meat of the animals it hunted, but also used their skin and bones. In depictions from prehistoric times, semi-savage people are seen wrapped in animal skins from the waist down and holding the jawbone of the animals they killed or stone-tipped sticks instead of weapons (Sakaoğlu and Akbayar, 2002). The basic needs of human beings include nutrition, shelter and clothing. In the history of humanity, the first people met their needs such as clothes, shoes and tents by using the skins of wild animals they hunted to meet their nutritional needs. The importance and evolution of leather in human history reflects a cultural and technological development beyond the purpose of clothing and protection. The practice of using leather by early humans arose from the need for protection from natural factors and attacks by wild animals. While protecting the naked body from cold, heat, rain and other external factors, leather also became a part of hunting and survival skills. It is possible to state that leather products, which have a long history, have become an integral part of modern life and an element of prestige beyond the artistic and cultural value they carry from past to present and from present to future. In this context, they are considered as material culture products representing high

quality craftsmanship and superior artistic value in all areas of social life (Coşkun, 2018).

The hides and skins of killed animals were used for clothing, shelter and other purposes long before the evolution of modern humans. One example of this use is shown by Australopithecus habilis, which lived in East Africa about two million years ago and consumed more and more meat. Australopithecus habilis is the first creature to start using skins systematically. Unlike other carnivores, this species did not have specialized teeth or claws to penetrate the skin. However, the stone tools used by Australopithecus habilis during this period proved effective at cutting through even the thickest skins. This fundamental technological discovery led to the more widespread use of sharp-edged stone tools, playing an important role in human evolution. In addition, specific bone deposits found at Australopithecus sites during this period indicate that the flesh of larger animals was butchered, and possibly animal skins dragged back to their habitat. This suggests that skins made of hard and flexible material were used for different purposes. These skins may have been used to make clothing and shelter. This early use of leather is considered part of human evolution and heralds a major advance in both technological and cultural terms. Humans recognized the advantages of leather to adapt to their environment and survive and learned to process the material more efficiently (Kite & Thomson, 2006).

The next stage in the development of the use of hides and skins is associated with the Pithecanthropoid hominid group (Java Man). These creatures are known as systematic and successful hunters. They learned to control fire and cooked their meat. They also developed a wider range of tools, including the typical Ashelien impact point, which was used for both butchery and leather processing. A workshop refers to a work area used by people in the Stone Age to make stone tools. These areas were usually located in naturally sheltered places, such as caves, and were equipped with hammerstones, cores and other tools necessary for making stone tools. Ateliers allowed people to produce the tools necessary for hunting, food preparation and other vital activities. Some groups of Pithecanthropoids lived in large, tent-like shelters built by spreading skins over wooden frames. The skins were also used to form rough bundles that ran along the edges of the shelters. These dwellings were heated by a fire in a central hearth, which allowed the leather to dry slowly. More importantly, the light tanning effect of wood smoke was also evident. The claim that Pithecanthropus erectus

observed and exploited these changes is supported by the fact that they developed specialized stone tools to scrape off unwanted fat and flesh. This scraping process also distributed the fat into the skins, resulting in a more flexible product. Stretching the hide as it dried would also have produced a softer product. It is therefore quite possible that a raw type of leather was produced by these hominids a million years ago. Thirty-five to forty thousand years ago, Cro Magnon Man (Homo sapiens) appeared in Europe. The works of prehistoric artists have given us the first direct evidence of the use of leather as clothing. Rock paintings from thirty-five thousand years ago show men wearing leather loincloths and a woman wearing a skirt. Similar paintings from the next twenty-five thousand years show people wearing pants and dresses, probably made of leather. It is concluded that by the time Homo sapiens evolved, the art of leather making was fully developed, and tanning was probably the first human manufacturing process (Kite & Thomson, 2006).

Figure 1.1. Upper Paleolithic Depiction of Men and Women Wearing Skin Garments.

Source: Kite & Thomson, 2006

The hunters who colonized the frozen northern regions during the Old Stone Age wore well-sewn garments made of animal skins, not furs thrown randomly over their shoulders. Archaeologists have found the earliest known bone-eyed needles at archaeological sites dating back to 20,000 BC, and other discoveries have confirmed that their purpose was to make clothing. Furthermore, items decorated with discolored

earth and bead patterns around three men's graves found in 1964 near Sunghir, Russia, suggest that the inhabitants were buried in hats, shirts, pants and moccasins made of fur or leather. Likewise, in the contemporary Buret region of southern Siberia, a figurine carved from a mammoth tusk was discovered with a figure wearing a fur dress like traditional Eskimo clothing (James et al., 1995).

Leather is a sheet material whose area ranges from tens of square centimeters to six, seven or even more square meters, depending on the animal from which it was obtained. Such features indicate a common characteristic of leather and other leather products in prehistoric times. However, linguistic research shows that different materials, such as rawhide, oil-tanned hide, alum-tanned leather and vegetable-tanned leather, were differentiated from each other from early times (Kite & Thomson, 2006).

Çatalhöyük is an important prehistoric settlement in Turkey, dating back to the Neolithic period. Wall paintings from this period date back approximately seven thousand years and depict men wearing animal skins made of pink leopard skin and hats of similar material (James et al., 1995). These paintings provide an early example of the use of leather as clothing and accessories at that time. Furthermore, these findings provide information about the cultural practices and lifestyles of ancient societies. The depiction of garments made of leather suggests that leather had important functions, such as providing protection, warmth and perhaps symbolizing social status or cultural identity. This archaeological evidence reflects a long history of human use of leather for a variety of purposes, demonstrating that the deep-rooted bond between man and leather has endured throughout history.

As the raw skin of the animal has a living organic structure, it deteriorates rapidly, hardens as it dries and becomes difficult to shape. Therefore, processing is necessary to make the skin usable for the desired purposes. After processing, the leather can be used in two different ways, with or without the hairs or feathers removed. Skins with the hair removed are usually called "hides" and are obtained from soft-haired animals such as deer, tigers, sheep and Angora goats. Such skins are used for clothing and clothing and are often called "fur". However, the skins of small animals are also treated and made into fur; such animals include marten, fox, rabbit, mink, sable, cockatoo, chinchilla, lynx, beaver and badger. In addition to skins with the hair removed, skins with the hair removed from their surface are also used for a variety of purposes. These

skins are utilized in different fields, from shoe making to the production of face plates and linings, from clothing to upholstery. In prehistoric times, skins were often peeled, smoked and oiled. This made the leather more durable and workable and helped people to meet their clothing, shelter and other needs (Dağtaş, 2007a).

Leather, which was roughly processed during the Paleolithic (old stone age, 6000000-10000 BC) and Mesolithic (epi-paleolithic, 100000-8000 BC) periods, started to be processed consciously during the Neolithic (new stone age, 8000-5500 BC) period as a result of the transition to settled life and the domestication of animals (Dağtaş, 2007a). In the Neolithic period, people first learned to process stones. Thousands of years ago in the Stone Age, people living in caves used the skins of the animals they hunted as natural clothing and successfully painted the pictures of these animals on the cave walls. The cave paintings and the simple stone tools used by the people of this period from the Neolithic Age to the present day are considered among the oldest documents on the history of leatherworking. Stone tools may have been used for hitting, cutting, smashing and beating in the same period. Findings from cave archaeology suggest that these tools were also used in Stone Age tanning methods. It also shows that the furs, hides and skins of animals such as bears, foxes, wolves, goats, Angora goats, lambs and calves, which are hunted or slaughtered in rural areas today, were salted, dried, scraped with a knife, beaten with a mallet, and the hides and skins were rubbed in water and then smacked. Therefore, it can be said that primitive tanning methods are still alive (Sakaoğlu & Akbayar, 2002).

Figure 1.2. Cave Paintings.

Source: Sakaoğlu & Akbayar, 2002

Figure 1.3. Stone Age People.

Source: Sakaoğlu & Akbayar, 2002

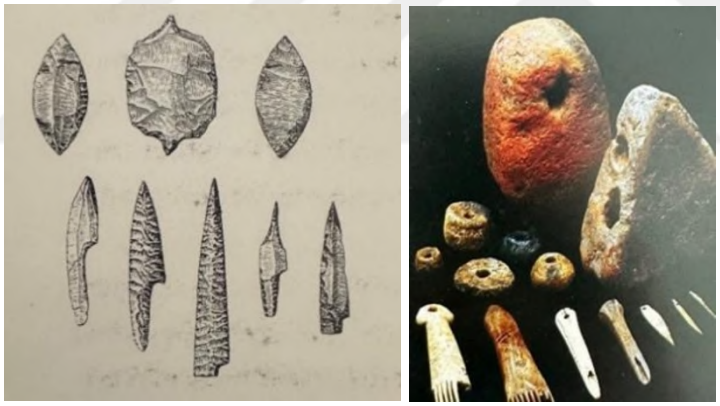

Figure 1.4. Stone Tools.

Source: Sakaoğlu & Akbayar, 2002

It is fair to say that leather is needed in every region where human beings have chosen to live. Especially in ancient Anatolia, numerous findings have been unearthed indicating the use of fire and the making of certain tools. The absence of leather pieces among these findings does not mean that the people who laid the foundations of civilization and culture in this peninsula did not use leather. This is because, although leather goods are probably the most important items of clothing, goods and tools that

primitive industry based on natural and animal materials could produce, this organic material could not be as durable as stone, flint, bone or even wood in any environment and condition. In 1931, archaeological excavations at Chou-Kou-Tien in China yielded prehistoric finds including charcoal, calcified bone and skin remains, ash layers, chipped stones and, most importantly, worked deer and other animal antlers and jawbones. These findings show that the human hand processed hides and skins by trial-and-error methods and produced clothes and various items from hides and skins (Sakaoğlu & Akbayar, 2002).

In the Chalcolithic (mining-stone age 5500-3000 BC) and Bronze (old bronze age / first bronze age 3000-2000 BC) periods, metal was used instead of bone in the processing of leather. Leatherworking tools made of bone, stone, obsidian and silica in prehistoric times have been found almost everywhere as a result of excavations in Preasia, Egypt and countries around the Mediterranean. Paleolithic silex tools from the Drabchenlock Cave in the Eastern Alps of Switzerland and examples from the Swiss Lake Houses have also been found in the same form. All communities living in the Prehistoric Period used such tools for leather processing. The place where leather processing, debagging and tanning is done is the tannery. It is also called debbaghane. Today, tanneries are included in the definition of leather processing industry. Leather is a product that has existed, processed and used since the earliest periods of human history. In other words, debagat / basketry / leather processing is one of the oldest and deep-rooted arts known to mankind. The processing of leather is one of the oldest professions in the history of technology (Dağtaş, 2007).

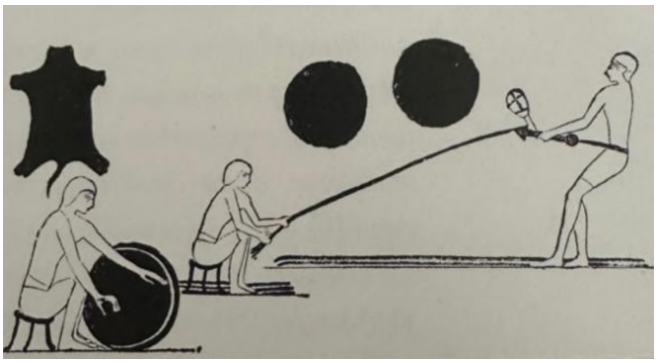

Figure 1.5. Illustration of Leather Embroidery in Egypt.

Source: Dağtaş, 2007

China, Central Asia, Mesopotamia, Anatolia, Egypt and Europe have been identified as the cultural regions that provide the oldest data and traces of leatherworking history (Sakaoğlu & Akbayar, 2002). Based on archaeological and ethnographic heritage, it is possible to date leatherworking activities to the hunting-gathering period. Finds from kurgan graves in the Altai Mountains suggest that the common use of leather products was shoe and boot making (Sakaoğlu & Akbayar, 2002). The Bible often refers to garments made of leather (Yamauchi & Wilson, 2016.). In Bible, "God provides animal skins for Adam and Eve for clothing" (3:21). Another use of leather was as a writing material for secular and religious texts. Although it could be used to write short compositions on broken pottery (ostraca) and carved inscriptions on plaster or stone, the preferred material for "recording important texts" was leather parchment. Leather was a superior option to papyrus in terms of durability, which was more functional, especially for longer texts, and could also be more easily rolled. In the oldest Jewish tradition, the Torah was written on leather scrolls. Parchment is specially treated leather for writing and storing information. Parchment was first produced in Pergamum around the 3rd-2nd centuries BC. This practice originated at a time when animal skins were the only available writing surface if a given text had this length. The Hebrews produced a special type of parchment using calf or lamb skins. These skins were first processed, cleaned of hair, and then rubbed with a stone like pumice to obtain a smooth surface, especially on the hair side (Yamauchi & Wilson, 2016). It has also been observed that the leather materials used by early humans up to 3000 years ago are still intact (Rines, 2020). Leather remains that have survived to the present day are found especially in regions with dry desert climates and in places where frozen samples are found in cold climates. Apart from these few finds, cave paintings and depictions on tomb walls provide some clues about the use of leather. In addition, leather analyses provide information on the tanned and dyed materials (Dağtaş, 2007). In caves in various parts of the world, people have made countless paintings. These paintings, beyond being works of art, were also made to increase the chances of hunting and even to be used for religious beliefs and rituals. Whatever the reason, these paintings are an indication that animals were hunted and used for food in the early periods of human life. The animals depicted in the caves were initially depicted in raw

form, then partially preserved and finally made more useful for humans by the process of debinding.

In cave wall paintings dating back to 20-25 thousand years ago, it is known that hunters covered themselves with leather. Especially in Tervel Cave in Spain, paintings from the Palaeolithic period show female figures wearing leather skirts. In the Cogul Cave of the same period, in the Pyrenees region of Spain, there are wall paintings depicting a hunter wearing leather trousers. It is also known that the members of the Tasilli tribe, who lived in the cave period due to their primitive lifestyle, used leather to cover themselves (Yelmen, 2005).

Figure 1.6. Hunter in Leather Trousers in Cogul Cave, Spain & Women in Skirts on the Wall of the Tervel Cave in Spain

Source: Yelmen, 2005

The cave near the town of Chapelle-aux-Saints in France, where the skeleton of Musterien Man was found, is known to date from the Middle Paleolithic. The archaeological layer at the base of this cave yielded bones of reindeer, ibex, bison, cave hyena and mammoth, as well as chipped flints, various points, scrapers and worked bones. These findings show that the primitive ancestors of that period had a highly developed animal culture. Similarly, finds of red dyed skins dating back to the 4th millennium BC from excavations in the Euphrates Valley in Mesopotamia suggest that this region also had a similar characteristic (Sakaoğlu & Akbayar, 2002).

Cuneiform tablets dating to the 2nd millennium BC, which tell the story of Gilgamesh, the ruler of the city of Uruk in Mesopotamia, tell that Gilgamesh, who wandered in the deserts for a long time, wore animal skins and wore a lion's fur coat on this long journey of adventure. A depiction of Gilgamesh in this outfit, standing between two

lions, is recognised as the Gilgamesh motif in world iconography. Among the offerings to the gods, cuneiform documents and wall reliefs testify to the presence of leather goods, such as sandals. The Sumerians produced sandals as simple footwear that best reflected the natural structure of the human foot, consisting of a leather sole with toe and ankle straps. According to the information obtained from the tablets, leather clothing and sandals were at first privileged clothing items only for kings and priests. However, under the influence of war conditions and political expansion, soldiers, postmen, merchants and the public also began to wear leather clothes and shoes. In Sumerian, Akkadian, Babylonian and Assyrian societies, different types of clothing made of fur and hides such as "aguhhu," "kaunakes," and "guffas" have been found. The reliefs in the Louvre Museum in Paris, the British Museum in London and other museums show that gods and kings always wore long skirts and caftan-like leather upper garments covering the body (Sakaoğlu & Akbayar, 2002).

Figure 1.7. Leather Sandals.
Source: Sakaoğlu & Akbayar, 2002

Figure 1.8. Gods and Kings Wore Long Skirts and Caftan.

Source: Sakaoğlu & Akbayar, 2002

2.1. Leather Industry in the Modern Era

The technological revolution and scientific advances at the beginning of the modern era diversified and improved leather processing. Shoe leather in a shiny black color called patent leather was invented in 1819 as an example of these developments. Before the tanning process was fully mechanized by the mid-1860s, leather was used in a wide range of applications, from clothing to work equipment, bags, military equipment, household goods, bookbinding, toys, saddles and shoes. Towards the end of the century, the industrialization of the leather processing industry and the decentralization of fashion in the early 20th century extended the use of leather to a wide range of highly personalized gift items, from custom footwear to interior furnishings, from automotive accessories to leather bags. The first product to stand out among French leather goods was a seamless wallet made from a single piece of leather called "Sans Couture" in 1898. This innovative product won a silver medal at the universal exhibition in 1900 and became the center of attention. This new arrangement emphasized the luxury status of leather and consequently paved the way for a growing demand for exclusive accessories. By the late 1930s, many leather accessories for both men and women and new styles of evening bags, including handbags, were introduced and popularized. The year 1955 was marked by leather gifts and presentations, and luxury leather goods were in great demand during this period. Leather has taken center stage in the world of luxury fashion and is now used in many different fashion products, from luxury brands to street fashion. The wide range of leather products has increased the material options in the fashion industry and improved the perception of leather materials. In a period when fashion products are short-lived, consumers are encouraged to buy new products every season. Fashion cycles are changing rapidly and planned obsolescence with design aesthetics directs consumers to new products.

2.1.1. Production of the Leather

Leather is a sought-after material due to its durability and easy application of various technical embellishments. Leather is one of the basic components of animals, which are living organisms, and its basic structure consists of fibres. These fibres are brought

together in bundles and form a solid surface by overlapping side by side. The quality of the leather is determined by factors such as the geographical region where the animal lives, weather conditions, climate, vegetation, animal species, age and nutritional conditions. In hot climates, the skin may be thin and weak because nutrition is not natural, while in cool and humid regions the skin tends to be harder and thicker. Feeding animals with feed or natural nutrition can improve the quality of the leather and give it vibrancy and lustre. The raw material for leather products comes from the skins of mammals. The leather that has been processed and made ready for use is called "finished leather". Raw, unprocessed leather or leather still on the live animal is defined as "raw leather". The processing of raw leather with plants and oils has been found to delay the deterioration process of leather. Firstly, the process of oiling leather to increase its durability dates to 8.000 BC. Over time, this method was replaced by tanning with materials such as smoke, alum and the bark and leaves of some plants (Coşkun, 2018). Tanning is a general term that includes various processing steps for animal hides or skins to become finished leather. Fresh hides and skins are full of components including water, proteins, fats and some mineral salts. Among these components, collagen protein, which is essential for leather production, stands out. Tanning is the process of transforming raw hides and skins from a potentially decayable material into a durable leather. In this process, sensitive chemical bonds such as hydrogen bonds are replaced with chemicals such as chromium, aluminium or other mineral salts, vegetable or synthetic tanning agents to increase the durability of the leather and protect it against microbial degradation. Leather production is a process belonging to the natural products industry and involves a series of complex chemical reactions and mechanical processes. All these processes shape the process of converting fresh hides or skins into finished leather products (Emission Scenario Document on Leather Processing Industry, 2004). Animal hides and skins vary greatly between the skins of large animals, e.g. cattle, and the skins of small animals, e.g. sheep. All animal skins are largely composed of a fibrous protein called collagen. Therefore, one of the most important issues for tanners is the chemistry of this fibrous protein and the properties it gives to the skin. In addition, other components of the skin also influence the processing, the chemistry of the material and the properties of the product, i.e. the skin. Therefore, understanding the relationships between leather structure at the molecular and macro level is useful for understanding the changes that

occur when the chemistry of the material is altered and the final properties of the leather. Leather production is a traditional industry and dates to ancient times, in fact it has existed for over 5000 years. This industry dates to the period of the Code of Hammurabi, 1795-1750 BC. The use of animal skins is one of the oldest technologies that may be as old as tool making.

It is known that the first people who started civilization made use of natural resources. They survived by utilizing the drying effect of the sun, the cleansing function of water, the filing ability of stones, the heating power of fire and the function of smoke. They may also have skinned the animals they hunted, cleaned them and then hung them from tree branches or stretched them between stakes. It is likely that the first simple preservation methods available to them utilized natural substances such as earth, salt and alum. Such early practices can be considered to mark the beginning of leatherworking and thus the history of leather processing (Sakaoğlu & Akbayar, 2002). Raw leather obtained by skinning involves physical processes such as stripping (removing the remaining flesh from the skin), tanning with chromium or vegetable tannins and dyeing. As a result of these processes, a material that can be considered as an intermediate product is obtained. This product is then transformed into various products such as shoes, clothes, bags, belts and presented to the end user. In prehistoric times, leather was processed only by basic processes such as peeling, smoking and oiling. From the Neolithic period onwards, it is thought that leather began to be consciously processed. Archaeological depictions, leather remains, and processing tools found in excavations show that leather was used from the Paleolithic period onwards. However, we do not have information about the exact time of tanning. Written sources have not yet been found for this period, so we do not have more detailed information about this period. It is believed that leather was processed with simple methods as early as the Paleolithic (Musterian, Orinyarian and Magdalenian) periods to reduce its hardness and prevent deterioration. In the simplest way, it has been observed that the smoke from campfires and melted fat helped to protect the leather and give it flexibility. However, it has been suggested that in prehistoric times, the simple processes required prior to tanning may have been discovered by chance. For example, since the decay of the epidermis was thought to be a loss to the skin, the ability of humans to make fire, the short-term preservation of meat and the smoking of fish may have created the requirements for simple preservation of the skin. Pliny,

an important Roman historian, identified Tykhios of Beotia (Hyle) as the inventor of leatherworking. It is known that Tykhios applied the vegetable tanning method. It is important to note that the materials used in this method did not appear suddenly. Tykhios of Beotia discovered and developed this technology over a long period of time through random experimentation and experience. This is because these substances are the same as those previously used in the Middle East regions, Egypt, Palestine, etc. According to another rumor, the Chinese Shin-Tang, who is regarded as one of the leading figures of leatherworking, may have pioneered these important developments (Dağtaş, 2007).

One of the features that distinguishes human beings from other living things is their desire for industrialization throughout history. The first three raw materials used for this purpose are flint, bone and leather. The first people used these raw materials for hunting and survival. However, those with artistic talent realized the first artistic inventions by exhibiting their aesthetic and plastic skills. They also produced the most primitive furniture of the period using natural dyes and other materials. They also used carefully seasoned skins to decorate the interior surfaces of shelters and temple caves with animal figures and scenes of daily life. The ancestors of mankind needed leather to meet basic needs such as protection, defense, heating, equipping and dressing. For this reason, leather has been at the forefront of clothing and other necessities in the history of mankind. Therefore, leather has represented a culture different from other raw materials and industries in terms of "craft, trade, organization and morality". The discovery of the first tanning technique by mankind led to a special value being attached to the processed leather and even to their being considered sacred. Leather garments were frequently depicted in paintings and reliefs by gods and kingly figures. In addition, oracles and priests wore leather robes to call the people to worship. The technique of tanning was kept secret for many years and taught only to certain people (Sakaoğlu & Akbayar, 2002).

In the middle of the Stone Age, people began to produce clothing using simple tools and preserving the skins with smoke. The processing of the skins was then probably carried out by religious leaders. These leaders were both priests who fulfilled religious duties and doctors of the time, so they dyed the skins red with a substance derived from plants to make them more durable. Plant-based tanning was known in Sumerian, Babylonian, Assyrian and Arab cultures. A substance called alum was used for

vegetable tanning. Alum was usually found in volcanic regions and could be used on leather. The art of embalming was developed during this period and a mixture of neutrons and salt was used during embalming.

The oldest and most durable leather products came from Egypt. In Egypt, due to the culture of worshipping the dead, there are plenty of items made of leather in the tombs. Scientist Schiaparelli found a leather sample dating back 5 thousand years during excavations in Northern Egypt. A tanning workshop was also discovered in the same region. In addition to leather fragments, half-amyl leather and tools containing Acacia nilotica shells were also found in this workshop. These shells must have been used for leather processing at that time, as they contain the substance necessary for leather processing. This species of acacia is still found in Sudan and its dried bark contains 41 per cent of tanning material. Therefore, 3-4 thousand years BC, the skins were buried 1.5 meters deep, sprinkled with acacia bark and covered with stones. The vegetable tanning agent was used to tan sole leather, sandal leather and leather. However, vegetable tanning was not the only method used in Egypt. The Sumerians, Babylonians, Assyrians and Hittites passed on oil and alum tanning techniques to the Egyptians. A ceremonial robe made of antelope skin from 3000 years ago in a museum in Boston shows that alum tanning was used. The Hittites, who migrated from Anatolia in 3000 BC, gained great power and left important traces both in Anatolia and in other regions they influenced. One of these traces is aluminum tanning. Hittite tanners had considerable experience, which is used in today's tanning techniques. They discovered that aluminum tanning would produce smooth leather, while vegetable tanning would produce less durable leather. They therefore combined the two tanning techniques. However, they were able to solve the problem that alu-tanned leather hardly absorbs vegetable substances with grape juice. The method of tanning with minerals was developed in America and the method of tanning with chromium began to be used in the late 1800s (Yelmen, 2005).

Excavations in Egypt show early examples of tanning through wall paintings from tombs dating back to the fifth and twenty-sixth dynasties. A scene from the Rekhmire tomb, dated ca. 1500 BC, depicts skins being soaked in large jars containing meat and softened or scraped with a grass edging tool. The finest glove skins appear to have been softened with a similar tool. The first detailed descriptions of tanning processes date from around the same period. Sumerian magical ritual texts describe the

preparation of ox and goat skins used to make drums for religious festivals. Although these texts date to around 1000 BC, they probably reflect techniques dating back to the third millennium. The rise of city-states and the transition to urban life led to an increased demand for leather for civilian and especially military purposes. Leatherworking evolved from a small-scale handicraft activity into an important industrially organized profession. Early Sumerian and Egyptian texts show that a complex trade network for raw and treated leather, tanning materials, processed leather and materials developed in the Near East around 5000 years ago. This trade continued into the Classical Greek period and expanded as tanners became a wealthy and influential segment of society, employing 120 slaves in a specialized factory producing leather shields in Piraeus. But the development of leatherworking was not confined to urban civilizations. High-quality leather remains have been found at different Late Neolithic, Bronze and Iron Age sites, such as the Frozen Tombs, the Hallstatt salt mines and the Danish bog graves. The Romans recognized the vital importance of leather for military forces. Legions demanded leather and leather products as tribute, and cattle were allegedly raised for their skins, not their meat. Rather than relying on local sources, the Roman Army established its own tanneries and workshops. Some clues to the tanning techniques used in the Roman period can be obtained from the remains of civilian tanneries unearthed at Pompeii. In fact, between the classical Greco-Roman period and the Industrial Revolution of the nineteenth century, there appears to have been basically little progress in terms of leather production technology (Kite & Thomson, 2006).

Cattle, goat and sheep skins are made up of three basic layers: the epidermis or outer layer, the dermis, known as the inner part of the skin, and the lower flesh layer, which contains the fatty tissue. The rotting of hides can be stopped by a process known as "curing", which is carried out by methods such as salting or sun drying. After hardening, the skins are washed again and cleaned from the inside to remove hair from the inner layer and to obtain a smooth surface. To remove the hairs, the skins are soaked in a chalky solution, which is used with a scraper that allows the hairs to be easily scraped off. They are then processed to wash the outer grain side of the leather again to make the hides smooth. Ancient tanning methods were designed to produce leather of different qualities and included the use of tannin-producing substances such as hazelnuts, pomegranate peel and oak bark. In some cases, swellings formed by

insects laying eggs in oak trees increase the amount of tannic acid in the bark, providing an effective tanning agent. Acacia bushes can also provide tannins, and human and animal urine has been used as an effective tanning agent from early times (Yamauchi & Wilson, 2016).

To prevent the rapid deterioration of hides, salting was an ancient process, similar to today's practices. Moistened raw hides were softened using sticks. Before this process, the leather was chewed. The beating of the leather increased its elasticity and allowed it to accept tanning agents more easily. Salted hides were soaked in cold water to clean and soften the dirty substances and aluminum in the hides. After soaking, the leather was laid on a bench and the pieces of meat stuck on it were removed with a knife. This process is similar to today's machine meeting process. The process used to separate the hair follicles from the skin and remove the hair was known as heat treatment or "sweating" in ancient times. The skin was moistened with heat and humidity, during which bacterial activity caused it to decay and the hair follicles to loosen, causing the epidermis to lift. Another ancient method used to remove hair was the method used by communities such as the Celts and the Germans of putting the skins in urine. Although lime is used today, lime was an important material for leatherworking in ancient times and was also used in the ancient practice of placing the skin in lime after bathing. During liming, the leather swells and becomes ready for the tanning process. The hides were dried using the sun and smoked with wood. It is also known that vegetable and mineral tanning methods were used in ancient times. Herbal tanning was known in ancient Greek and Roman communities and the inventor of this method was a tanner named Tykhios of Hyle. In ancient times, skins were dyed with various plants, mineral and vegetable dyes (Dağtaş, 2007).

Tanning, which is the main branch of leatherworking and provides raw materials for other leather arts, had been highly developed in the Aegean basin since the Ancient Age thanks to the dense population and trade activities in this region. The leatherworking methods used in Anatolia included salting, washing, cleaning, heating, hair removal, feather removal, softening, soaking and washing, scraping with blunt knives, rotting and feather removal, beating, tanning (debağat) and finishing. Debağağlık, the main branch of the leatherworking professions, developed where the first tanneries were established near rivers, livestock markets and slaughterhouses. The tanneries operated as workplaces consisting of makeshift open sheds, which could be

described as places where foul odors spread and vermin were found (Sakaoğlu & Akbayar, 2002).

Figure 2.1. The Site of the Old Tanneries.

Source: Sakaoğlu & Akbayar, 2002

In ancient civilizations from the Mediterranean to Central Asia, leather was an extremely important raw material and was accepted as a necessary material in almost every field (Sakaoğlu & Akbayar, 2002). In Mesopotamia and Egypt, there are no remains of tanneries from the ancient period, whereas such finds came to the fore especially in the Greco-Roman period. For example, Homer and Pliny mentioned large tanneries in cities such as Athens. In the Hellenistic period, leather processing shops and licensed leather production workshops were found in Greece and Egypt, and this practice continued in the Roman period. Remains of Roman tanneries have been found in Bonn, Wiesbaden, Mainz and Pompeii. However, the remains of tanneries from very old periods have not been found in Anatolia. Leatherworking tools from prehistoric times have also been found, which were developed over time and made of different metals, e.g. copper and bronze. These tools were used in processes such as scraping, cutting, piercing and polishing of skins. The wells, troughs and looms required for tanning were also developed over time. In addition, threads, nails and adhesives were used for sewing. With the discovery of writing in the third millennium BC, it became possible to access information on leatherworking (Dağtaş, 2007).

Depending on climatic conditions and local resources, different communities developed their own leatherworking techniques and passed on these skills from generation to generation. Leather craftsmanship is also an art that evolves in accordance with changing needs. The processing of leather, which is mentioned as

"teri" and "tirik" in ancient Turkish texts, was simple in those times. This etymological meaning emphasizes the special place of leather in our social and economic history. The earliest remains of the use of processed leather as clothing and goods in the Turks were unearthed during excavations in the kurgans in the Altai Mountain ranges. In the way of life of Turkic societies, leather goods have always had a symbolic significance in addition to meeting their various needs. From ancient texts, we learn from Ibn Fazlân's travelogue that the Bulgarians presented a sable fur coat to their ruler every year as a fur coat, and that the Bulgarian kaan sent a certain amount of fur to the Khazar ruler as a tax. It is understood that furs were a major tax item in this region. Ibn Rusta's al-A'lak al-Nafisa also mentions that the people of this region used squirrel skins instead of money. In a chapter of Prof. Dr. Bahaeddin Ögel's "Introduction to the History of Turkish Culture", there are important observations on the clothing culture of the Turks. It is stated that especially the pastoralist Turkic communities needed clothing resistant to environmental conditions and for this reason they had the tradition of wearing boots, trousers and leather belts. It is also stated that woolen leather and fur formed the basis of Turkish clothing, and that clothing was also influenced by beliefs. These observations emphasize the importance of leather processing and clothing culture of Turks throughout history. Leather was not only a material, but also had a symbolic value and influenced the way of life of Turkish communities (Sakaoğlu & Akbayar, 2002).

Figure 2.2. Examples of Figures Showing Leather Clothing in Bahaeddin Ögel's "Introduction to the History of Turkish Culture".

Source: Sakaoğlu & Akbayar, 2002

Figure 2.3. Ottoman Leatherwork from the Topkapı Palace Museum.

Source: Sakaoğlu & Akbayar, 2002

Figure 2.4. Qur'an Cases from the Ottoman Period.

Source: Sakaoğlu & Akbayar, 2002

Figure 2.5. Handbags from the Republican Period Leather Production

Source: Sakaoğlu & Akbayar, 2002

The production of leather and leather goods is known as a widespread craft throughout Europe and was second only to the woolen textile industries from the early medieval period until the mid-eighteenth century (Kite & Thomson, 2006).

Among leather processing techniques, there are chemical-free alternatives to chrome tanning. However, these alternatives are higher in terms of application time and cost. Vegetable tanning is an original method for leather processing with origins dating back to 6000 BC. The cheaper and faster chrome tanning method was developed in the middle of the 19th century and soon became widespread in leather production. Vegetable tanning is a method using tannins found in trees and other plants to give leather durability, resistance to decay and flexibility. It is a traditional process passed down through families and requires high quality workmanship. The leather is processed by soaking in tannin-filled barrels for months. The leather processed with vegetable tanning has a thick, durable and biodegradable structure. However, this method implies that the final product will be more costly than chrome-tanned leather due to the labor requirements and process (Gopal, n.d.).

In the modern world, the global leather industry is sustained by the existence of the meat industry. Therefore, most of the leather produced worldwide is derived from animals such as cattle, sheep, pigs and goats. Given that cattle slaughter is approximately 300 million annually, the weight of such a by-product can have a huge environmental impact of 10-20 million tones if not utilized by tanners. Leather producers around the world have shown great success in transforming an unwanted and discarded by-product of an industry into one of the most desirable and widely used materials worldwide (Covington & Wise, 2019). This is an important topic of discussion in the assessment of industrial processes and consumption patterns in terms of sustainability and environmental impact.

Anthropocene refers to a period in which the effects of human activities on ecological systems and geological processes on Earth have become apparent. This term is used to emphasize the role of human influence in the geological history of our planet. The far-reaching effects of human impact on the biosphere, atmosphere, hydrosphere and geosphere increase the importance and complexity of this period. The concept of sustainability, on the other hand, refers to an approach that aims to use natural resources in a balanced way and to protect the environment, considering the needs of

future generations while meeting the needs of current generations. In the Anthropocene era, the sustainability debate has become increasingly important. With the increasing human impact, the depletion of natural resources, loss of biodiversity, climate change and other environmental problems have further increased the importance of the concept of sustainability. In this context, the sustainability debate addresses how strategies can be developed to reduce the impacts of human activities on the planet, conserve natural resources and maintain ecological balance. These strategies include innovative approaches in various fields such as energy transformation, waste management, environmental protection policies and sustainable agriculture. Environmental and ecological changes in the Anthropocene era emphasize the importance of the concept of sustainability. In this era, we as humanity must manage natural resources wisely and develop effective strategies to protect the environment, which is vital for the health and well-being of both current and future generations.

2.2. From Past to Present: Synthetic Leather

In the past, animal skins were prestigious symbols owned only by a limited number of people or groups. Royalty and wealthy elites were privileged to have access to this rare material. Today, however, excessive consumption habits have endangered our planet and all living things. When we think in terms of sustainability, the leather industry is not limited to animal and non-animal skins. We need to address the issue more comprehensively. It is insufficient to focus only on the production processes of leather materials. We must also consider factors such as the adoption of humane practices in the animal hide supply chain, the sustainability of production, the effective use of by-products of the food industry, the ethical tanning of raw hides up to the final stages and the improvement of the living conditions of production-related workers. Not only the consumption of leather products, but also the environmental impact of the production process, sustainability issues and social responsibilities must be considered. As consumers, we need to understand the different stages and impacts of this complex chain and act in a conscious way to support more sustainable options. This is important to respect both the protection of our environment and the rights of future generations. The production of raw materials for the fashion and luxury sector has a huge impact in terms of environmental degradation and damage to ecosystems and people. The challenge for fashion companies to compete on sustainability at the

same time as aiming for more profit is a major challenge due to the textile industry's dependence on chemicals, which are the main cause of environmental problems. Moving towards a more sustainable future requires the use of sustainable and long-lasting materials that lead to minimal emissions, this concept is not a new idea. However, some companies are having a negative impact on the industry by misleading customers with sustainability claims. Due to the development of state-of-the-art textile materials such as bio fabrication, leather substitutes or synthetic leather, precise quantitative data on long-term environmental impacts are limited (Muthu, 2020).

Synthetic leather has become a material that is rapidly gaining popularity in both fashion and industrial applications in today's modern world. This synthetic alternative to natural leather offers many advantages, but also raises some environmental concerns. Artificial leather is generally defined as a material produced without animal hides. This is a material that mimics the texture and appearance of leather. At first glance, it is quite similar to natural leather, but the manufacturing process and material differences make faux leather a different alternative. Many consumers turn to faux leather because of its animal protection and sustainability.

Synthetic leather is a synthetic material that goes through a longer production process compared to genuine leather. Faux leather is a type of fake leather. It is a synthetic material that imitates real leather and contains no animal by-products, so it can be an attractive alternative for vegans. The composition of faux leather can differ from natural and synthetic fabrics. The synthetic components used to create this material usually include PU or PVC. These components increase the durability of artificial leather, while at the same time providing properties such as water resistance and easy cleanability. However, it should be noted that artificial leather can contain natural fibres or be completely synthetic. The synthetic fibres determine the texture and appearance of the material, and this can vary depending on the intended use and design preferences. For this reason, faux leather has gained popularity in fashion and other industries as an alternative that does not contain any animal products and aims to limit environmental impacts. The use of synthetic components eliminates the possibility of harming animals, while contributing to sustainability goals. Therefore, faux leather plays an important role in enabling more industries to explore and adopt sustainable material options (Gopal, n.d.).

Synthetic leather is produced by chemical processes and industrial methods that are completely different from real leather. The most common method of production of synthetic leather is the bonding of a plastic coating onto a fabric layer. The types of plastic used in these coatings can vary and this can determine whether the product is environmentally friendly or not. PVC can still be found in the composition of some alternative leather products, although it has decreased, especially since the 1960s and 70s. PVC can release dioxins, which are potentially dangerous indoors and can become particularly hazardous if burnt. They are also used to make substances such as phthalates, which are used as plasticizers to make them flexible, and the use of these substances can be highly toxic depending on the type of phthalate used. A more modern and less environmentally harmful plastic is PU, which is constantly being developed to reduce its shortcomings, such as the dangerous toxins it releases during production and oil-based polymers that use fossil fuels. These developments reflect efforts to reduce the environmental impact of materials used in the production of alternative leathers (Gopal, n.d.).

2.3. Beyond Animal Hides: Vegan Leather

2.3.1. Sustainability and Veganism Concepts

Nutrition is one of the most basic needs for human survival. Humans, in this adventure they started as foragers, with the invention of sharp tools and the invention of fire, they switched to hunter-gatherer order. With this transition, they have taken important steps in providing food diversity in their diets. With the domestication of animals and plants, people who have settled down have gained the ability to supply their meals in advance and have been able to solve food shortages to some extent. Humanity has provided language and cultural interaction with the spread of wars and trade and has continued to develop and progress with the transfer of knowledge in these processes. As technology progressed, techniques that facilitated food production also developed and the machines that entered our lives with the industrial revolution accelerated this process. With the facilitation of living conditions, population growth has accelerated. This situation has led to changes in food content to facilitate food production and meet the needs of the population. As a result of industrialization and competitive pressure, the tendency to lose nutritional values in food products has increased. In addition, efforts have been made to produce food faster with various changes. However, foods

that have lost their healthy properties as a result of these processes have also caused ecological damage to the environment. Increasing industrialization and competitive pressure have caused many food products to lose their healthy properties and damage the environment as a result of cheap cost and fast production. This situation has led to people consuming more food than necessary and being exposed to various diseases. Among the different types of diets adopted worldwide and applied in daily life, there are various options such as veganism, vegetarianism, omnivorousness, carnivorousness. These diet types diversify within themselves and are practiced by different communities. Vegetarianism is a diet practiced by familial, religious, ethnic and cultural groups and is derived from the Latin word "vegetus", meaning "healthy, alive" (Genlik, 2022). The term vegan was used for the first time in 1944 by Donald Watson, one of the founders of The Vegan Society, and was defined in 1979 as follows: "It is a philosophy and way of life that avoids (as far as practicable) all forms of exploitation and cruelty to animals for food, clothing or other purposes, and at the same time supports the development and use of animal-free alternatives for the benefit of people, animals and the environment." This lifestyle, which can also be called veganism or veganism, aims to avoid harming animals and is based on the belief that animals do not exist for human use and exploitation. There can be many different motivations for adopting a vegan lifestyle. However, the common characteristic of all vegan individuals includes avoiding all animal foods such as meat (including fish, shellfish and insects), dairy products, eggs and honey, as well as avoiding materials of animal origin (wool, silk, leather, etc.), products tested on animals (cosmetics, detergents, toothpaste, etc.) and places that use animals for entertainment (Özyurt, 2021).

Veganism, often considered only as a narrow dietary regime, can overlook various nuances in people's relationship with animal consumption. Giving up the use of animal skins as clothing material is not equivalent to simply giving up meat, eggs and dairy products. Animal skins have different meanings that are not directly linked to food, because the human body interacts in different ways between clothing and food. In the words of Elspeth Probyn (2000), "food enters the body, then breaks down and leaves the body, and every time this happens our body is affected." This continuous cycle differs from animal skin, which is a more permanent substance. Instead of travelling through the body and exiting as waste, leather has a slower process of change. Leather

is a unique material with a distinctive smell, texture, color and even taste; it can also carry physical traces of the human or other bodies it comes into contact with. Because it has a porous structure, leather can absorb traces of the past more deeply. Therefore, to stop using or wearing leather may mean not only losing the physical properties of the material, but also losing the physical traces of other bodies (Hamilton, 2019).

In recent years, veganism has emerged as an important consumer point in the fashion industry. Vegan fashion products are highly visible, unlike other vegan products such as foodstuffs, and can be used as a communication tool for social interaction (Jeong & Chun, 2022). According to a 5,000-member trade group representing 70% of the UK retail trade, the terms "vegan" and "sustainable" should not be used interchangeably. In 2020, according to Grandview Research, the global value of the women's vegan fashion market stood at US$396.3 billion in 2019 and is expected to grow at a Compound Growth Rate (CAGR) of 13.6% during 2020-2027. In 2021, the Inter Press Service news agency reported that countries such as the United States, France, the United Kingdom and Germany have invested heavily in vegan products. In the United Kingdom, people have observed a 75 per cent year-on-year increase, while in the United States there has been an 11 per cent increase. According to the state of fashion report by Mckinsey (2017), 65 per cent of consumers in markets in India, South Africa, South Korea and other emerging markets prefer sustainable clothing. These same countries support movements organized by global non-profit organizations such as Fashion Revolution. Such initiatives have brought the fashion industry under the UN Sustainable Development Goals (SDGs). However, the growth of the market during the period 2021-2027 will face challenges due to start-up costs and rising inflation. Moreover, concerns about sustainability have increased following the pandemic, but only a small number of consumers are purchasing truly sustainable fashion products, creating an attitude-behavior gap. This attitude-behavior gap is based on intrinsic and extrinsic barriers. Furthermore, the demand for vegan womenswear is expected to increase due to cultural trends and current fashions. However, circular thinking and various environmental issues such as biodiversity and climate-friendly approaches support the progress of the sector (Baliyan & Diwan, 2021).

In today's business understanding, the concept of sustainability has become extremely important because it aims to meet the needs of the present generation without impairing the needs of future generations. Problems such as industrial production

polluting natural water resources, global warming, soil and air pollution cause serious environmental pressures in industrial enterprises (Bayramoğlu, 2019). Sustainability aims to act to meet current needs without harming the needs of future generations. In this context, sustainability definitions are usually derived from the intersection of a firm's economic, social and environmental objectives. The economic dimension assesses whether the economic needs of stakeholders are met effectively and efficiently, while the social aspect focuses on issues related to human rights and employee health and safety. The environmental dimension focuses on environmental issues such as minimizing waste, reducing emissions and protecting natural resources. Consumers' perceptions of companies' sustainability practices are an important factor that can influence consumers' attitudes, intentions and behaviors. Consumers expect sustainable products and services from companies that do not harm the environment and society. However, a sustainable business model is not only limited to environmental efforts but can also be financially successful. According to research, approximately 60% of companies that have transformed into a sustainable business model are financially profitable (Güney, 2020).

The question to be asked is: Is vegan leather sustainable? Vegan leather is usually produced using synthetic or plant-based materials. In many cases, such as in fast fashion examples, vegan leather is produced with materials such as PU or PVC. However, since these materials are of plastic and petrol origin, they are not considered the most environmentally friendly options. Consumers who prefer vegan products often look for assurances such as certification, labelling or registration. These criteria aim to reassure consumers that vegan products meet certain standards. Phrases such as "sustainable," "biodegradable" and "circular" can lead to confusion due to a lack of precise definitions. It can therefore be misleading to claim that a product is automatically sustainable simply because it is "vegan". Although the production processes of many vegan brands are generally sustainable, a holistic definition of sustainable fashion should be considered in more detail given the complexity of these terms (Jeong & Chun, 2022). According to PETA, vegan fashion represents any type of "cruelty-free" clothing. This means that no feathers, wool, fur, silk, leather or other animal-derived fibres are allowed. Vegan fashion is becoming increasingly important, considering not only animal welfare, but also the environmental damage of the fur trade and animal agriculture. Vegan fashion reflects a way of life and philosophy that

includes all aspects of life. Many people have begun to adopt an animal-friendly lifestyle as a result of unnecessary suffering and destruction. According to the Clothing Resources Business (2020), veganism is on the rise not only in the food industry, but also in the fashion industry. Some leading brands have contributed to this change by abandoning the use of fur, such as Versace, Gucci, Burberry and Chanel. This shows that consumers' demands are becoming more conscious (Baliyan & Diwan, 2021).

According to the report of New India Express (2021), sustainable fashion is becoming a fast-growing trend in the fashion world because it is a fact that an ethical lifestyle makes the world a place with less guilt in all aspects of fashion, shopping, travelling and construction. Sustainable fashion specifically aims to reduce the environmental impact of clothing, focusing on biodegradable or recyclable fibres and keeping carbon emissions to a minimum. However, many sustainable businesses still use materials such as cashmere, wool, leather and silk, which limits their ability to be labelled as vegan. Designers in the global fashion industry are shaping the fashion of the future that reduces pollution worldwide by utilizing food waste, plant waste and textile waste. According to the Good Housekeeping Institute (2020) report, ethical or sustainable fashion focuses on five main issues in the fashion industry: water use, hazardous chemicals, short product life, waste management and agriculture. A research report published by Forbes (2020) shows that 88% of consumers want brands to produce more environmentally friendly products. However, if the fashion industry continues its current path, it is expected to account for 26% of the global carbon footprint by 2050. Considering the long-term effects of COVID-19 worldwide, there has been an increase in awareness and demand for environmentally friendly and vegan products, which has contributed to the growth of the apparel category (Baliyan & Diwan, 2021).

2.3.2. History of Veganism

Although the origins of vegetarianism cannot be determined exactly, it is thought to date back to ancient times in European and American history. Since the beginning of some major religions such as Hinduism, Buddhism and Jainism, there has been an understanding of vegetarianism for health and ethical reasons. Many religions have rules emphasizing good treatment of animals. Empedocles, who was a vegetarian in the 5th century in the pre-Islamic period, stated that not killing other living creatures was a virtue. The recorded history of vegetarian diets in Europe can be traced back to

the 6th century with the Orphaeans who did not eat meat in Ancient Greece. In this religious group, the consumption of animal-based secondary foods is avoided (Özyurt, 2021). Vegetarianism is an ancient dietary style dating back to Pythagoras, but there is not enough information about vegetarianism in Europe between the ancient Greek era and the 16th century. From ancient Greece to the present day, the views of vegetarianism and veganism have undergone various changes. Pythagoras is considered the pioneer of vegetarians who refused to eat meat for ethical reasons. Philosophers and thinkers, like Pythagoras, have argued that animals should not be killed for food and that dead meat pollutes the soul (Genlik, 2022). In the 19th century, many scientists and philosophers, influenced by the Greek mathematician and philosopher Pythagoras, who is considered the father of ethical vegetarianism, adopted a vegetarian lifestyle. Pythagoras is thought to have had a moral opposition to meat consumption based on his belief in reincarnation. Artists and scientists of the Age of Enlightenment, such as Leonardo da Vinci, adopted a vegetarian diet. Leonardo Da Vinci said, "The time will come when we condemn eating animals, just as today we condemn eating our own kind, eating human beings." During the Enlightenment period, thinkers such as Montaigne, Tyron, Rousseau, Voltaire and Wesley made critical comments on the mistreatment of animals. This understanding against the use of animals, which dates to the prehistoric times, may have defined a way of eating that describes veganism, such as the definition of vegetarian in the 1830s. The vegetarianism defined in the 1830s referred to a comprehensive diet similar to today's veganism, in which no animal products were used. Until today, the reasons for vegetarianism have been shaped under the influence of cultural, religious, familial and ethical factors. The Vegetarian Society, founded in 1847, allowed its members to consume dairy products and eggs while the definition of vegetarianism was not yet clear. During this period, there were debates on whether vegetarianism included the consumption of dairy products and eggs. After the First World War, these debates continued until Donald Watson founded the Vegan Society in 1944 (Özyurt, 2021). The term vegan emerged as a result of a dispute about dairy products in the British Vegetarian Society and was coined by Donald Watson. In 1985, the European Vegetarian Association was established in Belgium and introduced the V-Label logo to reduce uncertainties in products and services used by vegan and vegetarian individuals. In Turkey, Vegetarian Day started to be celebrated in 2010 with the efforts

of the Vegetarian Club. Veganism is a dietary style motivated by different factors such as ethics, health, culture, religion, ecology and taste. Worldwide, vegetarians and vegans make up 8-9%, 40%, 6-7%, 3-4% and 4% of the populations of Germany, India, Italy, the United Kingdom and the United States, respectively, while in Turkey this rate is below 1% of the general population. Lifestyle is the characteristic life that an individual prefers and lives. It includes a life shaped by distinctive values, behaviors and attitudes defined by sociologists in the context of the transformation of personal and social identities (Genlik, 2022).

Veganism has emerged as a diet, lifestyle and identity element that goes back to historical depths. This approach, which has been adopted for different reasons since the beginning of some major religions, has become easily accessible to information with the development of globalization and communication technologies, which has triggered change at the individual and social level. These factors have been effective in the spread of vegan thought in recent years (Özyurt, 2021). Lifestyle came to the fore as an area of transformation and struggle in the 1960s and 1970s, and such movements began to be analyzed and evaluated by scholars. In the 1980s, veganism as an identity and lifestyle caused various debates within the animal rights movement. In 1981, activists Myver Samra and Matthew Perry adopted veganism as the ideal lifestyle and emphasized that an individual's lifestyle should be consistent with their ideals. A society's lifestyle, beliefs and traditions guide its behavior and influence its way of life, determining how it views living creatures and nature. In line with this orientation, the attitudes of society and individuals towards animals are shaped. While animals are worshipped in some societies, in some societies animals can be seen as property. This situation is formed under the influence of the culture of the society and continues to be passed on to new entrants through cultural learning. For example, Hindus tend to see veganism as a moral lifestyle. In societies where meat consumption is widespread, individuals who choose a vegan lifestyle may sometimes be recognized and this may be reflected in their social life. In patriarchal and affluent societies, meat consumption can often be seen as a symbol of power, which is an example of the difficulties faced by those who adopt a vegan lifestyle in these societies (Genlik, 2022).

After the 2000s, the vegan lifestyle movement has grown significantly, and its scope has expanded over time. The relationship between human and ecology until today is characterized by a series of developments such as living in harmony by learning nature,

sensitivity to environmental pollution problems, awareness of environmental pollution and increasing awareness efforts. Various studies have been carried out to investigate the environmental problems experienced with environmental awareness and to improve or eliminate these problems. The replacement of anthropocentric thinking with the idea that humans are a part of nature is a part of this evolutionary process. It is possible to say that ecocentric and anthropocentric approaches have led to an increase in the vegetarian and vegan population. According to the anthropocentric approach, factors such as health, taste, economic status, social anxiety, religious views are effective, while according to the ecocentric approach, factors such as animal ethics and ecology lead people to veganism and vegetarianism. Veganism is a lifestyle and an example of activism that individuals live according to their social and political values. The reasons why individuals prefer veganism may include differences. Reasons such as health, ethical reasons, ecology, environment, culture, taste, belief can have an impact on individuals' preferences and are usually not limited to a single reason. In general, people who choose a vegan diet adopt this preference as a philosophy of life and attach importance to issues such as environment, animal rights and sustainability (Genlik, 2022). In recent years, there are many factors that affect the spread of veganism and lead individuals to become vegan. Among these factors, factors such as increased awareness of the individual and social risks of meat consumption and ethical reasons arising from respect for animals come to the fore. Globalization and the development of communication technologies trigger individual and social change by providing easy access to information (Özyurt, 2021).

The concept of culture refers to the common behaviors, views and values of the society. Culture consists of behaviors that are subsequently learned and shaped depending on the society in which they live and is in constant change. The influence of culture is also observed in food choices. Culturally, there are different cultural elements such as the fact that cattle, which are consumed as food in many countries, are considered sacred in India, meat consumption is accepted as a masculine behavior in patriarchal societies and meat consumption is perceived as a status indicator in developed societies. In addition, meat consumption is considered as a social activity in some social cultures. In this context, behavior towards animals is often shaped by cultural learning. For example, although dogs used as gifts are not accepted in some countries, there are different cultural practices such as consuming dogs as edible food

in other countries. There are rituals related to the use of animals in various religions. There are practices of animal sacrifice during religious celebrations such as thanksgiving and sacrifice festivals. In ancient Greece, animals were sacrificed to gods, in Japan to gods and the dead, and in China to gods and ancestors. In Turkey, while individuals sacrificed horses before the adoption of Islam, livestock such as calves and cattle were sacrificed after Islam to fulfil religious rituals. Religions such as Hinduism, Buddhism and Jainism teach good behavior towards animals. For ecological reasons, it is seen that people tend not to use these products to protect nature, opposing the environmental damage caused by the animal product sector (Genlik, 2022). In recent years, there are several factors affecting the spread of veganism. These factors include increasing knowledge about the individual and social risks of meat consumption, ethical concerns about animal welfare, and global climate crises. Globalization and the development of communication technologies encourage change at the individual and social level by providing easy access to information. With social media at the center of our lives, vegan thought has found the opportunity to express itself more effectively than ever before. In this context, it is predicted that in the near future, individuals' prejudices against veganism will decrease and the number of individuals who prefer a life free from cruelty towards animals and ecologically sustainable will increase. Due to Turkey's cultural and religious values, it is observed that the veganism movement is developing at a slower pace in our country (Özyurt, 2021).

Livestock breeding is an important cause of environmental pollution. The mixing of fertilizers into streams damages ecosystems by reaching rivers, lakes and coasts worldwide. Although the negative effects of agriculture on ecology are known, there is a significant increase in the need for feed to sustain animal husbandry as a result of increasing meat demand and animal production. This situation leads to the opening of new agricultural lands, destruction of meadows and forests and damage to the ecological system. By 2050, with the expected population growth, the demand for animal products for a population of 9 billion 600 million is expected to increase by 70 per cent. In order to meet this demand, mass production animals are raised in meat production farms, and this leads to a large consumption of fossil fuels. While the use of fossil fuels causes air and water pollution, it is known that each cattle produce at least 60 ml. of methane gas per day. This situation leads to the extinction of plant and

animal species and is one of the main causes of the climate crisis. In particular, 70 per cent of Amazonian forests have been destroyed for livestock and fodder cultivation. Industrial meat production is one of the most important factors affecting global warming. The United Nations' 2006 report "The Long Shadow of Livestock: Environmental Challenges and Options", greenhouse gas emissions from animal food production account for 18 per cent of total emissions worldwide, which is more than the amount of carbon dioxide emitted into the atmosphere by cars, planes, ships and trains worldwide. According to studies, the greenhouse gas emission from livestock is in the form of methane and the impact of this gas on global climate change is 86 times higher than carbon dioxide and 268 times higher than nitrous oxide. In addition, according to the United Nations report, the livestock sector causes biodiversity loss, soil degradation, climate change, air and water pollution, biodiversity and many other environmental problems (Özyurt, 2021).

The dietary habits of individuals and communities directly affect how they define nature, life and animals. As well as being effective in determining daily life practices, dietary patterns also bring about different approaches among people. Veganism is not only a way of eating, but also a lifestyle that encompasses all areas of life. Vegan lifestyle is considered as an effective strategy in combating climate change. Although the vegan lifestyle is not expected to completely solve ecological problems, it is thought to play an important role in this struggle. The shaping of vegan identity, as in other identity elements, is related to the individual's self-awareness and self-expression. It is a phenomenon that is generally not innate, developed and learnt as a result of the individual's interactions with other people and groups. Vegan individuals grow up with certain identity elements that are mostly associated with the environmental and cultural values they are born with. However, over time, they adopt a vegan identity for various reasons in line with their personal development and preferences (Özyurt, 2021). The increase in consumption and environmental problems today is directly proportional to population growth. This increase in consumption also leads to an increase in the industrial use of animals, which are part of nature. In this context, veganism is a lifestyle motivated not only by ethical reasons but also by criticism of industrial animal husbandry, health and environmental protection. Moreover, changes in consumers' eating habits and lifestyles show an increasing trend. Consumers demand certain features in their clothes, such as sustainability. Although

the definition of veganism is generally adopted worldwide, there are differences in behavioral intentions and attitudes, consumer purchasing decisions and behaviors in different cultures (Güney, 2020).

2.3.3. Vegan Leather

Human-nature relationship has existed since the first periods of life. However, with technological developments and population growth, human-nature harmony has started to deteriorate. With the industrial revolution, this incompatibility has accelerated and increased. As a result of this ecological damage, problems such as global warming, extinction of animal generations and depletion of natural resources have emerged. In the face of this incompatibility, it is thought that changing lifestyles can prevent the current deterioration. Vegan lifestyle is an accepted understanding in this context. Vegan individuals believe that their preferred consumption approach will minimize damage to ecology, prevent natural disasters caused by the animal industry, and reduce world hunger through the resource utilization of the animal product industry. Veganism is a rapidly growing economy as well as a growing trend. An increasing number of vegan individuals adopt this philosophy as a lifestyle and shape their preferences within the framework of values such as ecology, health, prestige, ethics/animal rights, taste/flavor, social environment (Genlik, 2022).

Leather, which has been used by humans for thousands of years, was originally made from the skins of hunted animals and has been used for various purposes such as clothing, footwear, shelter, parchment and military equipment in different cultures. Today, leather is generally obtained from the skins of animals raised and slaughtered for meat production. Some consumers and the leather industry suggest that leather is a 'by-product' of the beef and dairy industry, arguing that the production and use of fabric is a form of recycling or waste management. The argument that the use of leather, fur and feathers worn by humans are 'by-products', like the raising of animals for their meat, has been used to justify their use since at least the nineteenth century. Some vegans argue that leather is a 'co-product' of a wider industry based on the commodification of animals (Hamilton, 2019). The leather sector constitutes an economically high value-added market within other fashion industries. However, this brings with it some concerns. The processing and consumption of leather products is known for its environmental impacts. Large amounts of water and energy are

consumed to produce leather products, and they are also subjected to chemical processes. Obtaining the skins of animals also raises serious concerns in terms of animal rights. In recent years, sustainability and environmental concerns have come to the fore, which has started to affect consumer preferences. In this context, as an alternative to traditional leather, synthetic leather types known as "vegan leather (plant-based leather)" are produced using plant-based materials. Vegan leather is increasingly preferred because it does not require the use of animals and is more environmentally friendly compared to traditional leather products. Therefore, there may be a major transformation in the leather industry and consumption in the future. This transformation may be shaped by increased environmental concerns, increased sensitivity to animal rights and sustainability requirements. The development and adoption of alternatives such as vegan leather will play a major role in how the leather industry evolves in the future (Good Design, n.d). Labelling leather as a 'by-product' is a concept that aligns with philosopher Chloë Taylor's (2013) Western ethic that 'prescribes the use of the bodies of dead animals so that their deaths are not in vain'. This approach argues that 'waste' is the ultimate act of disrespect towards a dead being. Therefore, killing animals can be justified and even encouraged as long as their bodies are used for human purposes. This is in stark contrast to the prevailing view of Western ethics, which emphasizes the sanctity of the human body, argues that we should not make full use of it after death, and suggests that this use should not include its use as food for other beings, not just humans (Hamilton, 2019).

Environmental ethics and sustainability concerns are leading many people to re-evaluate their consumption habits, diet and lifestyles. Increasingly, this change is taking place as a result of an awareness that traditional materials have environmental and ethical implications. In addition, ethical concerns associated with the exploitation and use of animals are leading to greater popularity of campaigns to end these practices. These factors are leading people to reconsider their consumption habits, diet and lifestyles, seeking alternatives that are environmentally friendly and based on ethical values. Vegetable "vegan" leather, as the name suggests, is a type of leather produced with a different approach than animal leather. This type of leather is produced using different plants such as apple, corn, pineapple, banana, cactus, green tea, coconut, as well as mushrooms themselves and their waste. Vegan leather eliminates the need to raise and kill animals involved in the production processes of

traditional animal leather, while at the same time it does not require the harmful chemicals and processes used for tanning leather. Vegan leather is a completely non-exploitative, vegan and egalitarian product, despite having an appearance and texture similar to traditional animal leather. These characteristics provide an option that both respects animal rights and offers a suitable alternative for people with different lifestyles. In the future, vegan leather has the potential to become a more favored material both in fashion and in terms of sustainability. Synthetic leather alternatives began in the nineteenth century with the discovery of the first synthetic product to replace animal leather. Since then, people have worked on leather alternatives that are not derived from animals and have endeavored to improve the quality, durability and efficiency of these alternatives. However, most synthetic leather alternatives are made from plastics. These materials have environmental impacts, do not come from sustainable sources and do not biodegrade in nature. Therefore, although these alternatives prevent the exploitation of animals, they are environmentally inadequate and cannot be considered a sustainable option. Vegan leather offers a more environmentally sustainable alternative to these synthetic options. The plants used in vegan leather production are biodegradable and do not harm the environment. In addition, vegan leather offers a quality and durability similar to leather derived from traditional animal leather. Therefore, vegan leather is seen as a better option in terms of both animal rights and environmental protection (Prev Blog, 2023).

Growing concerns over the environmental impact of traditional leather is a key factor driving the rise of vegan leather. Current versions of vegan leather may have a shorter lifespan compared to traditional animal-based leather and may also be less resistant to heat and moisture. However, this should be seen as an opportunity to encourage further innovation in the sector. Concerns about the sustainability of vegan leather will stimulate technological development in the leather industry to create more sustainable materials that are less susceptible to wear and tear. In the future, research and development is expected to progress rapidly to improve the durability and reduce the environmental impact of vegan leather products. The vegan leather industry is poised to play a leading role in promoting the use of sustainable and environmentally friendly materials and increasing environmental responsibility. The quality and durability of vegan leather products will continuously improve to further respond to consumers' environmental concerns (Gopal, n.d.).

The first Vegan Fashion Week was organized in Los Angeles in 2019. This event was part of a conscious effort to develop and promote leather alternatives and to reduce the trade in traditional fur and exotic leather. In the same period, sustainable fashion weeks were organized for similar purposes, highlighting important values such as sustainability and recyclability. These events demonstrated the significant rise of innovative materials such as pineapple leather, mushroom leather, cactus leather, apple leather in the fashion world. Recently, there have been notable changes in the world of sustainability and vegan fashion. Leading footwear brand Dr Marten's has seen a staggering 279% increase in sales of its vegan boots. Global sportswear giant Reebok has contributed to the vegan fashion trend by announcing the launch of its first plant-based performance running shoe. Such collaborations embrace sustainability by enabling the transformation of ordinary waste into environmentally friendly and aesthetically appealing products. However, in response to the growing demands for sustainability and veganism, some certification bodies have launched new standards and guidelines to verify businesses in the fashion industry (Gopal, n.d.).

In March 2024, during Victoria Beckham's Paris Fashion Week show, the fashion show was disrupted by animal rights activists on the catwalk to protest her brand's use of animal products, such as leather. PETA, an animal rights organization, said that although Victoria Beckham has banned the use of fur and exotic skins in her collections, she continues to use leather, including calfskin. "No piece of clothing or accessory can justify the cruel killing and skinning of a sentient and intelligent animal," said Mimi Bekhechi, PETA's Vice President for Europe, in a statement. "We urge Victoria Beckham to turn to alternatives such as high-quality leather made from materials such as apples, grapes, pineapples, mushrooms, which are among the ethical and environmentally friendly innovations available today," Bekhechi added. PETA activists have previously protested the catwalks of brands such as Coach in New York, Burberry in London and Fendi in Milan (Victoria Beckham's Paris Fashion Week Show Stormed by Animal Rights Protesters, 2024).

Figure 2.6. Victoria Beckham's Paris Fashion Week Show Stormed by Animal Rights Protesters.

Source: CNN.

https://edition.cnn.com/2024/03/02/style/victoria-beckham-peta-protesters-paris-intl/index.html

2.3.4. The Concept of "Leather"

The term "vegan leather" or "artificial leather", especially used by shoe, bag and furniture manufacturers, can be misleading in some cases (Muthu, 2020). According to the 'Oxford Dictionary', the term "leather" describes a material obtained by tanning or other processes. Leather is made from animal skins. In this context, materials produced from synthetic or natural cork are not called "leather" (Gopal, n.d.). The word "leather" is not a terminologically correct term for plastics such as PU and PVC, such as petroleum-based synthetic materials, as it is a term describing materials of animal origin. Therefore, the use of more accurate and transparent terms in terms of materials is important for a sustainable consumption approach (Muthu, 2020). The term "vegan leather" is often used by marketing experts to emphasize the quality and usefulness of materials offered to vegan consumers as an alternative to real leather. The term "vegan leather" may initially seem like a contradiction, because it contains a contradiction. However, this term refers to a leather-like fabric made from a variety of plastic and vegetable materials, which is used instead of animal skin. Vegan leather aims to

provide an animal-free and sustainable option (Gopal, n.d.). But it cannot be considered a "leather". The differences between leather and leather alternatives are both material and ethical. Sensitivity to terminology is important to provide consumers with accurate information and set the right expectations. Therefore, referring to vegan leather as leather is questionable in terms of clarity and accuracy.

3. CHAPTER: LEATHER VS. LEATHER ALTERNATIVES

3.1. Advantages and Disadvantages of Leather

Leather not only provided warmth and comfort during the cold seasons but was also used as a means of communication long before the invention of paper. In addition, the skins of hunted animals provided shelters that protected people from bad weather conditions. The way leather materials were used conveyed to the individuals who used them an important sense of value and status within the community. Historical studies show that in past societies, only people with a certain amount of wealth could buy products made of leather, for example boots or leather scrolls used to store information.

Leather stands out as an indispensable material for craftsmen and designers because it has a wide range of uses both indoors and outdoors and has a number of desirable properties. These unique qualities make leather favored in the production of clothing, footwear and other apparel. Leather stands out as a material that can breathe, especially thanks to its hydrophobic structure, but at the same time it can keep moisture out. The physical and chemical composition of leather increases its durability and enables it to be used in the production of many products. However, the durability of leather may vary depending on the source of its raw material, the applied process, the tanning process and its thickness. At the same time, leather has a high aesthetic value; its general appearance, texture, color and smell make it a preferred material. The differences between genuine leather and synthetic leather are often compared. Synthetic leather may be similar in appearance to real leather, but it cannot match real leather in important properties such as resistance and tactility. These differences are achieved by subjecting the leather to various processes and preventing decay. Leather acts as an insulation that protects people against cold weather conditions, making it ideal for use during the cold winter months throughout history. Genuine leather does not harm the environment, does not biodegrade and does not pollute the environment. Therefore, it has no negative effects on both human health and the environment (Rines, 2020).

Today, it is a fact that the world population exceeds 7 billion 924 million people and those who adopt a vegan lifestyle are in the minority. For this reason, animal hides and skins continue to be processed into different areas of use. The 9-10 million tons of animal hides and skins obtained from the meat industry worldwide will be released into the environment as organic waste if these materials are not transformed into leather products. This would create a larger carbon footprint compared to the processing and consumption of leather materials today (Good Design, n.d.). The leather sector has been of increasing importance in the Turkish economy since the 1970s. This sector provides net foreign exchange inflow to the country, especially due to its activities based on foreign trade and tourism. At the same time, the leather sector, which requires a large labor force, is a large area with the potential to create employment. Due to the high added value of its products, the sector is important in terms of exports and has a share of 2% in the total manufacturing industry and a share of 1.5% in total employment. With an annual leather processing capacity of 400.000 tones and 1200 companies, it is considered as one of the tenth largest industrial sectors in Turkey. According to 1999-2000 economic data, the leather sector ranks in the top five in the distribution of investment incentive certificates and among the sectors operating at full capacity (Cengiz, 2002).

It is known that developed countries have shifted their leather tanning and processing processes, which is a labor-intensive industry, to developing countries due to increasing production and labor costs and the high costs of environmental protection measures. The chemicals used in these processes are mixed with nature and cause working conditions that threaten the health of the processors. Many industrial countries, including Turkey, have started to control leather production and processing processes with ecological certificates. However, the leather industry is still an important economic source of the $1.3 trillion fashion industry, and this raises a serious waste problem, both due to the utilization of unused leather pieces in the production process and the high volume of objects such as unsold clothing and accessories that cannot be put into use or whose value has decreased. Leather products, despite their long-life span, cannot maintain the market value determined at the end of each season due to the need to be compatible with rapidly changing fashion trends and lose value at end-of-series sales points. The three pillars of the principle of sustainability, i.e. the cyclical relationship between nature, people and economy, can

be seen concretely in the leather industry (Good Design, n.d.). Chemical substances, which are used for a better standard of living, stand out as substances that disrupt the ecological balance, pose serious dangers to the health of humans, plants and animals, and whose effects are increasing in addition to some of their benefits. These chemicals, which are used for different purposes, harm workers working in factories on the one hand, and on the other hand, they adversely affect all living organisms and ecosystems by causing pollution of air, water, soil and food as a result of industrial wastes and non-industrial uses. It is a fact that there are millions of chemical substances and not all these chemical substances harm human health. However, it is known that most of these substances have properties such as explosive, oxidizing, irritating, carcinogenic, mutagenic and environmental pollutants. Toxic gases used in the industrial sector can cause asphyxiating, toxicity or irritant effects and the number of industries where such chemicals are used intensively is quite high. The leather industry, which operates in nine provinces in Turkey and is considered to be the tenth largest industrial sector in the country, uses such chemicals intensively (Cengiz, 2002).

Although developments in the field of technology offer many innovations and conveniences, some important problems have emerged in parallel with these advances. One of the most prominent of these problems is environmental pollution. Pollution seriously threatens the future of people living in the world and this threat is increasing day by day. The role of chemicals in environmental pollution is quite large, especially considering that many of these chemicals have explosive, toxic, polluting and carcinogenic properties, the problem becomes even more urgent. There are currently over 8 million chemicals, of which about 80,000 are actively used. However, it is very difficult to determine precisely how many of these are harmful to humans and the environment. Scientific research shows that our world is rapidly under threat. In this context, the problem of environmental pollution due to the leather industry is multifaceted. Solid, liquid and gas wastes of the industry, pollution of water, accumulation of heavy metals in soil and air pollution are the main causes of environmental pollution and this is the first dimension (Cengiz, 2002). The leather processing industry is recognized as an important financial sector in many countries. However, the different and stringent contamination from the wastewater of tanneries has become an issue of increasing environmental concern. The unregulated disposal and dumping of these wastes create areas of high potential for environmental

contamination. This poses a growing threat to living organisms and environmental health. Tannery wastes are recognized as one of the primary sources of environmental concern. Wastes generated in agriculture, transport, mining, industry and energy sectors are among the major threats to environmental health. Tannery wastes have the highest toxin content among these wastes. Tannery operations are intensifying in developing countries in order to respond to and meet the needs of modern society. In the period 1970-1995, the production of light leather products increased from 35 per cent to 56 per cent, while the production of heavy leather products increased from 26 per cent to 56 per cent. The terms light leather and heavy leather are generally used according to the thickness of the leather. Light leather usually refers to thin and flexible leather types. This type of leather is commonly used in clothing, footwear and fine leather products. On the other hand, heavy leather refers to types of leather that are thicker and tougher. These leathers are often used in the production of durable and lasting products such as furniture, bags and belts. Therefore, light leather is usually softer and more supple, while heavy leather tends to be more durable and harder. The leather industry plays an important role in the human lifestyle. While animals such as cows, oxen, alpacas, bison are raised for milk, transport, freight transport and other purposes, the resulting hides are seen as a valuable resource by leather producers. However, due to tanning processes, tanneries can dispose of wastewater without harming the environment by using wastewater treatment technologies. Various reports claim that the chemicals used in tanneries cause environmental pollution in this industry due to their toxic properties. Tannery wastes contain highly toxic pollutants, and these pollutants are known to damage the environment. Since these pollutants cannot be effectively removed by wastewater treatment processes, they cause environmental problems. The content, color and components such as toxic metals in tannery effluents complicate the degradation of these wastes. It is important to implement more sustainable and cleaner wastewater treatment technologies to help reduce the environmental impact of tannery wastes. Furthermore, with increasing water demand and diminishing water resources, saline wastewater is known to pose a serious problem by reducing soil fertility. Therefore, it is important to treat tannery wastewater properly and reduce its negative impacts on the environment (Muthu, 2020). Tannery effluents must be effectively treated before discharge to surface waters. Wastewater treatment strategies may include mechanical pretreatment,

physico-chemical treatment and biological treatment. These processes can be applied on-site or off-site and are intended to reduce the negative impact of wastewater on the environment. These treatment processes are critical for environmental sustainability and play a major role in protecting environmental health. Therefore, tanneries apply these techniques to control their effluents and emissions. This helps to ensure compliance with environmental norms and regulations and contributes to environmental protection (Emission Scenario Document on Leather Processing Industry, 2004).

The tannery procedure consists largely of three main stages: pre-tanning, tanning and post-tanning. During the pre-tanning process, the raw leather/skins are subjected to various treatments such as soaking, calcination, descaling, pickling and degreasing. In this process, many chemical compounds such as pesticides and detergents are released into the environment with the wastewater generated by the pre-tanning process. In addition, the tanning process is divided into three main types: vegetable tanning, chrome tanning and combined tanning. During the tanning process, harmful salts such as chromium, zirconium and aluminum are used, which can cause various harmful health effects and environmental concerns. A combination of vegetable oil, sulphated oil, mineral oil, epsom and glucose is used for the tanning process, which is very difficult to break down during tannery wastewater treatment. In the post-tanning process, the tanned leather is cut and turned into a fine leather. In addition, the last stage of leather processing is finishing. During the finishing process, which is one of the hazardous wastes according to environmental criteria, various resins, pigments, waxes and binders are used. The effects of the chemicals produced during these processes on natural habitats should be considered (Muthu, 2020). Tannery effluents contain many different constituents and are analyzed for a variety of parameters including pH, BOD (Bio-Chemical Oxygen Demand), nitrogen, sulphides, suspended solids, settleable solids, gross solids, fats, oils and greases, heavy metals, dyes and toxic chemicals. The generation of chromium-containing wastewater poses a major threat in terms of environmental problems. Chromium is a highly toxic compound, and it is common practice to dispose of chromium-containing materials in landfill in many countries where landfills are limited. Air emissions are often associated with the use of vitality, but the use of natural solvents and dyes can also contribute to air emissions. Approximately 8-9 million tons of fresh animal hides are produced each year and about

1.4 million tons of soil waste is generated during this process. Strong waste measurements and results can be provided for each tone of crude oil preparation. The segregation and safe disposal of strong wastes, especially those containing chromium and sludge components, is often expert-led and costly. However, waste minimization is necessary to reduce the pollution load from tanneries. About 15 per cent of solid waste from tanneries is a mixture of both solid and liquid materials, of which 29 per cent is in liquid form. Many chemicals such as formic acid, chromium oxide, sodium chloride, ammonium sulphate and sulphuric acid are used in leather processing. In addition, chemicals such as HCl, caustic soda, formic acid, chromium, sodium arsenite, soda ash, sulphuric acid and arsenic sulphate are used in soaking, liming, tanning and similar tanning processes. After each process, water is used for cleaning and washing the chemicals and machinery. Most of the solid waste is generated from the processes of cutting, grinding, polishing, drying and packaging of animal skins or hides. It has been observed that about 56% of the waste from tanneries is black in color with solid and liquid components, resulting in the emission of an unpleasant odor. Furthermore, disposal of tannery waste without proper treatment has the potential to cause health problems such as skin diseases, diarrhoea, dizziness, asthma, fever and respiratory problems. However, it also creates various negative impacts on the environment and may adversely affect aquatic life and other living organisms (Muthu, 2020). Some chemicals used in the leather industry carry the risk of destruction of the entire ecosystem. Some of these chemicals can cause great damage to plants if they are found in very low amounts even in soil. Burying industrial wastes in the soil can lead to extremely dangerous consequences. In soils irrigated with water contaminated with wastes of chemicals used in the leather industry, the concentration of toxic substances may increase over time. This situation may adversely affect the whole ecosystem and may seriously threaten natural habitats in the long term (Cengiz, 2002).

The leather industry is classified as one of the industries that cause high levels of environmental pollution due to the use of large amounts of water and various chemicals in the tanning process and the formation of various solid, gaseous and liquid wastes. These wastes have various characteristics that are generated during the application of different chemicals to raw hides. Solid wastes generated in tanneries mainly include salts, raw trimmings, hair waste, meats, splitting waste, chrome chips, polishing powders, shell trimmings and finished trimmings. These solid wastes and

by-products, if not properly treated or disposed of, can damage soil and groundwater, as well as release odors and toxic greenhouse gas emissions into the atmosphere. While the tanning industry generates a significant amount of solid waste and effluents, environmental concerns are becoming an increasingly serious issue with increasing costs of discharge and storage. While a large amount of solid waste is generated at different stages of leather processing, there is no established effective utilization method for this waste, which presents a problematic situation for tanners. In general, the leather industry generates about 800 kg of solid waste per 1000 kg of raw leather production, of which only 200 kg is raw material. Worldwide, about 600,000 tones of solid waste is generated annually by the leather industries (Yorgancıoğlu et al., 2020). Producing an estimated average of 45-50 m2 of waste liquid and 800 kg of solid waste per ton of raw leather, the leather industry involves the use of lime, sodium sulphide, ammonium salts, sulphuric acid, chromium salts and other polluting chemicals such as vegetable tanning materials in the tanning industry. The release of these chemicals into the soil causes many leather industries to release raw water into the soil, affecting soil fertility. The global leather industry accounts for more than one billion by-products (hides and skins) from the meat industry each year. Moreover, given that animals are exposed to overcrowded and confined conditions during meat production, this industry raises ecological and ethical concerns (Liao & Solatorio, 2019).

In the past, tanneries were established outside the residential areas, and the necessity to meet the need for water cleaning throughout the year was effective behind this decision. While the use of stream waters for soaking leather caused water pollution in the period, today the meeting of industrial wastes with streams and rivers causes water pollution. Water from industrial plants is considered as directly harmful wastewater due to the harmful substances they contain. On the other hand, the mixing of detergents mixed with nitrogenous and phosphorus fertilizers with water causes harmful wastewater indirectly. Sources of water pollution include industrial plants, power plants, residential areas, households, small businesses, fertilizers, pesticides and farms producing animal waste. In addition, organic pollutants are substances that pollute water by depleting the dissolved oxygen of water. Such pollutants are usually introduced into water by human impact and if the water flow is insufficient, these substances accumulate at the bottom of the water. For plants and animals living in water to survive, the oxygen concentration must be at a certain level. When oxygen

levels fall, vertebrates are the most affected, followed by invertebrates and bacteria are the least affected. In one study, it was reported that heavy metals and toxic substances from industry accumulate in the food chain in Izmir Bay. The use of polluted water for irrigation reduces yields and renders projected investments inadequate or reduces their viability. Heavy metals and toxic substances in irrigation waters can accumulate in the soil. When the concentration of these substances in the soil exceeds the growth limits of plants, plant growth is adversely affected. The rapid increase in the world population has increased the need for water and exacerbated the problem of water pollution. The main source of chemical pollution is industrial wastes. Industrialization has caused more environmental pollution than population growth. There are harmful heavy metals, radioactive substances, plastics, gases and mineral salts in the wastewater of petrochemical, leather, textile, paint and mining industries. Unplanned disposal of wastes causes water pollution by being carried to surface waters, wind and groundwater by rain. Today, water pollution has reached a dimension that seriously threatens human health. Chemical substances that dissolve and gasify in water can cause carcinogenic effects on living organisms, chronic or acute poisoning. Some chemicals used in the leather industry are associated with occupational diseases. The use of these chemicals may increase the incidence of health problems such as hypertension among workers. Statistics show that 10-15 per cent of workers in the leather industry have hypertension. Chromium compounds, which are widely used especially in the tanning process, are harmful to health. There is evidence of carcinogenic effects in both humans and experimental animals when tannery workers are constantly exposed to these chemicals. Epidemiological studies in different regions over the years have consistently reported that the risk of bladder cancer is associated with workers in the leather industry (Cengiz, 2002).

Natural leather is known as a biodegradable organic material. The chemicals used in the processing of natural leather, which are present in only 10 per cent of the leather, have a very short biodegradation time. Therefore, the negative effects of natural leather on the environment are limited. However, leather alternatives presented as synthetic materials consist of 100% chemical components. Synthetic leather produced by converting chemicals such as liquid PVC and polyurethane into fine tissues is not biodegradable. Therefore, it requires a much longer time to break down in nature, usually an average of 200 to 1000 years. Although synthetic leather is classified as a

recyclable material, the breakdown process can trigger other chemical reactions that can harm human health and natural ecosystems. Therefore, the environmental impacts of the use of artificial leather should be considered and assessed in terms of sustainability (Good Design, n.d.).

Figure 3.1. Izmir Menemen Wastewater & Chemicals Used.

Source: Author

3.1.1. Leather vs. Synthetic "Leather"

Artificial or synthetic or faux leather is usually produced from plastic-based materials. It contains synthetic substances such as polyurethane (PU) or polyvinyl chloride (PVC). Leather is obtained from animal skin. Cattle, sheep, goat and pig skins are among the commonly used types. One of the main differences between leather and artificial leather is the price range. Although leather is a by-product of the meat industry, it is still sold at a high price and is often equated with premium products and can be seen as worth investing in over the long term due to its quality and durability. Synthetic leather, on the other hand, is a relatively more economical option and can often be favored by those looking to save money. In terms of durability, although leather is a very durable material because it contains natural fibres, it needs regular maintenance. Stains and spills may need to be treated immediately; otherwise, permanent scars may occur, but it is longer lasting and can gain beauty over time. Synthetic leather is less durable than genuine leather but can last 5 to 10 years depending on proper care and use. Because leather is a naturally porous material, it absorbs stains and can trap odors, so it cannot be washed. synthetic leather is generally

not washable but has the advantage of being less porous than genuine leather. Synthetic leather is weaker than genuine leather in terms of breathability as it is plastic-based and can cause sweating in some cases. Leather is better breathable and more effective in regulating body temperature because it has natural fibres. Synthetic leather can achieve a regular appearance during the production process but may lack the texture and flexibility of natural leather. Leather has a natural texture and unique appearance. Wrinkles and color tone variations over time create the unique character of genuine leather. The production of artificial leather often requires the use of petrochemicals, which can have environmental impacts. Leather can be criticized for the environmental impact of animal farming and the leather processing industry, but as a natural material it can be considered more sustainable in some cases. Another important difference between artificial leather and genuine leather is found in the color options. Leather used to have limited color options, usually black, brown and rarely white. Today, however, many different patterns and techniques are available to dye leather in the desired color. For synthetic leathers, the range of colors is much wider, giving consumers more choice. It is becoming more and more difficult to distinguish between genuine leather and synthetic leather. However, you can pay attention to some signs to make this distinction. The first is to examine the pores of the material. Genuine leather will have more irregular pores than the pores of synthetic leather. A product in which the pores are arranged in a regular pattern is probably made of synthetic leather. Sensory experiences can also help you. Smell and touch can help you understand the nature of the material. Synthetic leather usually does not smell like leather and can feel plastic. Although choosing an animal-friendly alternative may seem like a basic decision, other factors such as environmental factors should also be considered. From an environmental perspective, both PU and PVC based synthetic leathers are not good options. Therefore, while it may be an ethical choice to opt for artificial leather in order not to harm animals, it may not be an ideal option for the sustainability of the planet. According to analysts, global demand for leather alternatives is expected to grow by 49.9 per cent per year to reach USD 89.6 billion by 2025. The main reason for this growth is the growing awareness of animal welfare and rights, which will encourage the search for more animal-friendly products, especially in the footwear, apparel and furniture industries. Therefore, the options for consumers sensitive to ethical and environmental concerns are increasing. Ethical consideration of leather products is

also an important issue for consumers for whom animal ethics is not a priority. Leather production represents a complex issue with various ethical and environmental factors. PU, one of the most common alternatives to leather, is a popular choice. However, polyurethane has its own economic and environmental challenges. One of the main concerns with polyurethane-based synthetic leather is the potential toxicity of the solvents used in the production process. The manufacturing process involves the application of polyurethane in liquid form to a fabric backing. Liquefaction of polyurethane at this stage requires the use of solvents, and these solvents can often be toxic. Newer versions of polyurethane include water-based coatings, offering a more environmentally friendly option. However, the type of polyurethane used can affect the environmental impact depending on the quality of the product, the fabric used, and the chemicals used in the production process. It is important to consider these factors in order to minimize environmental impacts in the production of synthetic leather products (Gopal, n.d.).

3.1.2. Leather vs. Vegan "Leather"

Leather has historically been at the center of a process starting from raw hides and transforming into animal skins, while constituting the basic norm of consumption habits. In the past, leathers of animal origin were produced as a subset of by-products derived from animals. The luxury sector paved the way for a privileged innovation with skins from animals not associated with widespread food consumption, such as crocodiles, snakes and ostriches. However, the methods used to obtain animal skins are changing with an increasingly sustainability-orientated interest (Muthu, 2020).

Most vegan leather, although plant-based, is produced using plastic-based materials. Although we are aware of the problems of plastics, leather alternatives such as bags, belts, wallets, shoes and similar products are still generally recognized as a more sustainable and ethical option than real leather. The use of these two synthetic materials has raised questions about the safety and environmental impact of vegan leather. With some rare exceptions, vegan leathers are produced from materials that are not derived from natural resources. However, more environmentally friendly options include products made from materials such as cork, cactus and pineapple leaves. Leather retailers often characterize vegan leather as poor quality, offering limited color options and generally being a bad investment. However, this point of

view is often untrue. Although vegan leathers are composed of similar components as inorganic modern synthetic materials and plastics, they often have fewer toxic properties. Avoiding the hazardous chemicals commonly used in traditional leather processing and the factory farming industry makes the vegan leather option attractive. In terms of appearance and durability, vegan leather has improved significantly with the growing demand in the fashion world. When both types are looked after, they gain their longevity depending on how they are preserved and cared for. The most reliable way to distinguish between vegan leather and traditional leather is therefore to look at the back of the product. Vegan leather comes in many different forms and qualities, so some may be more "leather-like" than others. A quality vegan leather product can offer a look that is quite close to quality real leather. However, because it is a synthetic material, it does not develop a patina over time like real leather and is less breathable because the pores pressed into the leather are artificial. Impacts on animals and the environment are the main concerns that influence the preference for vegan and real leather. However, the term "vegan leather" does not always refer to an environmentally friendly product. Vegan leather can lead to environmental impacts depending on the types of plastics used in the production process. Quality and durability are important factors to consider when comparing vegan and real leather. Vegan leather is generally a thinner and lighter material than real leather. While this can offer flexibility in terms of fashion, it can reduce its durability. Good quality genuine leather products can last for years when properly cared for, whereas products made from quality vegan leather can have a much shorter lifespan. Vegan leather, especially if it is PVC-based, does not allow the skin to breathe like real leather. For this reason, vegan leather can be uncomfortable in products that come into direct contact with the skin for a long time, such as clothing products. However, plant-based vegan leather can breathe like real leather. When making a choice between vegan and real leather, it is important to consider both environmental and quality and durability factors. Both options have advantages and disadvantages and can vary depending on personal preferences, intended use and environmental concerns. Vegan leather has waterproof properties as it is a plastic-coated material. This makes the cleaning process quite simple. Vegan leather can be found in different quality levels. Its quality is usually directly proportional to durability. Good quality vegan leather will last longer than lower quality options (Gopal, n.d.).

The leather industry is one of the industries with the highest environmental impact and adversely affects the environmental balance due to the creation of by-products as well as liquid, solid and gaseous wastes. This industry is located as a sub-sector of the textile sector and leather production is one of the oldest production methods applied by mankind since primitive times. Traditionally, these products, which are obtained by processing the by-products of the meat industry, have been called leather and have been turned into a valuable product with various uses. In this context, the leather industry can be considered an environmentally friendly industry as it processes by-products from meat production and transforms waste products into a useful product (Yorgancıoğlu et al., 2020). However, chemicals used in the leather processing industry include formaldehyde, coal tar derivatives and cyanide-based varnishes. Leather stands out with its sustainability. Synthetic leather alternatives such as PVC and PU may not be as durable as real leather. When synthetic leather is worn, it does not create a stylish patina as real leather. The worn state of leather is different from the worn state of PU. Genuine leather generally looks and feels better with age, which increases its longevity and potential to be recycled. Quality and durability should also be considered when comparing vegan and real leather. Although synthetic leather is generally thin and lightweight, it may not last as long as real leather. The environmental impact of a synthetic leather product that is replaced many times may be greater than the purchase of a single quality genuine leather product (Gopal, n.d.). In 2017, the report "Pulse of the Fashion Industry" by Global Fashion Agenda and The Boston Consulting Group presented findings that encourage the use of leather alternatives. This report emphasized that synthetic leather is significantly less effective than genuine leather in terms of environmental impact per kilogram. Likewise, it showed that the ecological impact of synthetic leather is only one third of the environmental impact of cowhide. The report also addressed the uncertainties about the environmental health impacts of artificial leather and genuine leather. In this regard, the following opinion is given in the report: "Different types of leather can vary greatly in terms of environmental impact, depending on animal breeding conditions, the tanning process and the type of leather. Switching to alternative materials can directly improve the environmental impact of the product." Synthetic leather ranked sixth in the study. This ranking includes silk, cotton, bast fibre and wool, as well as other vegan fabrics with the lowest environmental impact (such as nylon, modal,

viscose, lyocell, polyester and polypropylene). While the report is a positive development for vegans who care about the appearance of leather, it is important not to forget the responsibilities of vegan leather in terms of environmental impact (Gopal, n.d.).

3.2. Diverse Perspectives on Leather: An Applied Examination

After examining the historical development and theoretical differences of leather and leather alternatives, a detailed analysis is made in this section by comparing the different aspects of leather and leather alternatives on the same product. Leather and leather alternatives are compared and reported in terms of raw process, production process, sustainability, cost, durability, feel, texture, appearance, aesthetics and quality. This comparison was done to understand the advantages and disadvantages of each material and to gain a better insight into industrial applications and consumer preferences. This part of the research provides a critical assessment to understand the performance and properties of different materials in the journey of leather products from the manufacturing process to the end user. Five different types of leather were used in the comparison: vegetable tanned calfskin, chrome tanned calfskin, artificial leather and vegan leather (cactus leather and apple leather). When selecting the leather, care was taken to ensure that they were as similar in quality as possible. As a result of my research, I have found that vegan leather can be made from many different alternative materials, and for the purposes of this research, I have chosen apple and cactus leather as the most favored and what I consider to be the best alternatives to leather. This choice was made to ensure that the comparison provides reliable results in terms of objectivity and accuracy. I will provide brief information about these two vegan leather alternatives in the following sections. In the color selection, different types of leather were randomly selected in various colors. Different colors were chosen to emphasize the variety of colors in leather and leather alternatives. Threads, support materials and linings suitable for vegan materials were preferred in the sewing of the bags. To ensure that all bags look the same, different additional materials were used according to their thickness. This approach ensured that the bags have a more homogenous appearance. Within the scope of this thesis, a classic tote bag model was preferred as it was desired to observe the difference of the material while deciding on the design of the bag. In the light of the data obtained from this study, it will be

observed which material is more suitable for which style of bag and relevant observations will be made about which material will be used for my future research. In this way, a more conscious and scientific approach to material selection in bag design will be adopted.

3.2.1. Chrome Tanned Leather

Chrome tanned leather is a tanning method widely used in the leather industry. In this process, chromium salts are used to increase the durability of the leather and prevent decay. Chrome-tanned leather is obtained by chemically bonding chromium salts to the leather fibres during the process. This process improves the water resistance of the leather, while at the same time giving it a soft texture and flexibility. Chrome tanned leather can be processed in a shorter time and is more cost-effective than other tanning methods. It is also known as a long-lasting material due to its durable structure (S. Tahiroğlu, personal communication, June 20, 2023). However, chromium salts used in the production of chrome tanned leather can cause environmental and health problems. The release of chromium wastes into the environment can lead to environmental pollution and can cause health problems in case of skin contact. For this reason, some countries have strict rules and regulations to produce chrome tanned leather. As a result, chrome tanned leather is a popular leather type due to its durability and water resistance, but alternative tanning methods are being investigated due to environmental and health risks.

Firstly, the chrome tanning process is highly complex and requires a delicate balance. Chromium treatment of leather requires the use of the right amount of chromium compounds. This means that excessive use of chromium should be avoided because excessive chromium can damage leather and be harmful to the environment. Also, chrome processing must be carefully controlled because excessive chromium exposure can pose health risks to workers. Secondly, chrome tanning can be a lengthy process. The chrome treatment of leather takes place in several stages and each stage must be managed correctly. Any errors in this process can affect the quality and durability of the leather and adversely affect the quality of the product. Thirdly, the chrome tanning process can have environmental impacts. Chromium compounds are chemicals that can be harmful to the environment and must be disposed of correctly. Therefore, it is important that chrome tanning plants are meticulous about waste management and do

not harm the environment. Finally, the chrome tanning process can be costly. The cost of chromium compounds can be high and requires specialized personnel to manage the process correctly. Therefore, the cost of the chrome tanning process can affect the final cost of the product and increase production costs (E. Artkıy, personal communication, February 13, 2024). However, no problems occurred during the production of the bag. During the cutting and sewing stages, the production process was carried out in the easiest way because it was the type of leather that the bag master was familiar with. Since this type of leather is more resistant to bending, it was easier and more efficient to work with.

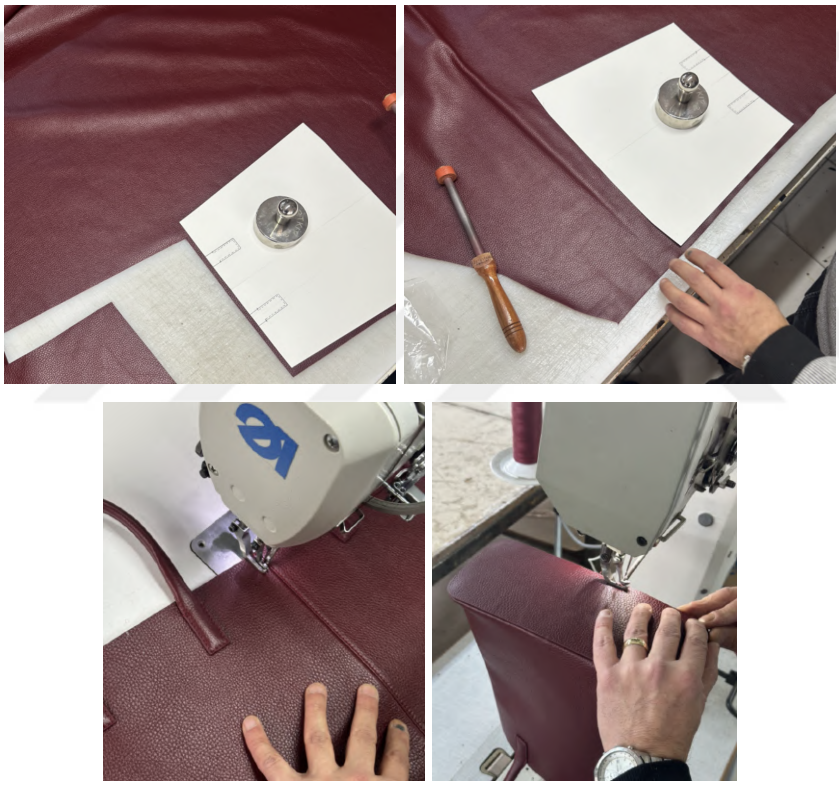

Figure 3.2. Cutting and Sewing Stages of Chrome Tanned Calfskin.

Source: Author

3.2.2. Vegetable Tanned Leather

Vegetable tanned leather is a method used in the production of natural leather and is usually processed using substances of plant origin. In this method, animal skin is tanned and processed with vegetable compounds, minimizing the use of chemicals. In

this processing process, natural substances derived from plants such as bark, leaves, fruit, and roots are usually used. The tannins contained in these substances increase the elasticity, durability and ageing time of the leather. They can also give the leather a characteristic texture and color. Vegetable tanned leather is generally considered a natural and sustainable product because the use of chemical substances is reduced or eliminated in the processing process. Therefore, its environmental impact is less than that of other leather tanning methods. However, the production process of vegetable tanned leather may take longer and require more skill. Vegetable tanned leather is generally high quality and durable. The use of natural materials increases the breathability of the leather and offers a more comfortable feel when worn. In addition, leather produced by this method usually ages better over time and develops a characteristic patina. Due to these characteristics, vegetable tanned leather is often preferred in luxury products, especially in accessories such as shoes, bags and wallets. Some difficulties may be encountered during the production of bags made of vegetable tanned leather. These difficulties are due to the nature of the production process and are influenced by the complexity of the process. Firstly, since vegetable tanned leather is produced by a natural process, the processes may take longer to complete. The vegetable tanning process requires the leather to be absorbed and treated with natural extracts, which can be time consuming. Furthermore, the quality and concentration of natural substances used during the vegetable tanning process is important, which can affect the production process and, in some cases, cause undesirable results. Another challenge is that vegetable tanned leather requires careful workmanship to achieve a certain quality standard. This leather, obtained using natural plant extracts, may not have a homogeneous color and texture. Therefore, during the production of bags, problems such as uneven coloring or differences in the texture of the leather were encountered. Such situations can further complicate the production process and affect the quality of the products obtained. Finally, the limited availability and cost of natural materials used in the production of vegetable tanned leather can be a challenge. The supply of natural extracts used for the vegetable tanning process can be difficult to obtain, sometimes depending on seasonal factors or regional conditions. Furthermore, the sourcing and processing of natural substances is often associated with higher costs, which may affect the cost of bags produced from vegetable tanned leather. To cope with these difficulties, manufacturers often must carry out careful planning and

resource management on the procurement and processing of natural materials (M. Artkıy, personal communication, February 14, 2024).

Figure 3.3. Cutting and Sewing Stages of Vegetable Tanned Calfskin.

Source: Author

3.2.3. Synthetic Leather

Synthetic leather is a leather alternative usually produced from petrochemical-based materials. Synthetic leather is usually realized by coating synthetic materials such as polyurethane (PU) or polyvinyl chloride (PVC). Synthetic leather can have a similar appearance and texture to animal skin but is more cost-effective and is often supported by animal rights advocates. Synthetic leather is used in a variety of industries, especially in the clothing, footwear, furniture and automotive sectors. The use of synthetic leather can save animal lives and reduce environmental impacts. However, synthetic leather production can have environmental impacts, especially due to the use of petrochemical-based materials.

The synthetic leather used in the bag was purchased from Güzelcan Artificial Leather in Işıkkent, Bornova, Izmir, Turkey, at a cost of 77 Turkish liras per meter. Synthetic leather is the most cost-effective alternative. Some difficulties can be encountered in the production process of bags made of synthetic leather. These difficulties may be caused by the properties of synthetic leather and may affect the production stages. Firstly, synthetic leather has a different structure than natural leather when it is cut or shaped. Therefore, synthetic leather may be more stressed during the cutting process and there may be difficulties in cutting smoothly. Problems such as breakage or rupture of synthetic leather may be encountered during the cutting of fine details or processing of complex designs. Also, synthetic leather may cause some difficulties during the sewing process. Synthetic leather may be stiffer or less elastic than natural leather, which may cause threads to slip or break during the sewing process. This may require more careful and meticulous stitching.

Another challenge in the production process is the residue or waste that can be generated during the processing of synthetic leather. The processing of synthetic leather can lead to the generation of environmental waste due to the use of chemical-based materials. It is important that these wastes are managed and disposed of correctly. Finally, the production of synthetic leather may require specialized equipment and techniques. Given the characteristics of synthetic leather, some conventional leather processing machinery or methods may not be compatible with synthetic leather. In this case, specially designed equipment and processing methods may need to be used, which can complicate the production process and increase costs. It is easier to cut and sew than other leather alternatives. However, since it sweats, the adhesive is expelled. In all alternative leathers, there is an opening in the adhesive in the support material.

Figure 3.4. Cutting and Sewing Stages of Synthetic Leather.

Source: Author

3.2.4. Cactus Leather

Cactus leather is a type of vegan leather produced from the cactus plant and adopts sustainability as a basic principle. This special type of leather is not only a highly sustainable material, but also perfectly soft to the touch. It is capable of high performance for a variety of applications and complies with the strictest quality and environmental standards. Its main objectives are to be free of harmful substances such as toxic chemicals, phthalates and PVC, to be cruelty-free to animals and to offer a sustainable alternative. Furthermore, this vegan leather is partly biodegradable and has the technical characteristics required by the fashion, leather goods, furniture and even automotive industries. The production process of the leather alternative involves the extensive use of rainwater to irrigate cactus plantations, with a new harvest every 6-8 months on the same plantation. This process involves drying the mature leaves of the cactus plant under the sun to achieve the desired moisture levels, which is a less energy-intensive method. It also does not use any herbicides or pesticides in its

production. These practices are part of the sustainable approach it adopts to minimize its environmental impact (Muthu, 2020).

As a leather alternative, I chose the Luxury Line of the Desserto brand, for which I prefer cactus leather. The main purpose of this choice was to make a fair comparison with top quality calfskin. Desserto is a natural and sustainable alternative brand made from cactus leather. This innovative material was developed in Mexico and stands out as an environmentally friendly option.

Desserto is based on a high-quality leather alternative derived from the leaves of the cactus plant. In addition to being vegan, it contributes to the sustainable fashion industry with its recyclable and biodegradable properties. Thanks to the strong molecular bonds of the cactus, it offers high resistance and excellent durability against abrasion, friction, tearing and stretching. This organic and sustainable material stands out as an excellent alternative to animal skin and other synthetic materials. The price per square meter (LM) of this leather alternative in Desserto's "Luxury Line" collection is 52 USD. The thickness is 1.3 MM (+/- 10%) and the back is 100% cactus treated cotton. The backing type is woven (Desserto, n.d.).

Figure 3.5. Cactus Leather.

Source: Desserto, n.d.

Figure 3.6. Stage of Cutting Cactus Leather.

Source: Author

Cactus leather is a naturally hard and dense material. For this reason, it has encountered difficulties during cutting. Compared to other leather alternatives, cactus leather has a harder structure, which makes it difficult to process. Especially during the cutting of fine and delicate details, the blades must be forced, and the material has to be cut smoothly.

Cactus leather is not suitable for some industrial machines. Working on these machines requires extra effort and attention to process the leather, and manual labor may also be required. The choice of support materials is important as it has a harder structure compared to traditional leathers. Some openings have occurred in the support materials used to reinforce the bag structure.

As the cactus leather is hard, it was strained during the passage of the threads during the sewing process. This requires extra care and attention during sewing. Also, the process of joining the leather pieces together requires extra care. Cactus leather may require more care and is more difficult to work with than other leather alternatives. However, compared to apple leather, it is better in terms of durability. It has been observed that it is the most similar leather alternative to leather in terms of feel and texture. When compared in terms of price, cactus leather is the most expensive option among leather and leather alternatives.

Figure 3.7. Cutting and Sewing Stages of Cactus Leather.

Source: Author

3.2.5. Apple Leather

Apple leather is a material that has gained popularity in recent years and is used as a leather alternative. This innovative material is obtained from the peel and other residues of apple fruit. Apple leather stands out as a sustainable alternative because it allows the waste from the fruit industry to be utilized. Apple leather is designed as an alternative to the use of animal skins and is often favored by vegan and eco-friendly consumers. This material offers a leather-like texture and feel and is used in a variety of fashion products, especially accessories such as bags, shoes and wallets. Naturally derived and biodegradable, this material has less environmental impact compared to traditional leather production. Furthermore, apple leather production makes a positive contribution to waste management and the use of renewable resources.

Mabel, my preferred brand for apple leather, is a pioneer in the field of apple leather and has been active since 2010 in the production of eco-sustainable materials from vegetable processing waste for the leather, footwear and paper industries. There are

currently approximately 30,000 tones of apple waste, which, if not reused, results in high waste management costs for companies. The carbon footprint of polyurethane (foam) is 5.28 kg CO2 equivalent/Kg PU, which gives zero impact compared to recovered waste. Therefore, every kilogram of apple scraps used instead of PU means a saving of 5.28 kg CO2. The technology developed by Mabel makes this material suitable for any use, with the same mechanical resistance as other synthetic fabrics (Mabel, n.d.).

The material is based on recovered fruit and apple waste from the juice industry. These wastes and residues such as stems, and peel are ground into a fine powder. The resulting powder is combined with a powder mixture of polyester, PU, cotton and viscose, which is necessary to give the material strength and durability. This liquidized mixture is pumped into large containers and allowed to stand until it turns into a solid. The solid material is then pressed to give it the appearance of fabric, colored and sent to a large oven to dry. In the final step of the production process, the inner lining is fitted, and the material is ready to be pressed to give it a specific texture or pattern, for example Croco-effect leather. Small scraps of the material are melted down and reused to produce new batches (Carter, 2022).

Figure 3.8. The Apple Waste from Apples is Ground into Apple Powder, which is then Converted into Liquid and the Final into Layers of Skin.

Source: Carter, 2022

The thickness of apple leather is in the range of 1.0 +/- 10% mm and the composition are 25% polyester (+/- 2), 19% cotton (+/- 2), 34% polyurethane (+/- 2), 22% apple (+/- 2). In the production of apple leather, the natural softness of the material may cause some difficulties during the cutting process. This may prevent the shaping of the leather and the achievement of details. It is also stated that apple leather, which is expected to have a certain thickness and durability, may have difficulty in obtaining a homogenous structure in some production stages. Some difficulties may also be experienced in the pressing and shaping process. Compared to cactus leather, apple leather is said to be easier to cut and sew. However, it was stated that problems such as breaks and wrinkles were encountered during the production phase. On the other hand, there was no need to use extra material. The fact that apple leather is a sustainable material and is obtained from recycled waste may pose additional challenges related to the procurement and processing of the raw material. The collection, processing and quality standardization of the material can take time and attention. Despite these challenges, the fact that apple leather is an environmentally friendly alternative and part of the sustainable fashion industry can be an important motivation for producers.

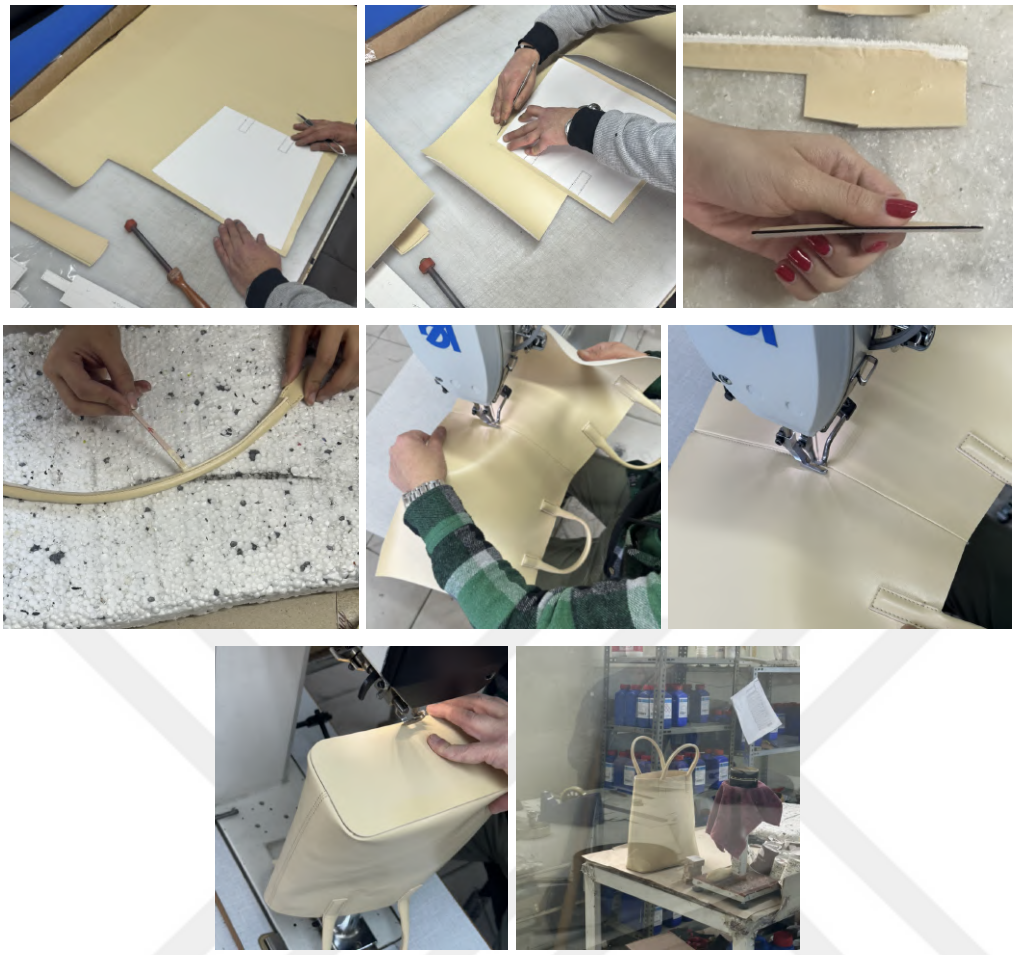

Figure 3.9. Cutting and Sewing Stages of Apple Leather.

Source: Author

3.3. Final Products and Comparison

A comparison of bag materials is important to understand the different tanning methods and properties of the materials. Summarized results of the comparison of five different bags made of vegetable and chrome tanned leather, apple and cactus leather and artificial leather:

- **Chromed Tanned Leather Bag:** Traditionally treated leather, generally softer and more supple, has a faster production process as it is treated using chromium salts, is durable, but its environmental impact and use of toxic chemicals can be a concern and is not a vegan and sustainable alternative.
- **Vegetable Tanned Leather Bag:** It has a high quality and durable leather material, it is produced using natural vegetable tanning method, it is an

environmentally friendly and sustainable option, however, the production process can take longer and requires labor and is not a vegan alternative.

- **Synthetic Leather Bag:** Made using synthetic material and is a vegan alternative, it is more cost-effective and usually offers a variety of colors and textures but can be subject to criticism for its environmental impact and limited durability. It has a higher share of wear and tear than leather.
- **Cactus Leather Bag:** It is an environmentally friendly option and a vegan alternative, it is obtained from the leaves of the cactus plant, it provides high resistance and durability, however, there may be some difficulties in the processing process and special equipment may be required and the share of wear and tear is higher than leather.
- **Apple Leather Bag:** It is a sustainable and vegan alternative, made from recycled apple waste, it is a high quality and durable material, however, some difficulties may be encountered in the production process and additional costs may be required, and it has a higher wear rate than leather.

In conclusion, each bag material has its own advantages and disadvantages. These factors can vary depending on the user's preferences, budget and environmental concerns.

Figure 3.10. From Left to Right, Chrome Tanned Calfskin, Apple Leather, Synthetic Leather, Vegetable Tanned Calfskin and Cactus Leather

Source: Author

4. CHAPTER: CONCLUSION

The focal point of this study is the sustainability of life on earth and the studies on usage materials that will be part of daily life from new lifestyles that respect living things for a world population reaching 8 billion. Leather, which is an indispensable material from prehistoric times to the present day, has been selected as the study universe.

The rise of biogenic and synthetic alternatives in the leather industry aims to replace animal-based materials with vegan options. In this study, chrome-tanned calfskin, vegetable-tanned calfskin (the main reason for choosing calfskin is that it is more suitable for bag production) and artificial leather, as well as apple-skin and cactus-skin (Desserto, Apple-skin), two of the most popular alternative materials today, were examined in detail. Comparison of the structural and technical performance of the materials helped to predict their potential application areas. According to the results of the investigations, no leather alternative could fully demonstrate the universal performance of leather. Leather exhibits unique properties such as strength, flexibility, water permeability, abrasion resistance, durability and longevity.

Made from chrome-tanned calfskin, the bag is treated using chromium salts during the process. This makes the leather softer and more supple, while at the same time increasing its durability and making it more resistant to water. These bags usually have a shiny and smooth surface and have a modern look. However, the production process of chrome-tanned leather can cause environmental concerns and may lead to allergic reactions for some people. On the other hand, bags made from vegetable tanned calfskin are processed using natural vegetable substances. This processing method offers a more natural and environmentally friendly option. Vegetable tanned leather undergoes less processing compared to chrome-tanned leather, which ensures that the natural texture and character of the leather is preserved. However, these bags can often be less durable than chrome-tanned leather bags and have less resistance to water. Bags made from chrome tanned calfskin are generally more durable and water resistant,

while bags made from vegetable tanned calfskin offer a more natural and environmentally friendly option.

It is inevitable that individuals who have adopted a vegan or vegetarian lifestyle or who are looking for an environmentally friendly and sustainable option prefer leather alternatives. For many years, the first option that comes to mind when it comes to leather alternatives is artificial leather. The bag made of artificial leather is made of synthetic materials with modern industrial methods. This bag is usually more affordable and offers a wide range of color and pattern options. It is durable and water resistant but does not provide as much breathability and flexibility as natural leather. The production of artificial leather can often lead to environmental impacts, but some innovative methods and recycling practices can help reduce these impacts. In the past, synthetic materials competing with leather were favored because of their lower cost. Synthetic materials are easier to process and can be produced on roll production lines to suit industrial needs. In recent years, sustainability concerns have increased in industrial production, which encourages the use of natural materials and the replacement of non-renewable fossil-based raw materials. Although leather is bio-based and renewable, these concerns have not brought about a rebirth of leather. Instead, the leather industry has come under further pressure due to ongoing debates on the greenhouse gas emissions of cattle farming, the sustainability of leather production and animal welfare. At the same time, a growing group of people are consciously choosing not to consume meat or use products of purely animal origin. These demands present new challenges in culture and material development and make vegan leather an attractive alternative. Today, for many people, consuming meat or dairy products and using animal products such as leather, wool and silk is a common habit. However, the increasing use of chemicals such as PU (polyurethane) and PVC (polyvinyl chloride) and other substances used in leather production has been one of the main causes of environmental hazards for many years. This situation encourages people to be more sensitive to sustainability. This slow but steady paradigm shift is creating a new trend in the footwear and textile industry by creating a shift in the minds of consumers towards environmentally friendly or green products. The fashion industry is becoming an important area of increasing awareness of animal welfare and rights.

The pandemic and social media platforms have made animal cruelty and damage to nature more clearly visible to people. Vegan brands have become a sub-category of sustainable brands and current trends indicate that there will be an increase in consumer demand for products derived from natural resources in the future. The fashion and apparel industry must be ready to adapt to these demands, as there is a high level of inconsistency, uncertainty and disorganization in this industry due to constant research and development. Overall, the vegan world offers great potential in terms of possible business opportunities and lifestyle by taking over artificial textiles. Therefore, no matter how unquestionable the quality of leather is, the rise of vegan leather is becoming an irresistible trend. Bags made from vegan (vegetable) leather offer an animal product-free alternative, often treated with natural plant materials. These bags are considered more environmentally friendly because the materials used during processing come from natural and renewable sources. They also address animal welfare concerns and are a viable option for consumers adopting a vegan lifestyle. Vegan leather bags are usually chrome-free, which reduces the risk of allergic reactions. However, chrome-free processing methods can reduce the leather's durability and resistance to water. When cactus and apple leather were analyzed, it was observed that cactus may be a better alternative to leather in terms of appearance and durability, but it is the highest cost option. Each alternative leather type offers different advantages and disadvantages. Faux leather bags are generally more durable and water resistant, but they can cause environmental impacts and the risk of allergic reactions. On the other hand, vegan leather bags offer an eco-friendlier and animal-friendly option, but they can be limited in durability and water resistance. Depending on users' preferences, needs and the features they value, it may vary which type of leather is most suitable. The results of the research emphasize the importance of evaluating different aspects of materials and their uses. Comparisons on factors such as durability, aesthetic appeal and environmental impact help us determine which material is more suitable for a particular use scenario. This study can contribute to consumers making more informed and environmentally friendly material choices.

In future research, materials need to be analyzed in a more in-depth and comprehensive manner. Further studies should be carried out to assess their environmental impact, sustainability and long-term durability in more detail. Furthermore, future research that will focus on the discovery and commercialization of new and innovative leather

alternatives will contribute to the adoption of eco-friendly and animal-friendly options in the fashion industry. In this way, it can help to create a more sustainable fashion industry and reduce negative impacts on the environment. To understand the durability processes of materials, updates on use and time are needed. In the future, long-term use tests as well as tests in various climatic conditions will need to be evaluated to learn more about the durability and performance of materials. It is also important to develop new technologies and methods to make production processes more sustainable and reduce their environmental impact. These efforts will contribute to a more environmentally friendly and ethical management of the fashion industry.

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