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Contents

PREFACE

This book is a compilation of studies prepared on various subjects in the fields of Natural Sciences and Engineering in Turkey. The book features selected topic headings chosen by scientists working in the fields of Natural Sciences and Engineering. Both qualitative and quantitative research methods are used in the studies in the book according to the structure of the study. These studies provide information on various topics related to the fields of Natural Sciences and Engineering. It is intended that the findings obtained as a result of these studies will contribute to the comprehensive evaluation of studies on various topics in the fields of Natural Sciences and Engineering and fill the existing gap in this regard. We would like to thank the scientists who contributed to the creation of this book by sending their sections and Duvar Publications, which made it possible for the book to start its publishing life and meet readers and researchers.

Editor
Doç. Dr. Fatih ERDEMİR

Beirut Explosion: One of the Largest Non-Nuclear Explosions in History

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Didem SALOGLU DERTLI[2]

INTRODUCTION

Chemical materials, whether used during peace or war times, have always been a concern during production, handling and use (1). Throughout history, explosions have taken place in different parts of the world due to the lack of compliance with safety precautions. One of the latest catastrophes that have happened due to the mishandling of ammonium nitrate took place at Beirut Port, a port that has a vital role in providing PPE equipment to combat COVID-19 (2). The history of Beirut Port goes back to the 15th century B.C. as a connecting hub between Asia, Europe and Africa. Besides that, the location of Beirut port in the city center and its closeness to historical landmarks helped make the port itself as well as the nearby marinas and the existing nightlife an important touristic attraction (3). The port of Beirut is the largest port in the country whereas the second largest port in Tripoli, Tripoli Port is as big as 1/3 of Beirut Port. It can be said that Beirut Port is the beating heart of Lebanon as it's vital to importing medical goods, wheat and construction materials (4).

The aim of this paper is to shed the light on the effects of the explosion on COVID -19 and vice versa and the explosion's impact on the socio-economic situation through investigating the possible cause of the Beirut explosion and the crisis manifested due to the explosion and identifying the factors that exacerbated the humanitarian situation as well as the local and international response to the crisis.

AMMONIUM NITRATE

Ammonium nitrate is used as a fertilizer for explosive materials, and it has been classified as a hazardous substance since 1996. Ammonium nitrate is stable, harmless, and non-explosive unless a high intensity ignition source is brought nearby. The analysis of past incidents has shown that no explosion of ammonium nitrate had happened while stored unless a preceding fire have taken place (5).

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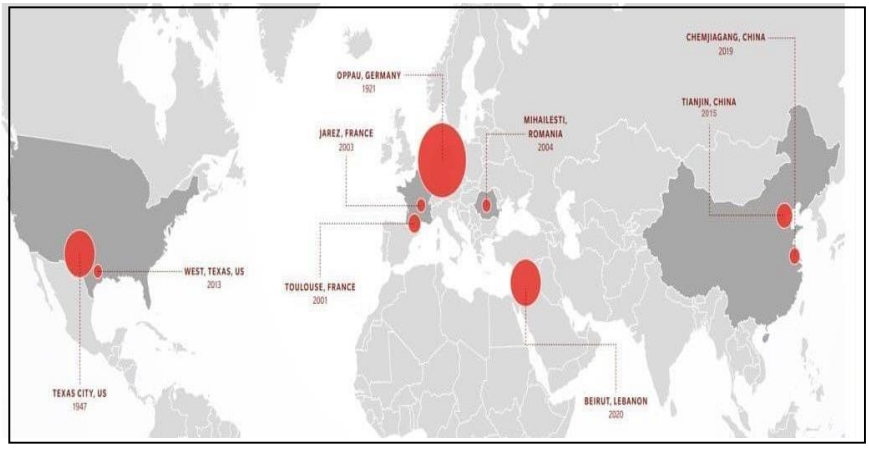
Figure 1. Ammonium Nitrate Explosions in History (6).



In the figure above a list of various ammonium nitrate explosions around the world is shown where Beirut explosion even when compared to other ammonium nitrate explosions is considerably humongous. The casualties resulting from each event varies and can be listed as below:

- OPPAU 1921: 507 deaths & 1917 injured (7).
- TEXAS 1947: 500 deaths & 3500 injured (7).
- TOULOUSE 2001: 30 deaths & 10.000 injured (7).
- JAREZ 2003: 0 deaths & 26 injured (8).
- MIHAILESTI 2004: 18 deaths & 11 injured (9).
- WEST TEXAS 2013: 15 deaths & 260 injured (7).
- TIANJIN 2015: 114 deaths & 722 injured (10).
- CHENJIAGANG 2019: 78 deaths & 617 injured (11).
- BEIRUT 2020: 200 deaths & 6000+ injured (12).

1. BEIRUT EXPLOSION

In 2013 MV Rhosus, which was loaded with ammonium nitrate sailed from Georgia where it had planned to reach Mozambique. However, due to technical issues the ship offloaded at Beirut Port and the shipment was abandoned for six years till the devastating explosions that took place on the 4th of August 2020 (13). It has been reported that the cause of the catastrophic event was due to welding operations being held to fix a warehouse door where the ammonium nitrate was being stored. The warehouse was located in an inhabited district

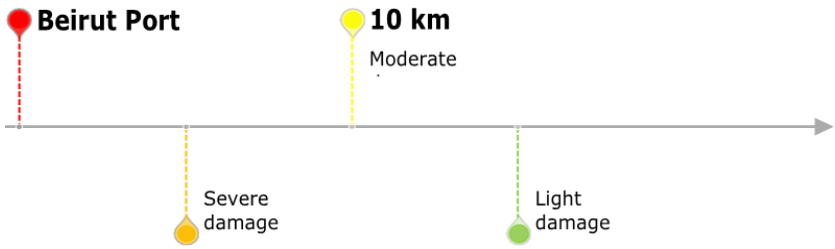
which exacerbated the humanitarian situation in the deceased city of Beirut (5). Besides having ammonium nitrate being left unmanaged for six years, it was stated by survivors that the existence of fireworks in the 12th warehouse have made it worse (14). However, the exact cause of the incident is still under investigation till today (15). According to USGS earthquake hazards program, the explosion had a magnitude of 3.3 in Richter Scale and it was felt by neighboring countries like Israel, Cyprus and Turkey (12, 16, 17). The severity of the explosion with respect to distance is shown in the figure below.

BEIRUT EXPLOSION: CASUALITIES

The destruction brought to the city of Beirut was as unexpected as the offloading was. About 200 people had lost their lives, 6,000 were injured and 300,000 were left homeless (12). On top of that, 73.000 homes were destroyed, 70.000 workers lost their jobs, 163 schools were destroyed, and 15.00 metric tons of grain were lost (18). It is estimated that the resulting damages are approximately have costed Lebanon around 15 billion USD (12).

The explosion has also left its mark on

Figure 2. Beirut Explosion: Severity with Respect to Distance (17).



The COVID-19 situation which demonstrated in the loss of 17 containers of PPE (Personal Protection Equipment) sent by WHO to combat COVID-19 besides the destruction of 6 Hospitals, 20 clinics and 80 healthcare facilities (18). 18 days after the explosion, it is estimated that out of every 100 COVID-19 tests an average of 10.5 were positive whereas the average was 2.7 before the explosion. The number of hospitalized patients due to COVID-19 have increased by 91.4% (19). Social distancing was no longer applied as people have gathered to help, check on others or watch (20). Major hospitals were damaged like Saint-George and Karantina Hospital. Also, Saint-George's intensive care patients have died as the ventilators stopped working due to the blast besides the death of some of the medical staff. As a byproduct, some patients were sent to hospitals 50 km away from the blast due to the destruction brought to the nearby facilities (13).

RESPONSES

Local Response

When considering the response to disasters as big as Beirut Port explosion, it is important to divide response into local and international. Initially, 9 firefighters and 1 paramedic have been sent to the port without knowing what they are about to face (14). After that, 75 ambulance vehicles and 50 other backup vehicles have been dispatched along with 2000 volunteers were sent by the Lebanese Red Cross to the explosion. On top of that, 1500 blood donations were collected on the explosion day of which 1100 were sent to the hospitals (21). As a result, a two-week state of emergency has been declared by the Lebanese government where the rescue team has been searching within 2 km^2 on six rounds after 72 hours 320 were rescued and 30 fires have been extinguished (14, 21). In the meantime, the hospital situation had become disastrous due to the lack of PPE and the destruction of two main hospitals in the city. The medical staff have found themselves forced to treat injured people in unexpected places such as parking lots and hallways (13).

International Response

According to the report published by The Lebanese Army, the international aid has come to life through sending The Lebanese Red Cross financial aid from IFRC (The International Federation of The Red Cross and Red Crescent) besides aids received from various red cross organizations. Apart from that, IFRC have continued its support through supplying medical aids to 17 hospitals as well as providing food stamps to the victims (21).

With aim to relief the humanitarian situation, a local- international cooperation was inevitable. For that reason, an international response cell has been established along with different rescue teams that were working hand in hand with The Lebanese Civil Defense and the operation was led by The Lebanese Armed Force (21). The timeline with the main milestones of the international response can be seen in figure 3.

The response strategy has taken into consideration that:

At the time when the explosion has occurred, Lebanon was in the middle of a multiple and compounding crises, including the Syria Crisis which led to the influx of around 1.5 million Syrian refugees, and an economic and financial crisis that deepened since October 2019 (18).

The emergence of a political crisis along with an economic and financial crisis which led to increasing levels of poverty and food insecurity, while further

compounding needs among the Lebanese and non-Lebanese communities alike, including the large refugee populations (18).

• Additionally, since February 2020, the COVID-19 outbreak has further strained Lebanon's health system, which was already over-burdened and under-resourced, resulting in unequal coverage of and access to both primary and secondary health services, particularly for dedicated COVID-19 hospital beds (18).

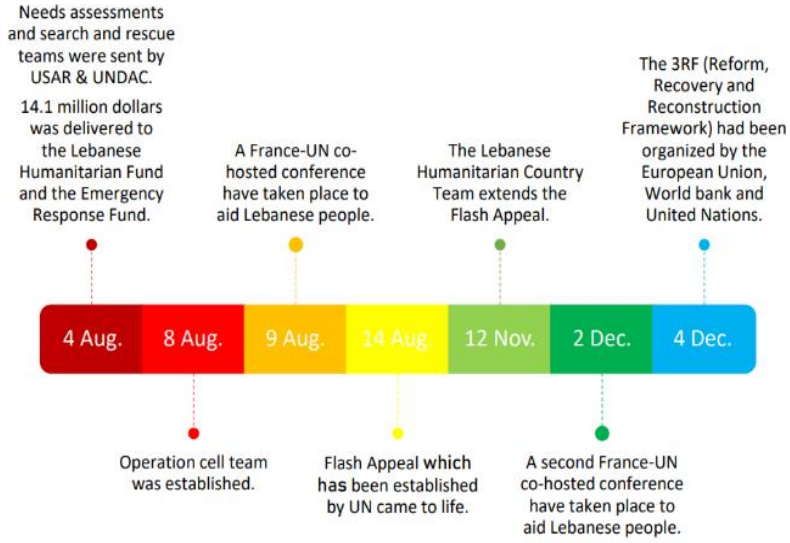
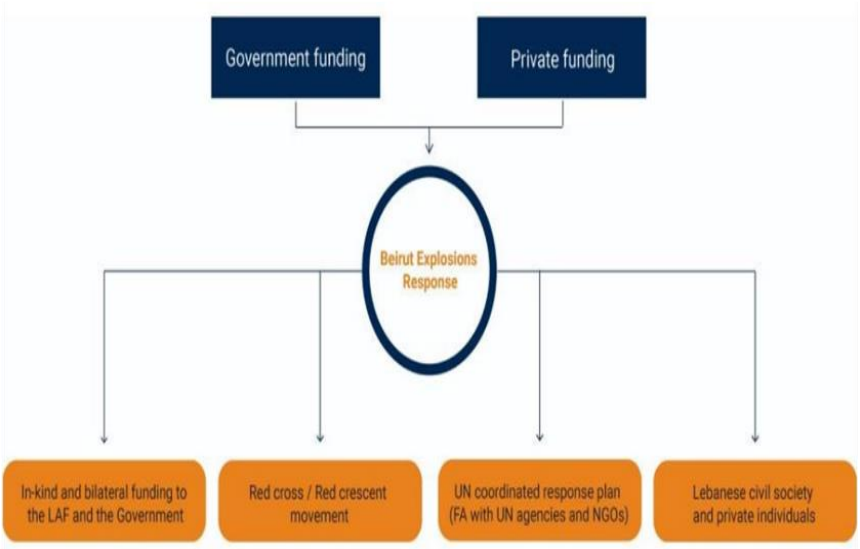


Figure 3. International Intervention Timeline (18).

For the forementioned reasons, The Government of Lebanon (GoL) have held the main responsibility of responding to the explosion along with Lebanese Armed Force (LAF) and other humanitarian organizations. As mentioned earlier, even though the operation was led by the Lebanese Armed Force, the humanitarian situation was beyond the means of the Lebanese Government Alone (18).

Figure 4. Government/ Private Funding flowchart (18).



Led by the Prime Minister Deputy two coordinating teams were established: Resident Coordinator and Humanitarian Coordinator. A Humanitarian Country Team was responsible for risk communication and engagement, assessment and cash force. Under The Emergency Operation Cell led by OCHA (Office for the Coordination of Humanitarian Affairs) four cells were established: Assessment & Analysis Cell, Civil Military Coordination Cell, USAR Coordination Cell and Environmental Emergency Cell. The collaboration led to covering food security, protection, WASH (Water, Sanitation and Hygiene), logistics, health, education and shelter (18). As seen in figure 5, under each target different international organizations were working so that the needs of the diseased people are met. Through aids received from 27 countries and 4 countries which consist of 74 planes of food aid, medical aid, medical equipment, and humanitarian aid, and 5 ships of medical aid, food aid and humanitarian aid respectively. Besides that, 78 teams were established by 18 countries and pool fund was organized by CERF (Central Emergency Response Fund) and LHF (Lebanese Humanitarian Fund) to distribute and cover the expenses of the 6 sectors mentioned in figure 5 (18).

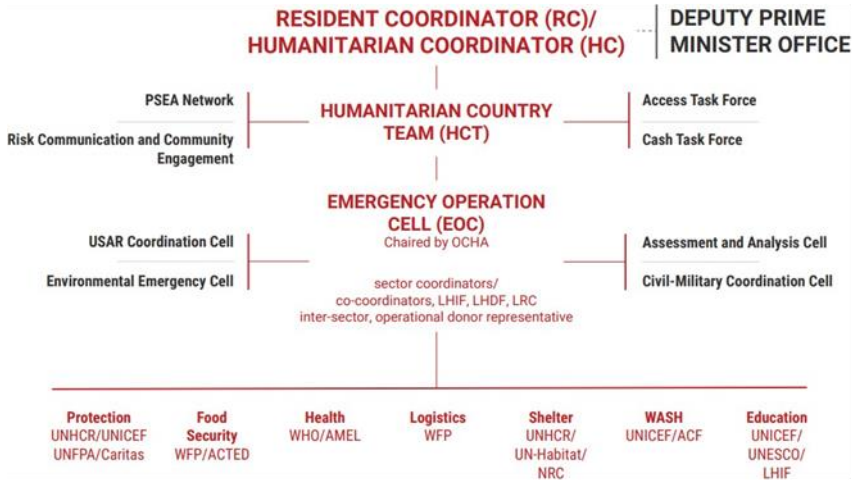


Figure 5. Operation Cell (18).

International Response Challenges by Sector

- Protection: Beirut explosions have widened the holes around economic stability: poor and the unfortunate communities have been disproportionately affected, as well as vulnerable groups, including refugees, and immigrant workers. While the overall funding is good compared to Flash Appeal, the Protection component is still greatly underfunded (13% as of April 10) compared with other sectors where the funds reached 50% on average. Responsiveness is possible thanks to flexibility in redirecting funding from Lebanon Crisis response plans and other sources of funding (18).

- Education: As a consequence of the constraints of apparent need at the time of the flash appeal, overdependence on estimates, and considering the fact that education was not prioritized in the early stages of the response, funding for this sector was initially very Limited. However, the impact of Beirut explosions extends beyond structural damage to the affected schools: increasing risk of dropping out, the vulnerability of disadvantaged children and/or have special needs, and the post-traumatic consequences of explosions are many factors that affect the continuity and the quality education. In addition, measures to contain COVID-19 have severely affected the education system, which has been weighed down by the economic crisis. There

is anecdotal evidence that COVID-19 has increased the proportion of children not attending school, many of whom do not have distance learning. Additionally, a significant number of affected educational facilities were also located outside the 3 km radius identified by the call response, resulting in a significant amount of funding being reported outside of the call (18).

- Food Security: Keeping track of the large number of different organizations, mainly operating outside of the Flash Appeal, has been difficult as a result of the explosions. Although this sector was well funded overall, the lack of funding from some partners on the prompt call for sector interventions to be planned to rehabilitate port infrastructure, healing rapid restoration of livelihoods and nutritional interventions. In addition, in the absence of legal consequences for violating Law 47/2008, it is difficult to prevent unsolicited BMS donations (18).

- 4.Health: The public health system faced many challenges prior to the COVID-19 outbreak. The surge in COVID-19 cases following the explosions has put additional strain on the health system and requires partners to take extra precautions when providing care to affected populations. Which resulted in an added stress and fatigue to responders and survivors alike. Property and livelihood damage, as well as the loss of healthcare facilities after the explosion have negatively impacted health services. A further deterioration of the general situation in Lebanon in 2021 will inevitably limit the availability and accessibility of vital health services, especially for vulnerable and/or disadvantaged groups given that the resources are limited (18).

- Shelter: Reconstruction work takes a long time due to technical expertise and bidding requirements, especially affecting the progress of restoration work. Different types of construction and high urban density have added to the complexity and speed of the response. In addition to the structural damage of many buildings, Beirut explosion damaged or destroyed heritage buildings, adding another layer of difficulty. In addition, many heritage buildings and low-income housing were in poor condition prior to the explosion. In some cases, poor pre-explosion conditions forced the partners to redefine their approach, allowing the inclusion of elements that were not directly

damaged by the explosion but required inclusion. Especially when the partners must meet the defined minimum sector standards. The limitations of finding contractors in an uncertain market, the availability of good building materials and fluctuating prices also contributed to the delay of the start of the shelter response. Likewise, the delay in funding commitments has slowed subcontractor participation and supplies, resulting in delayed field deployments. The shelter area, in the first weeks of the response, completed the development of a geo- split at neighborhood level to ensure clear deployment zones for partners operating under the appeal. However, the gradual increase of external agents to the flash appeal was another complication because that required continued endorsement to participate in coordination structure within the flash appeal. The tenancy commitment requires extensive endorsement on both public and private levels. At the official end of the flash appeal, it was reported that some households were still not supported due to housing, land and property (HLP) limitations and concerns. In addition, some families have declined the aid for fear of not being able to benefit from the government's cash assistance program. Despite new laws to protect residents from forced evictions and sales, tenants and landlords are largely unaware of their rights and obligations (18).

- Water, Sanitation and Hygiene (WASH): Beirut explosion have exacerbated the fragility of water and sanitation infrastructure in greater Beirut area, and numerous water reservoirs and drainage pipes in various buildings were damaged or destroyed. Despite the fact that the explosions showed the fragility of water systems, which is outdated and inefficient. In addition, the focus is on responding to and supporting individuals and households directly affected by the forementioned explosion have resulted in social and community tension (18).

- Logistics: Initially, consistent and timely information about logistics services and infrastructure available in the market was identified by partners as a gap, especially in relation to trucking, warehousing services and usable property. Additionally, vulnerabilities have been identified related to up-to-date logistical information about supply chain operations, including administrative procedures and the status of points of entry into the country. The customs procedures established by The Lebanese Government require a large number of

negotiations both from the sector side and from the side OCHA and Resident Coordinator/Humanitarian Coordinator (RC/HC) (18).

International Response Result by Sector

By the termination of the operation cell the below results were found per sector (18):

1. Protection: 100% of the people in need were targeted through 22 projects with 3.3 M USD funds.

2. Education: 43% of the people in need were targeted through 10 projects with 14.6 M USD funds.

3. Food Security: 10% of the people in need were targeted through 18 projects with 50.9 M USD funds.

4. Health: 30% of the people in need were targeted through 17 projects with 15.6 M USD funds.

5. Shelter: 54% of the people in need were targeted 27 projects with 46.7 M USD funds.

6. WASH: 10% of the people in need were targeted 8 projects with 1.1 M USD funds.

CONCLUSION

Given the details mentioned in the previous sections, the below can be concluded:

- The Incompetency of the Lebanese government in terms of preparedness as well as intervention manifesting in sending 9 firefighters and 1 paramedic to combat an explosion that is considered as one of the biggest non-nuclear explosions in modern times.
- Poor inventory management given that ammonium nitrate was stored for 6 years next to highly explosive materials such as fireworks.
- Working without safety precautions given that welding operations has been held next to explosive materials.
- Lack of compliance with international conventions manifesting in storing ammonium nitrate in an inhabited area.
- In COVID-19 context the explosion resulted in destroying PPE that were meant to help Lebanon combating the novel virus as well as

destroying health facilities that serve as the frontline to defy the pandemic.

- A conflict of interest represented in people gathering in certain areas to help the search and rescue teams where social distancing is needed to combat COVID-19.
- The deteriorating economic situation, the pandemic and the refugees had the crisis persist till today (22).
- Regardless of the aids received 82% of the population are in poverty (22).

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The Role of Magnesium Alloys in the Automotive and Defense Industry

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Hamid ZAMANLOU[2]

Ali SADIK[3]

INTRODUCTION

Magnesium discovered as an element in 1808 by Sir Humphrey Davey. It is the lightest metal of all construction metals [1]. Magnesium element reserves are very rich, as it is found in approximately 2.7% of the earth's crust and 0.13% of the oceans [2]. Magnesium, which is the 8th element among the most abundant elements in the earth's crust, is the alkaline earth element in group 2A in the periodic table. Considering the magnesium potential in brine deposits, salt lakes and oceans in the world; becoming the most abundant metal in natüre [3-4].

Magnesium is similar to plastics due to its lightness and to metals due to its strength properties. Magnesium alloys have light weight, high strength, recyclability, good castability, vibration damping capacity and good machinability. Its low melting temperature (650°C) and good weldability make it easy to join with other metals [5-7].

Magnesium and magnesium alloys are more preferred in automotive, aerospace industrial application, defense industry and light engineering materials. Magnesium is one of the alternative materials that can be used instead of steel and similar metals to make the car lighter due to its structural properties, as well as to reduce the weight of the car for fuel economy and reduce emissions regulations. The densities of magnesium and aluminum are 1.738 g/cm^3 and 2.7 g/cm^3 respectively, which is lighter than steel with a density of 8 g/cm^3. The fact that magnesium is 72% lighter than steel and 33% compared to aluminum allows it to be used as a building material in many industries [8] Compared to materials used in industrial applications, the use of magnesium alloys provides a significant

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reduction in weight. The advantages of magnesium's structural properties make it the alloy of choice for a variety of industrial applications [9,10].

Welding with other materials is of great importance in order to increase the usage area of magnesium alloys [11]. The welding method to be applied and the efficiency of the obtained material are important in terms of protecting and improving the structural properties of this material [12].

Magnesium alloys can be divided into two main categories in terms of production, casting and wrought alloys. Today, however, magnesium alloys are characteristically used as casting alloys. However, studies and research on wrought alloys have increased in recent years [13, 14].

Magnesium alloys contain small amounts of aluminum, manganese, zinc, zirconium, etc. It has strength values equal to that of mild steels containing [15]. Statistically, more than 90% of magnesium alloys are produced by casting, specifically by various die casting processes [16].

APPLICATIONS OF MAGNESIUM AND ITS ALLOYS

It is not possible to use magnesium metal in its pure form due to its low strength. The low strength in pure state necessitated the production of various alloys. The most important feature of magnesium and its alloys compared to other metals is lightness [13, 17]. Due to the lightness of magnesium alloys, the specific tensile strength is greater than the specific tensile strength of aluminum and steel. Due to its low density, magnesium appears to have high specific strength compared to aluminum, plastic composite materials and steels. Therefore, magnesium alloys are widely used in the automotive, electronics, defense, aerospace and aerospace industries today [18].

In studies aimed at saving weight in the automotive and aircraft industries, magnesium metal comes to the fore with its low density and lightness as a structural metal. The greatest interest in magnesium alloys comes from the automotive sector due to its structural lightness. The main reason for this is that the reduction in vehicle weight with the use of magnesium alloys provides fuel economy and, as a result, gas emissions can be reduced. In particular, the tendency towards light metallic materials is a desired and sought after situation in many areas only in the automotive sector [19]. Compared to today, lightness is a much more important requirement in automobiles that are predicted to operate with alternative energy sources such as solar energy, hydrogen and electricity. Fuel consumption planned to be achieved in future automobiles is a challenging target of reducing current fuel consumption by one third, which requires an

average of 30% reduction in automobile weight [20]. Although magnesium has a high cost compared to aluminum and steel, which are mostly used in the automotive industry, its use in automobiles is increasing due to the production of cast parts that are easy to form. In recent years, the use of magnesium alloys in the automotive and electronics industry is expected to increase significantly. Mg-Al-Zn (AZ91) alloys are mostly used for casting automobile and aircraft parts due to their lightness. Compared with other magnesium alloys; AZ91, a magnesium alloy, shows better casting, better yield strength properties. Figure 1 and figure 2 illustrate the use of magnesium alloy in auto parts. As can be seen from this figure, magnesium alloys are used in every part of automobiles from the engine to the chassis [21].

Properties of Magnesium and Magnesium Alloys

• The most commonly used alloying elements of magnesium can be said to be aluminum, zirconium, zinc and alkaline earth. But the most widely used magnesium alloys are aluminum and zinc group. Rare earth metals are used in new magnesium alloys developed for high temperature application areas [22, 23].

• Magnesium alloys are alloys with approximately 80-190 N/mm yield strength of 0.2% and a tensile strength of 160-300 N/mm and elongation at break of 2-15% [24, 25].

• Magnesium alloys find use in the automotive, computer, sports equipment and electrical electronics industries [21].

• Conventional magnesium alloys began to be developed in the last century. Today, there are alloys with many components such as plastics, fibers and reinforced composites [26].

• Increasing the strength of magnesium and its alloys; It is achieved by processes such as alloying, hardening, grain size reduction and precipitation hardening [27, 28].

•Since magnesium is found in large numbers in nature, there is no problem in terms of availability. Since there is a certain amount of magnesium in the earth's crust and sea water, there is no problem in terms of availability [29, 30].

Types of Magnesium Alloys

Magnesium alloys are named according to the first letters of the 2 elements with the highest ratio in the mixture and the percentages in the mixture.

Magnesium alloys have their own specific coding. Some of these are shown in Table 1.

Table 1: Classification of Magnesium Alloys

Series	Composition	Example
AE	Magnesium, aluminum and rare earth alloys	AE42
AJ	Magnesium, aluminum and strontium alloys	AJ52
AM	Magnesium, aluminum and manganese alloys	AM60B
AS	Magnesium, aluminum and silicon alloys	AS31
AZ	Magnesium, rare earth silver and copper alloys	AZ91D
EQ	Magnesium, rare earth silver and copper alloys	EQ21
EZ	Magnesium, rare earth and zinc alloys	EZ33A
HM	Magnesium, thorium and manganese alloys	HM21A
HZ	Magnesium, thorium and zirconium alloys	HZ32A
QE	Magnesium, silver and rare earth alloys	QE22A
QH	Magnesium, silver and thorium alloys	QH21
WE	Magnesium, yttrium and rare earth alloys	WE43
ZC	Magnesium, zinc and copper alloys	ZC71
ZK	Magnesium, zinc and zirconium alloys	ZK11
ZT	Magnesium, zinc and thorium alloys	ZT32

The ASTM B275-94 standard (American Society for Testing and Materials-ASM, 1988) is generally used for naming magnesium alloys, and each alloying element is coded using a different letter. According to this coding method, it indicates that the magnesium alloy contains nominal 9% aluminum and 1% zinc.

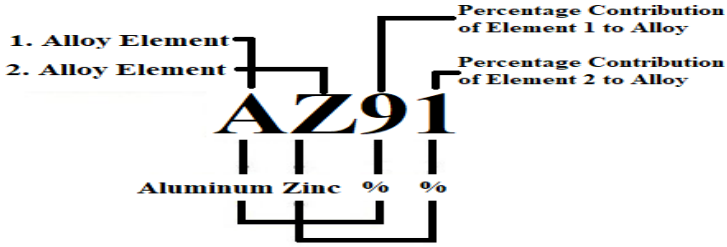

Figure 1. Naming scheme of maynesium alloys

As seen in Figure 1, magnesium metal is a matrix element in the naming of the alloy and it is not shown with any letter in the nomenclature. Binary or triple alloying systems can be used as alloying systems, and the binary alloying system is generally preferred. The name of the element with more weight % of the alloy elements added is written in the first row. When the alloying elements have the same weight %, the letters are written in alphabetical order [31, 32]. For example; A magnesium alloy containing 3% Al, 1% Zn by weight is named AZ31. AZ31 alloy contains 0.25-0.3% Mn in its content; however, since this amount is quite low and less than 0.5%, it is not named in the alloy coding. The processes to which magnesium-based alloys are subjected are given in Table 2. The process representation is separated from the alloy representation by a hyphen [33]. Mg-AlZn-Mn, Mg-Zn-Zr, Mg-Y-RE-Zr, Mg-Al-Mn, Mg-Zr, Mg-Mn, Mg-RE-Zr, Mg-Ag-RE-Zr, commercially are the most produced magnesium alloy groups. The Mg-Al-Zn alloy system is the most widely used magnesium alloy. The most used alloys are; AZ91D is AM60B AE42, AS41XB [32]. The standards of magnesium alloys are determined in ASTM B 93/B 93-94 and ASTM B94 documents, and the alloy element and its ratio are given in Table 2 [34].

Table 1: Magnesium alloy standards and compositions (ASTM B 93/B 93-94 ve ASTM B94)

Mg Alloy	Alloy Element and % Ratio											
	Al	Zn	Mn	Si (max.)	Fe (max.)	Cu	Ni (max.)	Be	Ce	Zr	Other	Mg
AM50	4.5-5.3	0.20	0.28	0.05	0.004	0.008	0.001	-	-	-	0.01	Balance
AM60	5.6-6.4	0.20	0.26	0.05	0.004	0.008	0.001	-	-	-	0.01	Balance
AS21	1.9-2.5	0.15	0.20	0.70	0.004	0.008	0.001	-	-	-	0.01	Balance
AS41	3.7-4.8	0.10	0.35	0.60	0.0035	0.001	0.001	-	-	-	0.01	Balance
AZ31	2.5-3.5	0.7-0.13	0.20	0.05	0.005	0.005	0.005	-	-	-	-	Balance
AZ91	8.5-9.5	0.45	0.17	0.05	0.004	0.001	0.001	-	-	-	0.01	Balance
ZE10	0.05	1-1.5	0.1	0.05	0.03	0.005	0.005	0.002	0.12	-	-	Balance
ZK60	0.05	4.8-6.2	0.1	0.05	0.03	0.005	0.005	0.002	-	0.3-0.9	-	Balance

Application Area and Place of Magnesium Alloys in Automotive

Automobile manufacturers have also started to produce magnesium alloy parts due to their superior and preferable properties compared to other metals. By examining the structural properties of the AZ91 alloy, BMW company produced the engine block and started commercial use. In the engine they call R6, the crankcase, cam cover are made of aluminum alloy magnesium, providing 10 kg lighter than the engines produced in this precedent [35].

It has been determined that magnesium alloys are at a sufficient level to be preferred for the production of engine parts such as engine block, gearboxes, crankcases, cylinder top cover, intake manifolds, oil pump body, land gearbox. Since these parts operate at high temperatures, their creep resistance and corrosion resistance must be high. At the same time, since they are sensitive parts, they must be easily pourable. Magnesium Development Industry (MRI) 5 alloys have been developed within the framework of efforts to improve the corrosion and creep resistance of magnesium alloys and to improve their mechanical and castability properties. These alloys are MRI151, MRI152, MRI153, MRI154, MRI155. The creep strength and corrosion resistance of these alloys under approximately 135 °C and 85 MPa are quite good compared to other metals [9, 36]. Figure 2 (a) shows the gearbox and (b) the combustion manifolds of a 12-cylinder engine manufactured by pressure die casting from AZ91 HP.

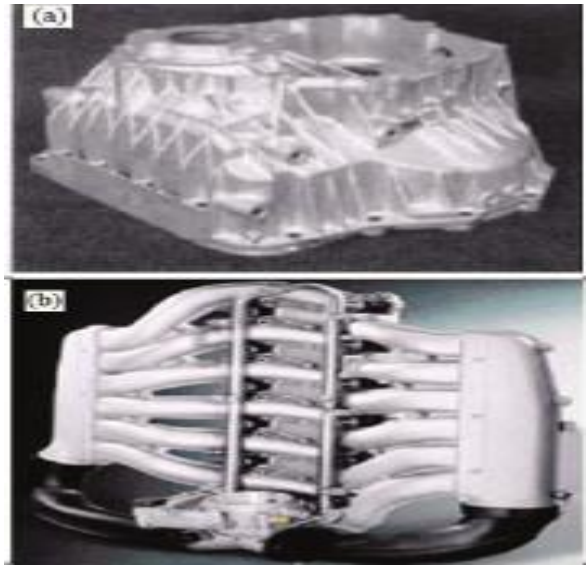

Figure 2. a) Gear box b) Combustion manifold [37]

As the interior parts of the car; seat parts, dashboard, steering wheel hub, brake and clutch pedal bracket, airbag holder etc. covers the parts. These parts, which ensure the safety of the car, are still produced from AM50A and AM60B alloys. These alloys form a good combination of high strength, ductility, energy absorption and castability. AM60B alloy is one of the most commonly used alloys in automotive applications. AM20 alloy with higher ductility and toughness, which is desired for these parts, can be used even though it has poor die casting properties. Therefore, magnesium development efforts have focused on combining the strength and castability of AM60B with the ductility and toughness of AM20 [9]. Figure 3 shows various vehicle parts made from magnesium alloys.

Figure 3. (a) door frame, (b) seat frame, (c) steering wheel and (d) transmission [9]

As chassis parts; engine seat skid, suspension parts, wheel rims, etc. Work continues on the use of magnesium to ensure its safety and reliability in the production of parts such as These parts are required to work in environments where both higher strength and high ductility and high fatigue strength are combined under variable stresses in a corrosive environment. AM60B and AZ91D alloys produced by conventional pressure die casting technique are not sufficient to meet these specifications. Therefore, alternative production techniques such as vacuum assisted pressure die casting, low pressure die casting, isostatic hot pressing are being studied [37]. Production of body parts; sheet elements can be classified as casting elements and extrusion elements. It has been observed that complex and thin-section parts such as the inner trunk lid have been successfully cast. Other applications will be on door interior parts in the near future. Body panels produced from magnesium alloys have low corrosion resistance and surface quality. Therefore, sheet metal fabrication should be developed in magnesium alloys. For a good surface quality, the sheets produced should not be rolled above 220°C and the mechanical properties, yield limit should be 160 MPa and tensile strength should be greater than 250 MPa, elongation should be greater than approximately 20% and can be produced in 1500 mm width [38].

Application Area and Place of Magnesium Alloys in the Defense Industry

Since the 1940s, magnesium alloys have been used for military applications, from aircraft component parts to land vehicles. The driving force for use was largely the usability and lightness of military systems. But the promise of widespread use was fulfilled. With recent fuel costs and logistical burdens, there has been increasing recognition of the need to develop and implement light weight strategies for all weapon platforms (land, sea and air) without loss of platform functionality. The potential for significant improvement in the mechanical and physical properties of light metals will drive the design of ultralight metal structures and components, thereby reducing large logistical loads, minimizing operational constraints and liabilities, and reducing security vulnerabilities. This course will cover past, present and future applications of magnesium alloy, focusing on the scientific barriers to magnesium alloy integration and solutions currently being developed to address these issues [39].

Although low ductility magnesium is suitable for machining in machining, it poses a danger due to its easy flammability. With these features, magnesium also has important and critical usage areas in the defense industry. It is used for flaming in ammunition with great destructive power, radar equipment, portable ground equipment and stingray torpedoes. Rod-shaped extruded magnesium is used as anti-tank ammunition. Magnesium is added as a supplement to the ammunition when firing standard 120 mm or 100 mm rounds. For this purpose, powders of AZ80, AZ61 and AZM alloys are used. In addition, when magnesium burns, it produces white light and intense heat. Primarily and atomized powders are used as flamethrower and army equipment, especially for danger signs and lighting purposes. Magnesium-based devices are used for target deception in the protection of military helicopters and aircraft. In addition, these lightings are used to visualize the ground in parachute jumps [40-41].

The main products in which magnesium alloys are used in the defense industry: (Şekiller 4-7) [42]

I. In firearms; Used in magazine, receiver, rifle butt, gun body.
II. In rockets and missiles; missile body, used in rudder body
III. In land vehicles; Used in tanks, gunner mirror, captain mirror, gearbox, engine filter base, air distributor block, oil pump housing, water pump housing, heat exchangers, oil filter housings, cylinder head covers, seat frame.
IV. In aircraft; It is used in rotor hub, reverse reaction system, gearboxes of helicopters and airplanes.
V. In personnel equipment; It is used in wearable fabric antennas, information display, computer and video receivers, helmets.

Figure 4. Gun body [43]

Figure 5. Titan 1 rocket [44]

Figure 6. Helicopter rotor hub [45]

Figure 7. HMMWV "Run-Flat" Wheels [46]

The Future of Magnesium Alloys

Magnesium is seen as the product of the 21st century with its fuel saving and low CO_2 emission qualities due to its high strength and lightness. In addition to these good features, there are expensive and difficult traditional production conditions. Magnesium is widely used because of its low weight and good mechanical and electrical properties. For example; It has uses in the manufacture of mobile phones, laptops, cameras and other electronic components [47, 48]. This also shows that; Magnesium metal has a very important place for electronic

devices. In addition, the use of magnesium alloys is gradually increasing in the aviation industry, defense industry, in line with the need for fuel economy and weight reduction. Most car interior magnesium components consist of the instrument panel, seat frames, steering wheel, wheels and other parts. In the near future, vehicles; We may encounter Mg alloys in roof panels, hood, rear contents, wheels, oil pan, starter and alternator systems [49]. The fuel saving of the magnesium used has provided recognition in many fields, especially in the automotive industry [50]. From the point of view of fuel economy; There is no need to make a major change in the part designs made for Mg alloys. As a result, it can be said that; The use of Mg and its alloys in the automotive industry can help keep the atmosphere cleaner. In this case, we can talk about the existence of a better fight against global warming. For this purpose, researches should be carried out in order to save weight, and it should be aimed to reduce the emission of CO_2 gas to the air significantly [51-53].

RESULTS

Magnesium alloys allow researchers to work in a wide range of fields with a global awareness of environmental protection. With the use of Magnesium alloys in the automotive industry, it is tried to reduce the weight and increase the fuel economy by reducing the CO_2 emissions. Weight reduction by using Magnesium in vehicles has produced good results. However, more research is needed to use cost-effective methods in Mg processing, alloy development, mechanical conditioning, and to reduce weight and greenhouse gas effects.

The defense industry makes significant contributions to the security and economy of states. Armies equipped with superior defense industry products make states strong both nationally and internationally. In order for the aviation industry to develop, it is necessary to put the advancing technologies into practice and to work with this technology. Newly produced alloys are a very important part of this technological development. Air vehicles are the biggest energy consumers compared to other fields in terms of energy, and since it increases the flight cost, reducing the weight will be the easiest solution to reduce the cost. When this is tried to be achieved with today's technology, the most important materials used instead of steel and cast iron are aluminum and magnesium. Magnesium alloys have comparable properties in metals and are more advantageous. However, it is not used enough in the aviation industry. With the development of forming methods in recent years, improvements in the forming ability of magnesium alloys have been observed. These positive developments also predicted the need for new research. This material is in the strategic materials group, and studies in this area are not sufficient.

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Chemical Analysis of Halloumi Cheese Produced in North Cyprus

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1. INTRODUCTION

The production history of cheese, which is estimated to have approximately 4000 varieties in the world, goes back many years. Various types of cheese can be produced in many geographies or that are specific to the region in which they are produced (1). Among these cheeses, the best place for halloumi cheese is Cyprus. Halloumi, which has been indispensable for Cypriot tables for centuries, is identified with Cyprus and is the first product that comes to mind when Cyprus is mentioned. Fresh and ripe, with an annual consumption of 12 kg per person, it is the favorite cheese type of Cypriots (2). It represents traditional village life and production based on social solidarity from past to present. With these properties, Halloumi means much more to Cypriots than a cheese. Halloumi is the most important symbol of Cypriot culture (2). Although the information about when the Halloumi production started on the island has disappeared over time, both historical and archaeological studies show that the Halloumi product has a thousand-year history. Florio Bustron, in his report written in the Venetian language in 1554, mentioned that a cheese named "caloumi" was produced in Cyprus for centuries. The mature halloumi, whose juice is stored in it, had a fundamental role in its nutrition in ancient times when there were no coolants (2). Halloumi making was an important activity in the daily life of local people in ancient times. Apart from meeting their nutritional needs, the feature made in Halloumi provided the opportunity for solidarity, solidarity, and socialization among the village women. Each family had its own small amount of dairy animals and this amount was often insufficient for making Halloumi (1). For this reason, families combined the milk they collected from their animals and made halloumi jointly from the accumulated milk. Over time, Halloumi began to be produced commercially not only at home but also in factories using traditional production methods. Many dairy factories established today produce Halloumi by integrating traditional production techniques with technology. Halloumi is a product obtained by adding rennet to milk and applying a production method specific to Halloumi. It is made from sheep-goat, sheep-goat-cow milk mixtures fed with plants unique to Cyprus, or sheep and goat milk separately (4). Fresh milk, rennet, salt, optionally dried or fresh mint constitutes the content of halloumi. The small

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and bovine animals that produce the milk used in the production of halloumi are mostly fed with plants that grow in the nature of Cyprus and have a sharp taste and aroma (5). A large number of these plants, which are completely Cypriot vegetation, some of which are endemic, have an important place in the feeding of goats, sheep and cattle. Milk used in the production of halloumi derives its unique aroma and smell from these plants (1). Halloumi is an important share in Northern Cyprus exports. Halloumi, which has an increasing graphic in total export figures, is the most exported dairy product of Northern Cyprus according to 2012 statistics. Generally, dairy products account for more than 15% of total exports (1).

Halloumi is a rare cheese that does not melt when cooked in various ways and is also commercially available. The unique flavor of Halloumi has reached the world today and has started to take place in the kitchens as gourmet cheese (6). Halloumi was registered as a Cyprus product by the Cyprus Turkish Chamber of Industry in TRNC in 2008 and in the Turkish Patent Institute of Turkey in 2009. Halloumi cheese, whose production area is Cyprus Island, has been registered as the " Protected Designation of Origin" (1). In the registration text of the Turkish Patent Institute, it was stated that halloumi cheese is produced in two types as "fresh halloumi" and "ripe halloumi", and the most important feature is that it is consumed by cooking in plain or by cooking methods such as pan and grill because it does not spread and melt. Cyprus Turkish Chamber of Industry is also a member of the Origin-International Geographical Indications Network Organization. This non-profit organization, headquartered in Switzerland, represents 350 producer associations from 40 countries (2). The technical specifications of Halloumi are audited by the Halloumi Auditing Board established within the Cyprus Turkish Chamber of Industry. The board, which is in charge of inspecting that Hellim is made in accordance with the registration, is also working on international platforms to emphasize that Halloumi belongs to Turkish and Greek Cypriots and to ensure that Halloumi can only be produced in the geography of Cyprus (2). In this context, the Halloumi Supervisory Board is responsible for the inspection, control and laboratory analysis and accordingly, the preparation of reports, the necessary analysis, control and inspection in the production, storage, marketing and packaging of Halloumi. The European Commission adopted two measures packages on Kıbrıs αλλούμι / Halloumi / Hellim, an important heritage of Cyprus, on March 29, 2021. The commission first registered the name Χαλλούμι / Halloumi / Halloumi with high brand value as EU-wide protection and protection against misleading and counterfeit products as a Product of Origin Protection (PDO) (3). Halloumi producers in the Turkish

Cypriot community will also be covered by this protection. An internationally accredited system will be established to monitor the application of traditional methods in the production of halloumi on the island of Cyprus. Halloumi cheese and the milk it is made from will need to comply with EU animal and public health standards. Accordingly, halloumi cheese produced by traditional methods anywhere in the island of Cyprus will benefit from its origin status in EU countries as of October 1. From now on, according to the product specification, only umiαλλούμι / Halloumi / Hellim produced in Cyprus are allowed to use the registered name, which is expected to bring net economic benefits to the island (3). Halloumi cheese, which is now the most important product of the island of Cyprus and known internationally, has become more popular with the recent registration of the European Union as the "Protected Name of Origin (PDO)". It is recommended to have the following logo on the halloumi which has been inspected by the Cyprus Turkish Chamber of Industry (CTCI) Halloumi Supervisory Board and has been approved according to registration (2).

1.2 The Importance of The Study

Cyprus is a country with a strong cultural background and diversity due to its geographical features. Cultural richness helps to build a country with a wide variety of products. Differences can be observed between regions in terms of cultural products and sometimes different products are seen in different regions of the same province. As the Turkish Cypriot people, we protect our country's cultural structure, history, and products that have survived to this day and are still produced by our people according to our traditions; It is of great importance both for our economy and for the proof of our presence on the island. In addition to being a traditional product owned by both communities living on the island, Halloumi cheese is undoubtedly vital for our country's economy.

Containing a quarter of the total exports of the Turkish Republic of Northern Cyprus, halloumi also provides job opportunities to approximately 17 percent of our population. In this study, halloumi cheese produced in our country will form the basis of the new food safety policy; The consumer is of paramount importance in terms of scientific advice, collection and analysis of necessary data, control, and emerging risks.

1.3 Aim and Objectives

To compare the chemical analyzes of halloumi cheese, the most popular product of Cyprus, between traditional and industrial halloumi cheeses with geographical indication, the differences between the cheese samples purchased from the market and the production methods of halloumi cheese will be

examined. By making chemical analysis, all of the samples will be analyzed according to the features of the TS EN ISO / IEC 17065: 2012 standard (7). The production and consumption of Halloumi cheese and the problems encountered in these stages will be determined and solutions will be developed for these problems.

2. METHODOLOGY

It is seen that there are many studies where chemistry analysis methods are used in engineering fields. Using this method's strategies allows you to compare multiple characteristics with multiple, better-choice options. The purpose of this study was to explain the differences in interest between the traditional and the cheese industry and to choose cheese that has unique and characteristics in terms of its quality. Industrial and traditional products from Halloumi from six cities of North Cyprus were collected from markets and sent to the laboratory. It was aimed to determine the standard measurements of halloumi cheeses registered in terms of geographical indication and this respect, by making a chemical analysis of halloumi cheeses. It is aimed to determine the standard sizes of registered halloumi cheeses by making chemical analyzes of halloumi cheeses.

2.1 Materials of Chemical Analysis

Halloumi samples containing different levels of fat value, pH value, salt value, and dry matter value were used as material for validation experiments. All samples were analyzed individually and also analyzed by an accredited laboratory. These values were used as reference values for calculations.

2.1.1 *Preparing of the Halloumi Samples*

Industrial and homemade halloumi cheeses collected from markets and villages in 6 regions are grated for analysis. Grated cheeses are prepared for oil, pH, dry matter, and salt analysis. Separate from the same production sample to perform the analysis again at 18 ° C, it prepared in slices for sensory tests.

Figure 3.1: Grated Halloumi Cheeses for Analysis

2.1.2 Reagents and Other Materials / Equipments

Gerber Centrifuge: The centrifuge has heating to 65 °C, 8 compartments, and a time setting (Figure 3.2). The cycle was 1000-1200 rpm.

Figure 3.2: Gerber Centrifuge

Pipettes: Manual and automatic pipettes were used to transfer amyl alcohol, sulfuric acid, and samples.

Sampling Container: Usually a 40 ml sampling container is sufficient.

Gerber Butyrometer: They are glass butyrometers known as cheese butyrometers or milk butyrometers. The butyrometers are glass and they must have rubber plugs (Figure 3.3).

Figure 3.3: Cheese butyrometer and the plug

Sulphuric Acid: The acid to be used in the Gerber method should be 90-91% purity. The density of the acid is a very important parameter for the quality of the product. If the acid density is high, the fat is burned; if it is low, the fat is not digested. For cheese fat analysis 90-91% H_2SO_4 with a density of 1.5 g / mol was used.

Figure 3.4: Sulfuric Acid

Amyl Alcohol: The amyl alcohol to be used for analysis should be pure and its density should be 0.811 ± 0.003 g / mol at 132 °C (Figure 3.5).

Figure 3.5: Amyl Alcohol

Rotating Lab Shaker: It is a device that allows many test tubes or chemical solutions to be agitated at a certain speed and direction before or during the experiment. With the programmable features, it can be rinsed in the intended time.

Figure 3.6: ASTORIA BR400

Precision Analytical Scale: Chemistry, biology, testing, etc. they are very sensitive scales used in laboratories. It has a capacity of 220 grams and 0.0001 g is sensitive.

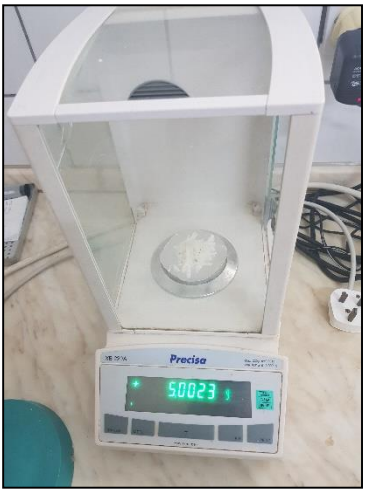

Figure 3.7: Precisa XB 220A

Burette: It is a graduated tubular glass material with a faucet at the bottom, used in titration processes and taking a certain volume of liquid. It has a special holding style.

Figure 3.8: Burette

Volumetric Flask: Volumetric bottles are very sensitive made science bottles. It is used to measure extremely sensitive liquid quantities.

Figure 3.9: Volumetric Flask

Potassium Chromate Solution (K_2CrO_4): In a neutral or very alkaline solution, potassium chromate 5% (K_2CrO_4) is used as an indicator to indicate the turning point of the titration of chloride with silver nitrate. In the Mohr method, the turning point is determined by the formation of a colored precipitate. At the turning point, the last drop of silver nitrate and a tile red-colored silver chromate precipitate are formed.

Figure 3.10: Potassium Chromate Solution (K_2CrO_4)

pH meter: pH meter is the name given to laboratory devices that measure pH value. pH is of great importance in milk technology.

Figure 3.11: pH meter

Moisture Analyzer: The moisture analyzer, which contains a balance and a heater, basically calculates the initial weight of the sample and the weight loss during the drying process in a short time. It is a laboratory device that gives the moisture and dry matter ratio of the substance as a percentage.

Figure 3.12: Moisture Analyzer (PRECISA XM 60)

2.2 Purpose and Significance of the Chemical Analysis Research

Food analyzes are carried out in order to take the necessary precautions according to the analysis results and to examine the critical quality control studies performed or to be done in various foods, the safety of the food. In terms of the integrity of food quality control applications and food analysis, the results of the

analyzes performed on food should be examined carefully in terms of the quality and reliability of the food product. Basic ingredient analysis of food products is one of the analyzes that must be done both for quality assurance and legal aspects. The chemical composition of foods is important in revealing the sensory and nutritional properties of the product. Official analysis methods should be used in order to reflect the real values of dry matter, protein, fat, salt and pH analysis in foods. Official analysis methods are critical for the analysis of foods and are crucial for determining the compliance of foods with the law.

Due to the effects of foods on human health, they must meet the "Safe Food" conditions. The only way to question the safety of food is laboratory analysis and test results. Halloumi cheese, currently the most important product of the island of Cyprus and internationally recognized, will carry out an international independent board audit to ensure the required standards and production procedures of the geographical indication. For this reason, all halloumi cheese samples must be analyzed according to TS EN ISO / IEC 17065: 2012 standard for chemical analysis to be at the same standard in every production place (7).

2.3 Method of Chemical Analysis

2.3.1 *Determination of Fat Value in Halloumi Cheese*

3 grams of grated cheese is weighed. It is placed in the glass bottom butyrometer unit. 10 ml of diluted sulfuric acid is poured on the sample. The butyrometer is placed in 70˚C bathwater and the cheese is shaking and melted thoroughly. If cheese pieces are left in the butyrometer, it is shaken by adding 1 ml of amyl alcohol. The butyrometer is filled with up to 35. line of the same sulfuric acid and the mouth is closed with a rubber plug and centrifuged for 10 minutes. It is kept in a 65 °C water bath for 5 minutes. This process is unnecessary if the centrifuge is heated. The amount of fat is read as % from the butyrometer scale.

Figure 3.13: Butyrometer-Prepared Samples for Cheese Fat Analysis

2.3.2 Determination of pH Value in Halloumi Cheese

Since the pH of the cheese samples will vary with each product, these samples are thoroughly grinded or crushed to make them homogeneous. A sample of this homogenized halloumi cheese is taken and placed in a small container where the electrode can easily come into contact. Electrodes are placed on the cheese sample with a thermometer to place the electrodes carefully. Cheese should not be diluted with water. This process will raise the pH to 0.3 units as it will disrupt the salt balance. Before testing the halloumi cheese, the pH meter is turned on and operated for 5 minutes. Then its accuracy is checked against standard buffer solutions. Standard buffer solutions for cheese should have a pH range of 4-6. The electrode is then placed in the cheese sample and the pH value is read from the pH meter (HANNA edge).

After each determination, the sample container is moved and the same cheese sample is measured at three different places. This means the correct measurement has been made. Then another measurement can be made after the electrodes have been thoroughly washed with blotting paper and dried. If not, the electrodes are replaced. If they are not suitable for another measurement, the electrodes are changed.

Figure 3.14: pH meter (HANNA edge)

2.3.3 Determination of Dry Matter Value in Halloumi Cheese

3 grams of ground halloumi cheese sample is weighed and mixed with sand with the help of a glass baguette and spread on the bottom of the container. Containers containing the halloumi sample are placed in PRECISA XM 60 at 105 °C and dried for a minimum of 30 minutes. Then the figures on the screen show the percentage of dry matter.

Figure 3.15: PRECISA XM 60

2.3.4 Determination of Salt Value in Halloumi Cheese

5 grams of Halloumi cheese is grated and placed in the ASTORIA BR400 mortar section with the help of hot water at 60-70 °C, and the aqueous part is transferred to the balloon-joje by crushing thoroughly. The same process is repeated 5-6 times and each time the aqueous part is taken into the balloon-joje.

In this way, after almost all of the salt in the cheese has passed into the water, the contents of the flask are allowed to cool for a while, and then the contents of the flask are completed with distilled water to the 500 ml line. The contents of the balloon are filtered through filter paper and 25 ml of the filtrate is taken into an Erlenmeyer flask. It is neutralized with 0.1 N NaOH. During neutralization, it is determined by titrating to a slightly pink color in the accompanied of a few drops of phenolphthalein indicator. 0.5 ml of 5% potassium chromate indicator solution is added onto the neutralized sample and titrated with 0.1 N silver nitrate solution until the tile red color is formed.

Figure 3.16: Erlenmeyer flask

4.RESULTS

For these studies, industrial and homemade halloumi cheeses purchased from markets and villages were analyzed in an accredited laboratory for dry matter (Drying Method), salt (Mohr Method), pH (HANNA Edge), and fat (Van Gulik Method) content analysis. All samples of halloumi cheeses have been analyzed with reference to properties in accordance with TS EN ISO / IEC 17065: 2012 standard (7). The chemical results of the halloumi cheese samples are given in the tables below.

4.1 Chemical Analysis of Halloumi Cheese

4.1.1 *Dry Matter Analysis Results of Halloumi Cheese*

The dry matter values of halloumi cheeses summarized in Table 4.1. When we look at the dry matter values of halloumi cheese samples, it changing in a range of 52,79 % - 61,93 %.

Tablo 4.1: Dry Matter Rates of Halloumi Samples		
Samples	Dry Matter Value % **(g/100 g)**	Limit Dry Matter Value % **(g/100 g)**
A1	58,74	37,0
A2	59,39	46,0
A3	61,95	37,0
A4	58,08	46,0
A5	55,01	46,0
A6	52,79	46,0
A7	54,63	37,0
A8	61,93	37,0
A9	57,24	46,0
A10	54,36	37,0
A11	59,67	46,0

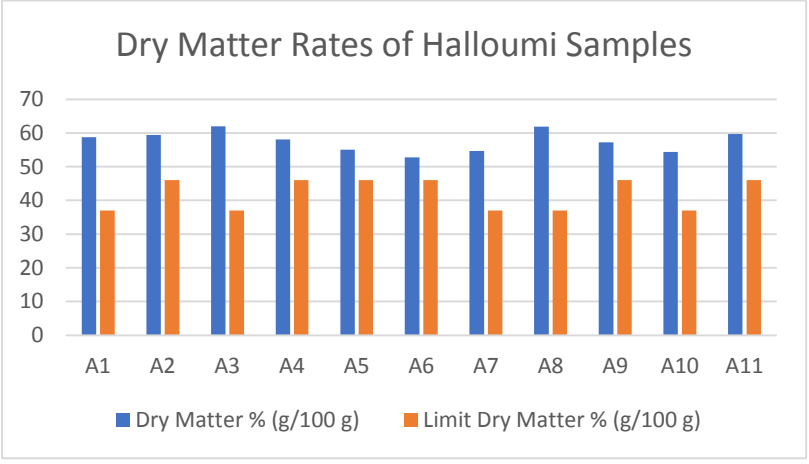

Figure 4.1: Dry Matter Rates of Halloumi Samples

4.1.2 Fat Analysis Results of Halloumi Cheese

The fat values of halloumi cheeses summarized in Table 4.2. When we look at the fat values of halloumi cheese samples, it changing in a range of 19 % - 27 %.

Tablo 4.2: Fat Rates of Halloumi Samples		
Samples	Fat Value % **(g/100 g)**	Limit Fat Value % (**g/100 g)**
A1	19	40,0
A2	26	43,0
A3	24	40,0
A4	24	43,0
A5	23	43,0
A6	21	43,0
A7	22	40,0
A8	25	40,0
A9	27	43,0
A10	19	40,0
A11	22	43,0

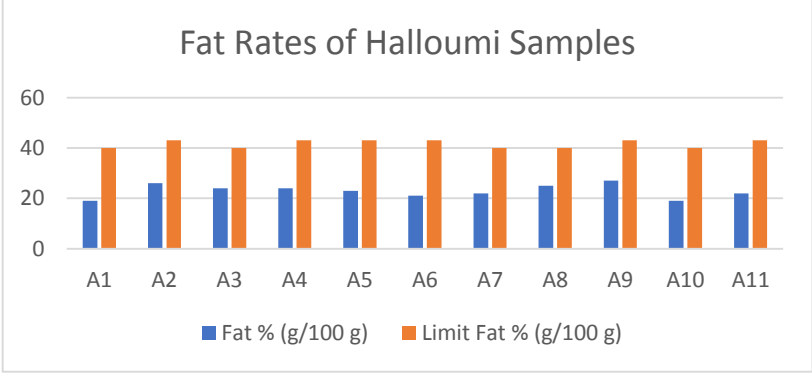

Figure 4.2: Fat Rates of Halloumi Samples

4.1.3 Salt Analysis Results of Halloumi Cheese

The salt values of halloumi cheeses summarized in Table 4.3. When we look at the salt values of halloumi cheese samples, it changing in a range of 2,10 % - 6,31 %.

Tablo 4.3: Salt Rates of Halloumi Samples

Samples	Salt Value % **(g/100 g)**	Limit Salt Value % **(g/100 g)**
A1	2,57	6,0
A2	3,27	5,0
A3	6,31	6,0
A4	4,21	5,0
A5	4,68	5,0
A6	3,97	5,0
A7	4,91	6,0
A8	3,97	6,0
A9	2,57	5,0
A10	2,10	6,0
A11	3,51	5,0

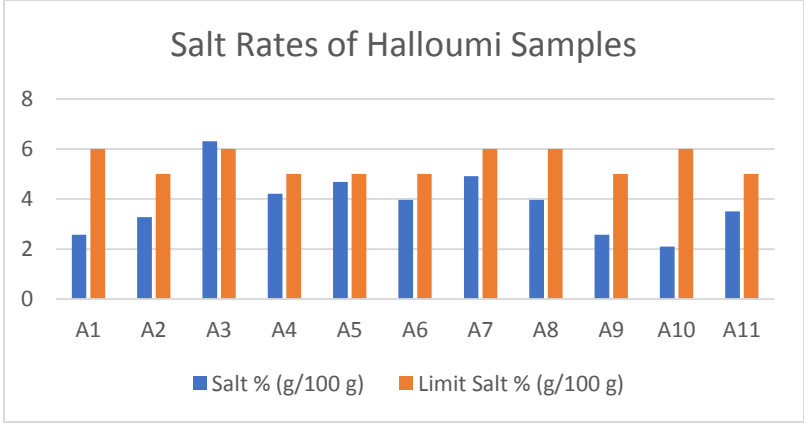

Figure 4.3: Salt Rates of Halloumi Samples

4.1.4 pH Analysis Results of Halloumi Cheese

The pH values of halloumi cheeses summarized in Table 4.4. When we look at the pH values of halloumi cheese samples, it changing in a range of 5,40 % - 6,48 %.

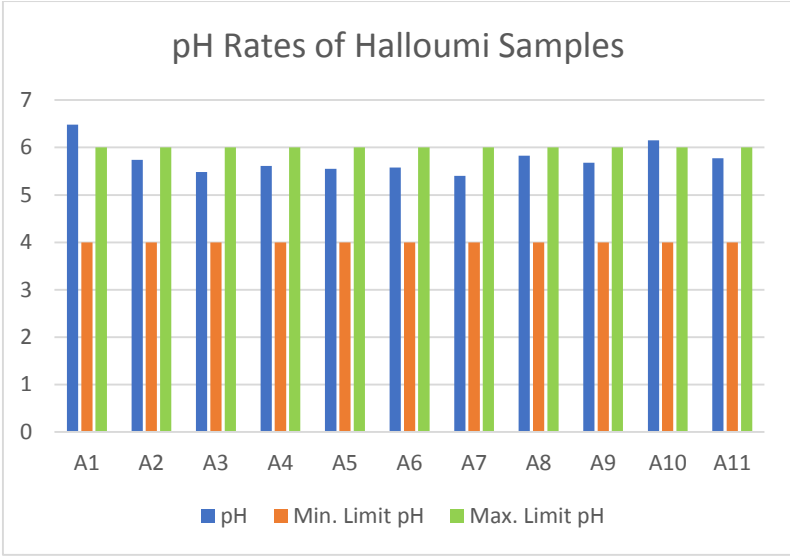

Figure 4.4: pH Rates of Halloumi Samples

Tablo 4.4: pH Rates of Halloumi Samples			
Samples	pH Value	Min. Limit pH Value	Max. Limit pH Value
A1	6,48	4,0	6,0
A2	5,74	4,0	6,0
A3	5,48	4,0	6,0
A4	5,61	4,0	6,0
A5	5,55	4,0	6,0
A6	5,58	4,0	6,0
A7	5,40	4,0	6,0
A8	5,83	4,0	6,0
A9	5,68	4,0	6,0
A10	6,15	4,0	6,0
A11	5,77	4,0	6,0

5.CONCLUSION

The determination and utilization of the strategy appropriate to the end goal of the tangible investigation are vital in getting solid outcomes. Accordingly, quality rules that influence the acknowledgment of food varieties by the buyer must be controlled by tangible tests. It is guaranteed that the best example or tests are chosen in tangible assessment. It is important to proceed with the examination of the quality attributes of halloumi cheeses delivered with various crude materials and creation methods as far as quality and standard item creation. For these studies, industrial and homemade halloumi cheeses purchased from markets and villages were analyzed in an accredited laboratory for dry matter (Drying Method), salt (Mohr Method), pH (HANNA Edge), and fat (Van Gulik Method) content analysis. All samples of halloumi cheeses have been analyzed with reference to properties in accordance with TS EN ISO / IEC 17065: 2012 standard (7). According to TS EN ISO / IEC 17065: 2012 standard, the maximum moisture percentage of fresh halloumi is 46%, and the maximum moisture percentage of

ripe halloumi is 37%, according to dry matter analysis. For fat analysis, fresh halloumi maximum moisture percentage is 43%, and ripe halloumi maximum moisture percentage is 40%. For salt analysis, the maximum moisture percentage of fresh halloumi is 5%, and the maximum moisture percentage of ripe halloumi is 6% (7).

For pH analysis, it should be a minimum of 4% and a maximum of 6%. In the dry matter analysis, fresh and mature halloumi values were found to be high in terms of maximum limits. In the fat analysis, fresh and mature halloumi values were not found to be high in terms of maximum limits. Fresh halloumi values were not found to be high in terms of the maximum limit in salt analysis, but the values were found to be close to the limit. One product exceeded the maximum limit in terms of mature halloumi values, other products did not exceed the maximum limit. Two halloumi product values for pH analysis exceeded the limit. Other halloumi product values were found under the limit. It is very important in terms of gastronomy tourism to protect our traditional and industrial cheeses with geographical indication and protect local production companies to bring unknown flavors to the surface. Geographical indication flavors introduced throughout the country without losing their unique characteristics, which can be produced in traditional and industrial sizes, will both allow the consumer to reach them more easily and satisfy the producer. When we look at our country in general, milk and dairy products draw attention among geographically indicated products with their wide product range. Chemistry analysis should be well-tested by experts, the scientific analysis should be complete and inspections should be frequent.

5.1 Recommendation

In this study, directed with cheese tests bought from the market to analyze the tactile properties of ındastrial and homemade halloumi cheeses delivered in Northern Cyprus, it is seen that the attributes of the creative techniques for halloumi cheeses are unique. The justification for these distinctions; It is believed to be identified with the method of raising dairy creatures, the feed plants utilized, the vegetation of the areas, the distinctions in the assortment of creature breed, and particularly the inclination of cow's milk or combinations of goat, sheep, and cow milk underway. The creation of modern halloumi cheese creation at the ideal level will add to the nation's economy and fares. Natively constructed halloumi cheese, then again, will offer more to the economy in the homegrown market with the cheeses delivered by rustic makers, when their item arrives at the ideal level. It will be advantageous to focus on consistency with sterile control programs at all basic marks of the creation of halloumi cheeses. Hand-crafted and

mechanically created halloumi cheeses, along with the examinations, are a significant item that has been made due to the current day is as yet delivered by people in general as indicated by the social construction and history of the country. It will carry its worth to the ideal level with the right perception of halloumi cheese by homegrown and unfamiliar shoppers and expanding the creation of halloumi cheese. As far as compound investigation of halloumi cheeses, particularly to improve their creation, it will be advantageous to focus on consistency with clean control programs at all basic places of creation, after the warmth treatment application. It was registered as a Protected Product of Origin Name and Protected Geographical Indications (PDO-Protected Designation of Origin) of Hellim / Halloumi in the European Union (EU). The inspection of Halloumi product's compliance with PDO requirements will be carried out by the internationally accredited inspection body Bureau Veritas. The producers who produce Hellim / Halloumi in accordance with the determined PDO conditions will have the right to use the registered name and PDO logo. The basic component analysis of food products is one of the analyzes that should be done both for quality assurance and legal aspects. Due to the effects of food on human health, they must meet the "Safe Food" conditions. The only way to question the safety of food is laboratory analysis and test results. The chemical composition of foods is important in revealing the sensory and nutritional properties of the product. For this purpose, speed, precision, and accuracy affect the analysis method to be chosen.

Official analysis methods are critical for the analysis of foods and are crucial for determining the compliance of foods with the law. It is a quality assurance system to establish basic hygienic principles based on defining and controlling food safety risks at every stage of the process from production to sales. In the production of chemical analysis results, attention must be paid to comply with the standards and not exceed the limit values. That is why, as soon as possible, halloumi cheese must be standardized by all producers in terms of production. Halloumi cheese produced in our country will now form the basis of the new food safety policy; The consumer should be informed about scientific advice, collection, and analysis of necessary data, control, and emerging risks. It is imperative that the state inspections be carried out thoroughly and the necessary arrangements are made accordingly. In a society, the production, marketing, and consumption chain must be a structure necessarily included in that people. There is a need for conscious, responsible, and educated producers, marketers, and consumers. Especially if the consumers are educated and conscious, it will affect both the production patterns and the patterns of the marketing sector and will

enable the economy and society to change. Consumers should pay attention to many issues related to the product when purchasing a food product, as food products have the property of perishable and unconscious use of the product can damage the health of the person. Increasing the education level and awareness of the consumers provides this attention. Today, consumers value information such as the name of the manufacturer, durability, and duration of use more than the price. As a result, the efforts of companies and the state to make conscious and careful food choices of the public will bring a conscious and healthy shopping environment in our country, and the creation of this environment will provide optimum efficiency to both many food companies and consumers. In order for consumers to know the characteristics of the goods they buy, there should be labels on food products that describe the product features in detail, and legal procedures should be applied for companies that do not show the necessary sensitivity. Considering that the demand for healthy and safe food products will increase day by day and that people's awareness of healthy eating increases with age and education, information and information about conscious food choice should be supported with new and wider researches. Regarding Halloumi cheese, which is the most important product of our country, we have achieved great success as a country, despite all the difficulties encountered by obtaining a geographical indication. However, after this process, we need to carry out the necessary inspections, protect the health of consumers and inform about our products, promote them abroad, and integrate them more against the domestic market.

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Investigation of V Addition to Ti-Nb Alloys Produced by Powder Metallurgy

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INTRODUCTION

Among the recently applied methods, Ti alloys produced by powder metallurgy (PM) have been found to be remarkable. Chemical composition control of the alloy can be achieved with the PM method. However, with this method, the subsequent machining operations are largely eliminated, mass production of parts with controllable porous structure in complex shapes close to the final shape or close to the final shape is ensured, and errors that may occur due to segregation during casting are prevented. Powder metallurgy has been developed as an alternative to production methods such as casting, hot and cold pressing, machining. Since coarse microstructures are produced by the casting method, powder metallurgy is seen as an effective way to promote a finer microstructure. Composites can be obtained by powder metallurgy method and materials such as surface wear resistance at high temperature, surface friction and surface tension can be increased. (1-3)

Among metallic materials, titanium and titanium alloys are the most suitable materials used in applications. Being a relatively light metal, titanium, although very expensive, is preferred because of its high strength. Other reasons why Ti alloys are preferred in industry are their low modulus of elasticity and corrosion resistance. Ti alloys react little with the surrounding tissue. Corrosion resistance is due to the stable surface TiO2 oxide layer. (4,5) Today, pure Ti and Ti-6Al-4V are widely used. However, the mechanical properties of pure Ti are lower than that of its alloy. For this reason, the alloying process was carried out using the Powder Metallurgy (PM) method using elements such as Al, V, Nb, Fe. Although powder metallurgy (PM) is not a new known process, it has only been used as an industrial process at the beginning of the 20th century. From the beginning to the present, the PM method has been widely used in various fields. As an example of

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these; tool steels, stainless steels, super alloys, aluminum and titanium alloys, copper and copper alloys, nuclear materials and cermets. (6-10) The parts produced by this method have a smoother surface compared to the parts produced by other methods and often do not require secondary processing. It has been determined that approximately 97% of the first material used in mass production with PM is used. In this direction, the production of the part is cheaper and in the desired composition, and also some parts that are difficult to produce and process with other methods are easily produced. By making changes on the value of the punch pressure, better quality and proper production of products in various forms can be achieved. In the literature, there are some studies on the production of Ti alloys by the PM method and the relationship between microstructure and mechanical properties. For example, Erden et al. (10) produced Ti and V microalloyed steel by PM method. The sintering process was carried out at 1150 ℃ for 60 minutes, and it was determined that there was an increase in yield and tensile strength as the Ti and V ratio (0.1-0.2%) increased. This was attributed to the formation of precipitates such as TiC(N) and VC(N) during sintering and cooling after sintering. The PM technique has been determined as the technique of producing parts close to the final shape. Taddei et al. (11) produced the Ti35Nb-7Zr-5Ta alloy using the P/M method. With the experimental data they obtained, they report that this alloy can be a candidate material for implant application due to its elastic modulus close to the bone. Wen et al. (12) fabricated the TiZr alloy foam material from Ti powder with 45 μm powder grain size and 150 μm Zr powders by P/M method. With the data they obtained, they suggest the elastic modulus close to the bone, the pore structure provided and its mechanical properties. (13-15)

Depending on the size, distribution, shape, dissolution temperatures and cooling rate of the carbon-nitrides formed by microalloying elements such as Ti, Al, Nb and V, the formation conditions are very important in terms of determining the mechanical properties. It is more difficult to control these properties in the casting method than in the powder metallurgy method. Erden et al. In this study, Nb-V microalloy steel alloyed with vanadium in different ratios was produced by powder metallurgy method and investigated how the amount of vanadium affects the mechanical properties. (16,17) Powder metallurgy production method; It is a manufacturing method in which metal and non-metal powders are produced and these produced powders are blended and mixed, then pressed in a mold to get the desired geometry and then sintering is applied. (18) This method consists of certain stages such as powder production, mixing the produced powders, pressing the powders, and sintering the powders . Very fine characteristic solid particles

with a size of less than 1 mm can be characterized as dust. Powders are usually metallic and the most important feature of a powder is that its volume is low relative to its surface area. The distinctive properties of the powder produced vary depending on the powder production methods and production parameters. (13,14)

The aim of this study is to investigate the effect of V additions on the microstructure and mechanical properties of Ti-Nb alloys produced by the PM method. In this study, the changes in microstructure and mechanical properties of TiNbMg-V alloy sintered at constant pressing pressure and constant temperature were compared.

Material and Method

To be used in the production of composite materials, 4 (four) kinds of mixtures were produced by powder metallurgy method. The properties of the powders used in the production phase of the samples were Ti, Nb, Mg and V with a purity of 99.9% and a grain size of 325 mesh. In the experimental studies, 1, 5 and 9% V powder was added to the TiNbMg matrix and produced by powder metallurgy method. The chemical compositions of the powders used in the experimental studies were prepared by weighing them according to the values given in Table 1.

Table 1. Chemical compositions of the produced test samples

Sample No	Ti (%)	Nb (%)	Mg (%)	V (%)
1	67	29	3	1
2	63	29	3	5
3	59	29	3	9

The mixing process was carried out in three-dimensional turbulence in order to homogeneously mix the powders, whose chemical composition ratios are given in Table 1 above. After this process, the pressing process was applied to the samples whose chemical composition was adjusted. As the pressing pressure, it was made under 600 MPa pressure. Sintering process was applied to the pressed samples. The sintering process was carried out in a tube furnace under Argon atmosphere for 60 minutes and at a temperature of 1050 ℃. After the sintering process, sanding, polishing and etching processes were applied to the samples for characterization processes (SEM and EDS) and XRD analysis.

Findings and Discussion

SEM Analysis Results

Scanning electron microscopy analyzes of TiNbMg composite samples produced by powder method by reinforcing V at different rates were performed (Figure 1). According to the results of this analysis, evaluations were made from the data obtained.

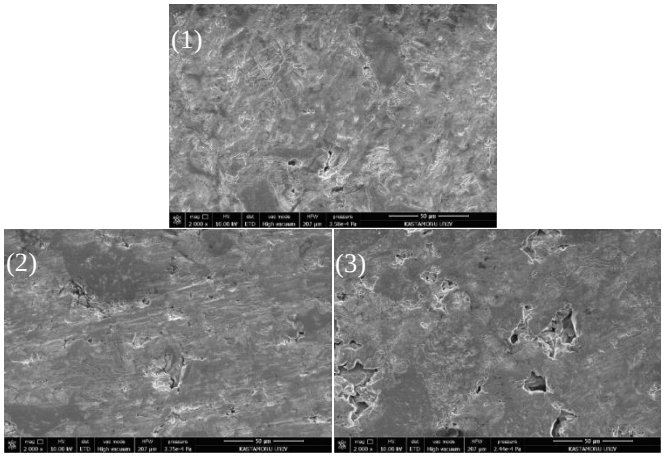
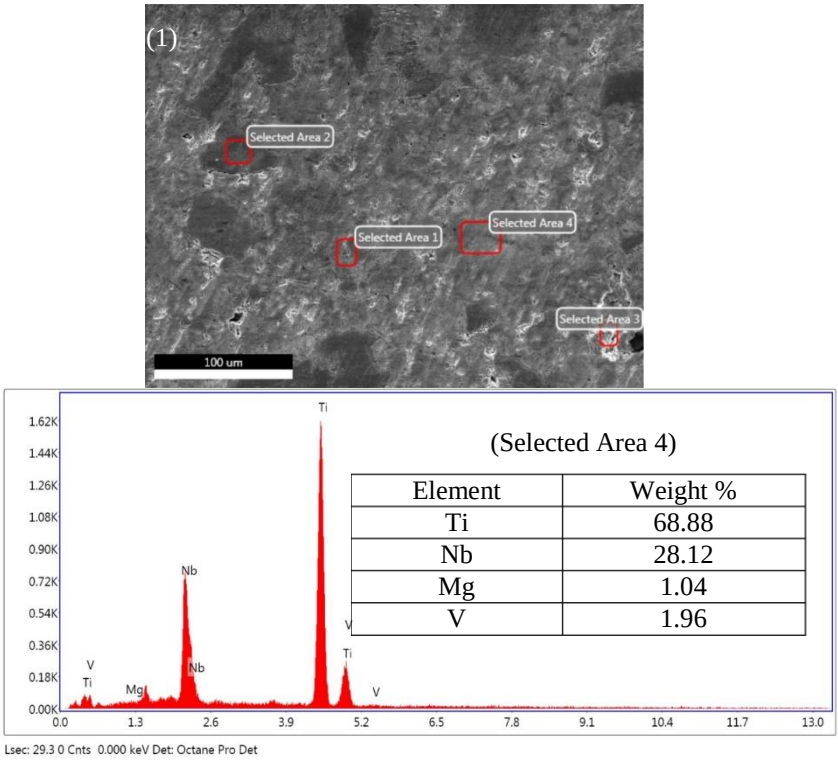


Figure 1. SEM images of the produced composites

The main structure of the TiNbMg compound is clearly seen in the SEM images given in Figure 1. It is clearly observed that V, which is added as reinforcement particles at different rates into this main structure, is homogeneously distributed. When the SEM images given above were examined, partial cracks and pores were detected in the samples produced. In addition, when the given SEM images were examined, it was determined that the amount of pores decreased and changed depending on the V addition rate. It has been determined that the homogeneous spread of the V material in the main structure depends on the mixing of the powders during the production phase and the correct sintering process. This determined situation is supported by existing studies in the literature. In addition, it has been determined that the V reinforcement particles added in different proportions are generally in irregular form and in similar form. (19-21)

SEM-EDS Analysis Results

SEM-EDS analyzes of composite samples produced by powder metallurgy method are given in Figures 2, 3 and 4 respectively.

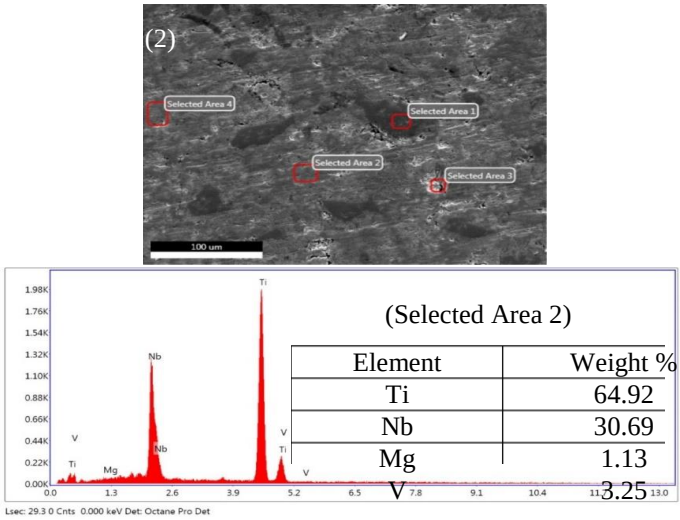


(Selected Area 4)

Element	Weight %
Ti	68.88
Nb	28.12
Mg	1.04
V	1.96

Figure 2. SEM-EDS analysis result of sample number 1 produced

When the analysis result of the 1% V reinforced sample given above was examined, it was determined that the produced composite sample supported the chemical ratios given during production. In addition, as a result of the characterization of the 1% V reinforced sample, it was determined that it was 68.88% Ti, 28.12% Nb, 1.04% Mg and 1.96% V according to the EDS analysis result taken from the region specified as selected area 4.



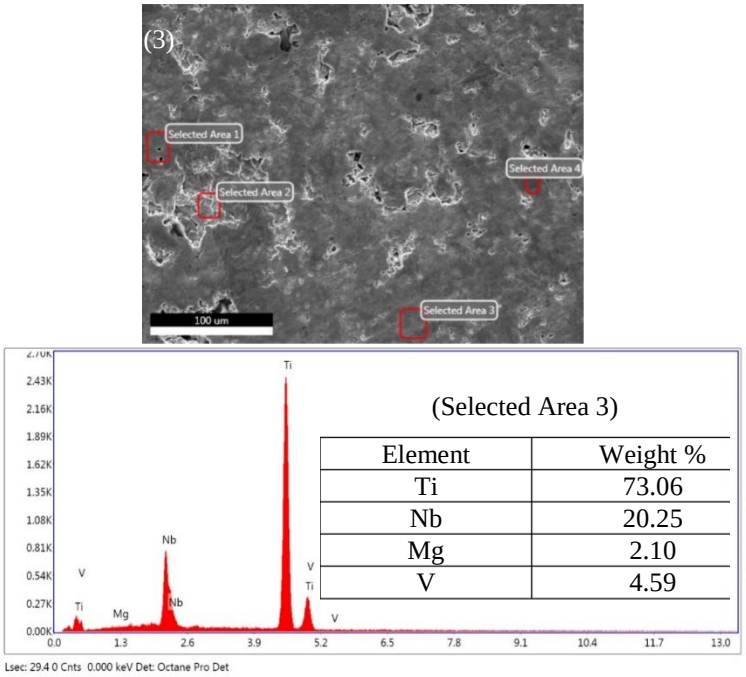
(Selected Area 2)

Element	Weight %
Ti	64.92
Nb	30.69
Mg	1.13
V	3.25

Figure 3. SEM-EDS analysis result of sample number 2 produced

When the analysis result of the 5% V reinforced sample given above was examined, it was determined that the produced composite sample supported the chemical ratios given during production. In addition, as a result of the characterization of the 5% V reinforced sample, it was determined that it was 64.92% Ti, 30.69% Nb, 1.13% Mg and 3.25% V according to the EDS analysis result taken from the region specified as selected area 2.

When the analysis result of the 9% V reinforced sample given above was examined, it was determined that the produced composite sample supported the chemical ratios given during production. In addition, as a result of the characterization of the 9% V reinforced sample, it was determined that it was 73.06% Ti, 20.25% Nb, 2.10% Mg and 4.59% V according to the EDS analysis result taken from the region specified as selected area 3.



(Selected Area 3)

Element	Weight %
Ti	73.06
Nb	20.25
Mg	2.10
V	4.59

Figure 4. SEM-EDS analysis result of sample number 3 produced

XRD Analysis Results

XRD graphics of composite samples produced by powder metallurgy method are given in Figure 6.

When the given XRD graph was examined, it was determined that Ti, MgNb, NiTi, MgV and V phases emerged. However, there was the presence of Ti, MgNb and NbTi compounds as the dominant phases. The phases we detected in this study were also determined in current literature studies. (22-24)

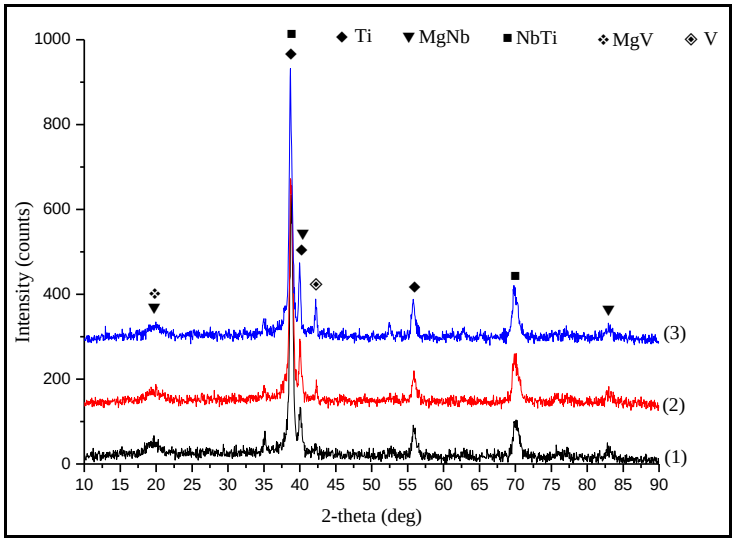


Figure 5. XRD graphs of the Composites produced

Conclusions and Recommendations

In this study, TiNbMg matrix composites produced by powder metallurgy method by adding V at different rates were produced. As experimental parameters; 600 MPa pressing pressure, 1050 ℃ sintering temperature and 1 hour sintering time were applied. SEM, SEM-EDS and XRD analyzes were performed on these samples produced as composite. Partially cracks and pores were detected in the samples produced in the SEM images. In addition, it was determined that the amount of pore decreased in the SEM images given, depending on the V addition rate. It has been determined that the homogeneous spread of the V material in the main structure depends on the mixing of the powders during the production phase and the correct sintering process. As a result of SEM-EDS analysis of the samples reinforced with V at different ratios, it was determined that the produced composite samples supported the chemical ratios given during production. As a result of XRD, it was determined that Ti, MgNb, NiTi, MgV and V phases were formed.

Acknowledgment

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Production of Mg-Reinforced Ti-Nb Matrix Composite by Powder Metallurgy Method: Microstructural Characterization

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Gülseren SAKARYA BULUŞ[3,4]

INTRODUCTION

Ti alloys produced by powder metallurgy (PM) have been found to be remarkable, among the recently applied methods, Chemical composition control of the alloy can be achieved with the PM method. However, with this method, the subsequent machining operations are largely eliminated, mass production of parts with controllable porous structure in complex shapes close to the final shape or close to the final shape is ensured, and errors that may occur due to segregation during casting are prevented. (1-4) Powder metallurgy has been developed as an alternative to production methods such as casting, hot and cold pressing, machining. Since coarse microstructures are produced by the casting method, powder metallurgy is seen as an effective way to promote a finer microstructure. Composites can be obtained by powder metallurgy method and materials such as surface wear resistance at high temperature, surface friction and surface tension can be increased. (5-8)

Depending on the size, distribution, shape, dissolution temperatures and cooling rate of the carbon-nitrides formed by microalloying elements such as Ti, Al, Nb and V, the formation conditions are very important in terms of determining the mechanical properties. It is more difficult to control these properties in the casting method than in the powder metallurgy method. Erden et al. In this study, Nb-V microalloy steel alloyed with vanadium in different ratios was produced by powder metallurgy method and investigated how the amount of vanadium affects the mechanical properties. (9,10) Powder metallurgy production method; It is a manufacturing method in which metal and non-metal powders are produced and these produced powders are blended and mixed, then pressed in a mold to get the desired geometry and then sintering is applied. (11) This method consists of

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certain stages such as powder production, mixing the produced powders, pressing the powders, and sintering the powders . Very fine characteristic solid particles with a size of less than 1 mm can be characterized as dust. Powders are usually metallic and the most important feature of a powder is that its volume is low relative to its surface area. The distinctive properties of the powder produced vary depending on the powder production methods and production parameters. (12,13) The aim of this study is to investigate the effect of Mg addition on the microstructural properties of Ti-Nb alloys produced by the PM method. In this study, the change in microstructural properties of TiNb-Mg alloy sintered at constant pressing pressure and constant temperature was compared.

EXPERIMENTAL STUDIES

Titanium (Ti), Niobium (Nb) and Magnesium (Mg) powders used in this study were obtained from Nanografi company. Ti, Nb and Mg powders are 99.9% pure and has an average powder particle size of 325 mesh. The sample of produced was mixed with three-dimensional turbula for 2 hour. The sample mixed in the this machine was subjected to the pressing of pellet process. Pressing of pellet process was done with GS15011 model and Specac brand press of pellet in the hydraulic in University of Kastamonu, Research of the Central Laboratory. The mold of sample in the cylindrical with a diameter of 13 mm was used as a mold in the pressing of pellet process. Pressure as a 600 MPa was applied as pressing of the pellet pressure. The pressed and massified samples were sintered under atmosphere control for almost three hour at 1100 ℃. The process of sintering of the sample was carried out with an controlled of atmosphere PTF 16 80 610 model furnace furnace in the University of Kastamonu, Research of the Central Laboratory.

Standard metallographic procedures were applied after the sintering process in order to obtain images from the test samples with scanning electron microscope. As sanding, polishing and etching, respectively ,these applied metallographic processes were applied Scanning electron microscope and energy dispersion spectrometry analyzes were taken from the Quanta 250 Feg model FEI brand device in the University of Kastamonu, Research of the Central Laboratory. The D8 Advance model Bruker brand device, Diffraction of X-Ray test analysis was taken from in the University of Kastamonu, Research of the Central Laboratory. Figure 1 is given as a flowchart.

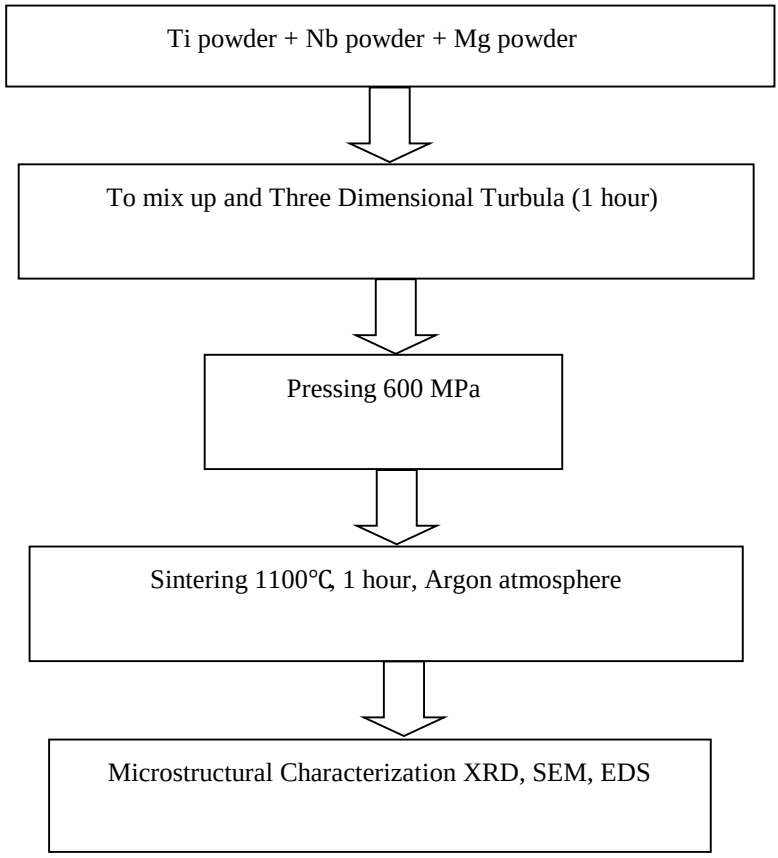


Figure 1. Flow chart of experimental studies

CONCLUSIONS AND DISCUSSION

The TiNb-Mg sample of the material was produced accomplishedly by pressing under 600 MPa pressure and sintering at 1100 ℃ temperature for 3 hour. In the Figure 2, SEM images taken from the produced samples are given.

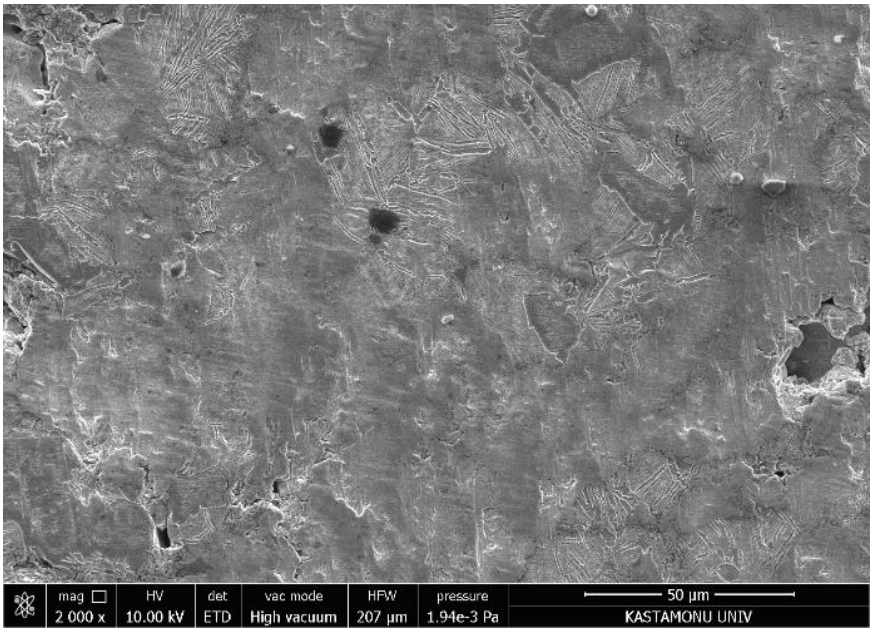
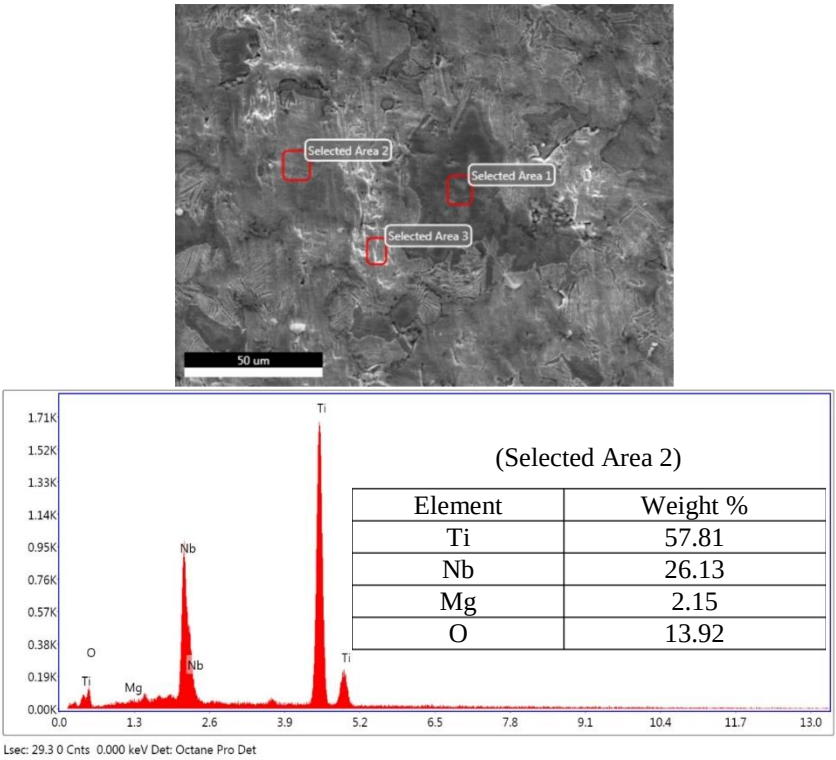


Figure 2. SEM image of the produced composite

When the SEM images given in Figure 2 are examined, it is clearly seen that there are two different structures. The light gray areas represent the TiNb matrix and the white particles represent the Mg. When the SEM images are examined, it is seen that the Mg particles are generally homogeneously distributed. (14-16)

SEM-EDS images taken from the produced TiNb-Mg composite are given in Figure 3.



(Selected Area 2)

Element	Weight %
Ti	57.81
Nb	26.13
Mg	2.15
O	13.92

Figure 3. SEM-EDS analysis result of Produced TiNb-Mg composite

SEM-EDS analyzes of the produced TiNb-Mg composite material are given in Figure 3.

EDS analysis is a method used to determine elemental composition from a sample. It is an analysis performed by sending a scanning electron beam onto the sample. The EDS analysis results given in Figure 3 support the chemical compositions of the produced sample. It has been determined that the produced samples have different ratios of Ti, Nb and Mg in their internal structures. (17,18)

XRD graph of TiNb-Mg composite produced by powder metallurgy method is given in Figure 4.

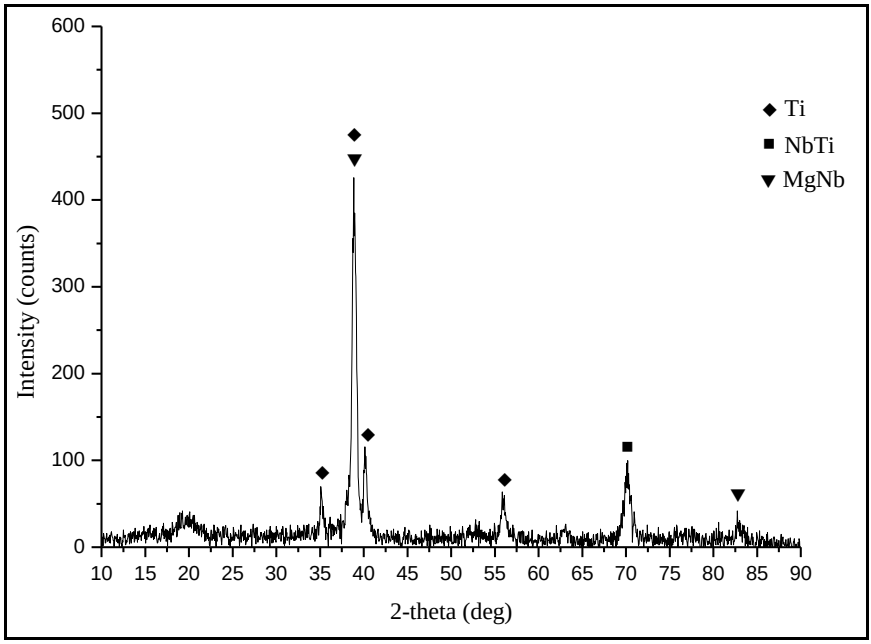


Figure 4. XRD graph of the composite produced

In the Figure 4 was examined, when the XRD graph given, it was determined that Ti, NbTi and MgNb phases were formed. Furthermore, it is luculently seen that the Ti phase dominates. Throughout the process of sample sintering, phases were formed between TiNb and Mg particles. In addition, it is thought that the addition of Mg creates associated solid solution between Ti and Nb in the composite material. (19-21)

Conclusions

In this study, TiNb-Mg composite sample was accomplishedly manufactured by powder metallurgy (PM) process. Scanning electron microscope and X-ray diffractogram tests were successfully applied to the produced sample of composite material. The state of the experimental results in the composite can be substanced as belows.

- ✓ It has been stated that Mg elements are homogeneously dispersed in the SEM view obtain from the composite.
- ✓ In the EDS test of outcome, the chemical composition of the manufactured sample was promoted and it was determined that the sample's internal structures had Ti, Nb and Mg elements in different ratios.

- ✓ XRD Ti, NbTi and MgNb peaks were detected.

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