

The Overview of Chemical Knowledge in Eighteenth Century Georgia According to the Chemistry Book by King Vakhtang VI

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Abstract: The article deals with political and educational-cultural situation in Georgia during the reign of King Vakhtang VI (XVIII century). It describes the book on chemistry compiled and published by Vakhtang VI. The methods of chemical experiments highlighted in the book are compared to the methods of early alchemists, such as: Jābir ibn Hayyān, Muhammad ibn Zakariyā Rāzī, Liebau and others. The article summarizes the methods to which Vakhtang VI agreed and also indicates the techniques, slightly differently presented in his records. The paper also points out how the King could get information on chemistry. It gives an assumption that the scientific information most likely was brought by travelers who were close to the king or was accumulated from the early period and was also linked with journeys.

Keywords: history of chemistry; book about chemical experiments; alchemists

1. INTRODUCTION

The presented article describes development of chemistry, as of a science, in the epoch of King Vakhtang VI and depicts his attitude towards this science.

Political situation

At the end of XVII century (the Kingdom of East Georgia was established in XV century, after the collapse of a single monarchy of Georgia) the king of Kartli, George XI, having fought against Iran's dominance for years, decided to conclude peace with the Shah and gain temporary peace for Georgia. Political situation in Iran was overstrained that time, especially after Afghans' riot. The Shah appointed George XI as the commander of Iran and sent against Afghan rebels. In 1703, the Shah appointed George's nephew Vakhtang as the ruler of Kartli.

Vakhtang carried out number of actions aimed at Kartli's strengthening: from faithful noblemen he

created "protectors' army", determined serfs' rights against the noblemen by law, defined the amount of rent, patronized the craftsmen and merchants; restored old and build new canals; built bridges, roads, caravanserais.... The king refurbished and renewed temples of Sioni and John the Baptist, Svetitskhoveli and Urnbnisi Churches.

For the purpose of reinforcing the Order, Vakhtang aggregated all the old Georgian laws into one collection and added his own statutes. Vakhtang's laws were applied throughout Georgia.

In 1709, the king of Kartli, George XI was killed by Afghan rebels. The next king of Georgia, Vakhtang's elder brother - Kaikhosro was also murdered by Afghans (1711). Shah demanded from Vakhtang to convert to Islam in order to become the king of Kartli, but Vakhtang flatly rejected and therefore was captured. Vakhtang's uncle and his tutor Sulkhan-Saba Orbeliani visited France twice and met the king Lui XIV in Versailles. According to historic sources, he had greatly impressed the king and his ministers. They attentively considered

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Orbeliani's proposal to send missionaries to Georgia, to use the territory of Georgia as a trading road and in return to liberate Vakhtang VI. These proposals were acceptable for the French royal court, but they preferred to abstain from active actions.

Sulkhan-Saba Orbeliani never lost his hope. From France he traveled to Vatican to ask help from the Pope, however, he was consoled with just encouraging promises.

That time, it was not so random from the side of Georgian politicians to seek political, cultural and trade connections with Europe. From the second part of XVII century the interaction between Europe and East became more active. French, England, Portugal and Holland were searching for new trade roads and were fighting for dominance in the East. Naturally these countries also showed interest in Georgia. As a result, the number of European merchants, travelers and catholic missionaries increased in our country. The missionaries were best at gaining trust of population, who except the propaganda of catholic belief, also spread education and provided medical assistance to Georgians, which, of course, resulted in an increased positive attitude towards them.

After several years of imprisonment, Vakhtang VI, who had converted to Muslim, returned to Kartli in 1719.

In 1722 the Russian emperor Peter I launched the campaign to conquer territories (being under Iran's domination) around Caspian Sea. Iran found itself in a very difficult situation. Afghans had appended the capital of Iran –Ispahan and conquered it. Turkish sultan also offered help to Vakhtang. Vakhtang VI chose Russia as an ally and with the army of 40 thousand soldiers he set for Ganja (the town in Azerbaijan) and there he waited for Russian army.

Vakhtang was waiting for three months in vain, but Peter I had changed his plans and decided to attack Darubandi (town located in south-north Caucasia) and conquer it. He had decided to stop the fight and go back, because fighting in Caucasia and allying with Georgia would entail acute reactions from Turkey. The peace between Russia and Iran proved to be very hard for Georgia. Russia recognized Iran's dominance in the East Georgia. In 1723, Shah gave Kartli to Muslim king of Kakheti - Konstantin, who had conquered Tbilisi. Soon the Turkish army invaded East Georgia. Vakhtang was forced to leave for Russia with 1200 retinue.

In 1724, the agreement was signed between Russia and Turkey. According to this agreement Russia recognized Turkey's dominance in eastern part of Caucasus (Including Kartli).

For Georgian emigrants the Russian Government allocated village Voskresenskoe (near Moscow). Georgian settlement was called "Georgian Sloboda". Nowadays, this territory is located within Moscow and is called "The Great Georgian"- "Большая грузинская". Soon this new settlement became the center of Georgian culture in Russia, emigrants actively continued to carry out scientific and literary activities.

Vakhtang VI tried his best, but couldn't get military help from Russia. Being disappointed, he left for Georgia and in 1735, on his way back Vakhtang VI died in Astrakhan. He was buried in Astrakhan, in the church of Assumption of the Virgin Mary [1].

Cultural-Educational Activity

In parallel, Vakhtang VI was engaged in active scientific, literary and translation activities. He made his name in Georgian history as a supporter of culture. Sulkhan-Saba Orbeliani, the king's uncle, played a major role in his personal development. Orbeliani wrote a book "Wisdom of Falsehood" particularly for Vakhtang, where he elaborated the conception of prince's education. Since his early childhood, Vakhtang was very close with his second uncle – great thinker, poet and public figure - Archil II.

In his youth, Vakhtang VI studied astrology. From Persian he translated two astronomic works "Ziji" and "The Book of Creation". For Georgian readers, Vakhtang provided Persian-Georgian astronomic dictionary, geographic coordinates for 244 towns, latitude and longitude of 250 geographic points and added them to his translation of "Ziji". Besides translating, he wrote two of his own works - "Khelta" and "Kvinklos".

Vakhtang rearranged "Karabadini" - the manuscript of XV century Georgian public figure - Zaza Panaskerteli. In that very period, an explanatory dictionary of Georgian language - "The collection of words" was created.

Vakhtang's work as a translator was not limited to only scientific literature. He has translated Persian classical work "Kabus-Name". Modern Georgian translator, Professor Levan Menabde writes:

“The starting point for Vakhtang had always been Georgian reality. He carefully studied “Kabus-Name”, specifically choosing the material for translation, and interpreted only the main parts. Vakhtang critically studied the text, discarded religious cover, excluded eastern themes and adapted it to Georgian reality” [2].

Vakhtang has also translated the famous work of Indian Literature -“Kilila and Damana” from Persian.

Vakhtang has translated “Apofthegmatus”, the collection of Sokrat’s and Roman emperors’ biography from Russian.

He thought, that by translating artistic and scientific literature, the literary and educational function of Georgian language could be revived. *“Georgia was repeatedly destroyed by enemies and it was hard to study Georgian language... I have translated books for Georgians to study and get interested in philosophy and be willing to philosophize on Georgian language”- wrote Vakhtang [3].*

Vakhtang has founded a “Commission of Learned Men”, instructing them to search for Georgian historical sources, edit the book “The Life of Kartli” and write the history of XIV-XVIII centuries.

“The Life of Kartli” tells the story of Georgia since the ancient times till the XIV century, combining the historical works created in different periods. The “Commission of Learned Men” also wrote the history of a new, yet unexplored period, XIV-XVIII centuries of Georgia, which required a colossal research work. It should be noted, that editing and supplementing works for “The Life of Kartli” were directly led by Vakhtang VI. Vakhtang's remarks are preserved on the survived manuscripts (on the records of “The Life of Kartli”).

The first typography was founded in Tbilisi in 1709. Vakhtang got priceless support from Antimoz Iverieli (clergyman from Rumania, Georgian by origin). Antimoz ordered his student- Michael Ishtvanovich to organize “typography houses”, which were built on the right bank of the river “Mtkvari”, between “Anchiskhati” and “Sioni” temples. The books were printed on paper imported from Europe and fully corresponded to world standards of those times. Twenty printed editions have survived up-to-date, out of which 10 were printed with the

participation of Mikheil Ishtvanovich. The rest were issued by his disciples. Most part of the published literature was of spiritual character (The Bible, the Old Testament and Oath). Some books of secular genre were printed as well- including “The Knight in Panther's Skin” by Shota Rustaveli [4].

Progressive ideas of Voltaire, Rousseau, Montesquieu, and other thinkers had a groundbreaking impact on the thinking of society, on the development of European political and social systems of that time. Unfortunately, since XV century, after the fall of Byzantine Empire, Georgia became separated from European and Christian civilization. The efforts of Georgian political and cultural figures – to restore ties with Europe failed to yield any tangible results for the country, being surrounded by Ottoman and Persian empires. The progressive ideas of educators began to spread throughout Georgia only after the end of XVIII century and therefore, they did not influence Vakhtang VI’s thinking and creativity. Since the end of XVIII, Georgian intellectuals started to get acquainted with the work of enlighteners more intensively. For instance, Voltair’s picture was hanging in the cabinet of Ioane Bagrationi, one of the members of the Royal family, and his encyclopedic work "Kalmasoba" was written under the influence of enlighteners’ ideas.

“Kalmasoba” - (Latin. - „quaerere“. Georgian. — „to go searching“, i.e. „searching“).

The second representative of Georgian Royal family, David Bagrationi made a special contribution to disseminating enlighteners’ ideas. He was the one to translate the works by Voltaire. Even the literary works of David Bagrationi were inspired by the ideas of French enlighteners.

Since the beginning of XIX century, the ideas of enlighteners are strongly felt in the works of Georgian writers and scientists.

Vakhtang VI- “The Book on mixing oils and making chemistry”, Tbilisi State University press. 1991.

Vakhtang’s book “The Book on Mixing Oils and Making Chemistry” reached our times in a form of manuscript containing 72 pages. The manuscript consists of 279 paragraphs; the text contains several draughts of chemical tools. It should be mentioned that under the term “oils” Vakhtang meant liquids of different ingredients. Thus the name of this book implies a chemical transformation through mixing

different liquids.

During his imprisonment in Ispahan, Vakhtang carried out fruitful literary and translation activities (1712-1714). Paragraph 64 reads: “*Tin exists of four types: one is in Yerevan, one in Kartli (in the Yeagluge), two are here, in Ispahan*”. These words confirm that Vakhtang began his work in Ispahan (Iran). Some part of the text was written in Tbilisi, after his return to Kartli. The last part of the book was written in Russia (1724-1737).

According to A. Chkhenkeli, the influence of alchemy, also the knowledge of chemistry obtained in Russia, Iran and French can be observed in Vakhtang’s book [5]. According to ethnographer M. Chartolani, paragraph 138 describes the method of preparing niello, also known in gold-work [6]. Vakhtang was quite well familiar with cinnabar, as mentioned below, so that he successfully tried to get the paint out of it, although, unlike alchemists, he did not expect to receive gold from it. He had information about Tezaab (Aqua Regina) and used to prepare it as well. Several times in his records we come across with “Aksira”, proving that he knew the works by Jabir.

M. Shengelia studied and published paragraphs of medical contents from chemical text written by Vakhtang [7]. According to his opinion, Vakhtang VI had carried out each chemical experiment himself. All the success and failure of each experiment was described by him with scientific honesty. According to M. Shengelia the technology of preparing glasses, as presented in this book, is the same as in modern optic workshops. He assumed that the optical workshop already existed in Georgia during the time of Vakhtang VI.

According to D. Bregvadze, Vakhtang began to write his book in Ispahan and continued in Kerman and Russia. The book is written in the form of a practical textbook. It is not a simple translation. Along with data gathering, Vakhtang elaborated the rules of obtaining certain mixtures and elements based on his own observation and wide scientific knowledge [8-9].

An interesting joint research belongs to T. Enukidze and V. Kokochashvili. They have managed to present the role of the book in terms of spreading knowledge of natural sciences and substantiate its scientific significance.

2. MATERIAL AND METHODS

1. Through critical analysis of the sources, we have studied the primary sources and scientific literature, systematized obtained information by thematic points.

2. While studying this issue, we have used a “comparative method”, enabling us to fill the gaps in historical data through comparing the developments and processes ongoing in different nations. comparative method allows to determine the similarities (an analogue) between the comparable societies, in their ways of thinking as such and define how these similarities are manifested. The method of comparison and analogy enabled us to compare Vakhtang’s opinion on different chemical process with the chemical conceptions and alchemical doctrines existing in his period. This gave us the possibility to determine:

- a) Research character of Vakhtang’s book;
- b) His original thinking;
- c) The level of influence of early or contemporary chemical and alchemical conceptions.

Comparison of trials and assumptions with already existing chemical knowledge, reviewed in Vakhtang’s book, convinced us that the book was not only a collection of known assumptions, but it was also an original scientific work, being used as a textbook in XVIII century Georgia.

3. For structuring the studied materials and achieved results according to the systematized scheme, we applied the synthesizing method.

This method involves the study of a subject or an event in its entirety, in interconnection of its parts. Through synthesizing method, we have defined interconnection among separate data sources, enabling to generalize the problem and perceive the data as a whole.

3. RESULTS AND DISCUSSION

Before Vakhtang’s book was published, books on chemistry were already available worldwide. The following is the list of some of them:

1. The book by Arab alchemist Jābir ibn Hayyān- “The Great Book of Properties” (VIII century);
2. The book by Arab alchemist Muhammad Ibn Zakariyā Rāzī- “The Secret Book of Mystery” (VIII century);

3. Egyptian alchemist Zosimos of Panopolis wrote the first encyclopedia, consisting of 28 volumes (IV century), later destroyed by Diocletian.
4. Albertus Magnus (Albertus the Great) wrote "The Book of Alchemy" (XIII century);
5. Rodger Bacon described gun powder in his book (XIII century);
6. Ramon Lull described water distillation method (XIII century); later on, this book was bought by King of Spain Philip II.
7. Pseudo Jabir also published draughts as a book (XVI century); [10-11].

Vakhtang's book slightly differs from the above mentioned books and contains the method of preparing various compounds. During that time Robert Boyle refused to use term "Alchemy" and established new term "chemistry". The people who served this science (yes, it was already considered as a science because until then it was perceived as craft) Boyle called "chemists". In 1661 he published the book "A Chemist-skeptic", where he wrote that a chemist must double-check each theory and fact in laboratory. Vakhtang VI also used the term – "Chemistry".

However, Boyle still thought that one metal could be transformed into Gold. It should be reminded that in 1689, by Boyle's insistent demand, the British government canceled the law on prohibition of gold transmutation. King Vakhtang has neither passed nor canceled any such law; however, he described his experiments in the book as though obtaining gold. Nevertheless, the text makes it clear, that the king did not believe in that.

The content of some of the paragraphs show that Vakhtang VI had written sources apart from the oral ones. For example, #128 begins as follows: "I've seen one manuscript describing how to make gold". Such records are contained in some other paragraphs as well.

#82 reads as follows: -"medicine that is said to transform silver into gold". It should be reminded that *aqua regia* as a mixture of hydrochloric acid and nitric acid was described by alchemist Andreas Libavius. It shows that Vakhtang had known about this mixture.

In addition, the book reveals Vakhtang's

knowledge about cinnabar. Experiment #42 was called- "Making the Cinnabar". #48 describes preparation of high quality cinnabar. For this purpose, iron sulfate (FeSO_4) should be added to sulfur and mercury. Prepared cinnabar needs to be sublimated. Vakhtang talked about quantitative measurements and wrote – "take two parts of sulfur and one part of mercury". As is known, alchemists did not pay attention to measurements. Jan Baptist van Helmont was the first alchemist interested in measurements. Afterwards, this method was founded by Lavoisier. Although the above-mentioned records show, that Vakhtang had information about the method of measurements.

#181 describes even more complex method of cinnabar preparation, using the powder of sandalwood instead of sulfur, while Mercury has to be taken in double quantity.

Cinnabar was known since the times of Egyptian alchemists, who considered sulfur and mercury as the basis for masculine and feminine and tried to get gold by mixing these two ingredients. Arabic alchemist Jābir ibn Hayyān thought, that as a result of sulfur and mercury interaction, only the grey powder was formed instead of gold, and explained the necessity of adding a process accelerant.

It should be underlined that cinnabar is the name of native mineral. Red paint was produced from cinnabar, which was actively used for various purposes. Vakhtang had known this, as shown from his last two records; therefore, he was trying to get exactly cinnabar and not just salt. Nothing is mentioned about cinnabar's transformation into gold. Thus, Vakhtang used cinnabar as paint. This is very important. Chemistry was already existing that time and alchemist's misconception was exposed, although there are facts in the history of chemistry when some chemists still carried out experiments for transforming metals into gold, for instance, such opinion was shared by Ioane Kunkel (XVII), and Johannes Becher (XVII), who were Vakhtang's contemporary German scientists.

Let's consider Jābir's view about accelerant. In VII century Jābir was searching a substance that could accelerate HgS transformation into gold. He believed it could be achieved without accelerant, though it would require lots of time. Jābir thought it was "certain" powder. In Arabian language powder is called "ixir", (article) "al" was added to it and a word "al ixir" was produced. Europeans slightly changed this term as a result of which a new word "elixir" was

created - same as “philosophical stone”.

Record #84 describes Vakhtang’s experiments of preparing elixir, making the reference to the word “Axir”. The purpose of elixir was to transform any metal into gold. This text is very similar to those of alchemists by style and is very difficult to understand.

Record #85 Vakhtang discussed elixir which could transform copper into gold. Copper was “connected” with gold by Bolus of Mendes. He melted it with zinc and obtained alloys brass. Vakhtang VI did not discuss alloys.

Record #89 Vakhtang discussed axire, which could transform mercury into silver, in other words, making mercury solid. If we remember the symbols of Egyptian alchemists, the symbol of silver was the half-moon, the symbol of mercury was assimilated with that of Mercury but sometimes it was presented by symbol of a reverse half-moon. Maybe alchemists were thinking that mercury could be transformed into silver.

Vakhtang VI believed that chemistry was an experimental science for the development of which experiments were needed and, furthermore experiments were necessary for solution of various issues. Vakhtang himself carried out number of chemical experiments. When experiment failed he underlined this facts - “*I have tried but can’t do*” (#102). This fact is confirmed by several drawings, depicting a laboratory vessel. It should be noted that that time glass containers were used and glass was boiled beforehand, since the book provides drawings of the stoves used for glass roasting.

Alchemical treatise reads about “spirits”. These spirits are chemical compounds having specific odor, for example ammonium salts (nuš×dir), arsenic (zirnīq), red arsenic-aromatic wax (al-zirnīqal-a-mar), arsenic sulfide (al-zirnīq al-a½far), yellow sulfur (al-kibrīt al-a½far), red sulfur (al-kibrīt al-a-mar) and white sulfur (al-kibrīt al-abyaÅ).

Record #19 reviews preparation of ammonia. The king calls this substance ammonia vodka. In #20, #21 Vakhtang explains the method of purifying ammonia through sublimation.

Record #50 describes the method of “Darishkani” preparation. It should be noted that in Georgian language arsenic is called “Darishkhani” and is very similar to word “Darishkani”. But this manuscript reviews mercury chloride $HgCl_2$ instead of arsenic. In his book “The Great Book”, Jābir writes

about preparation of mercury chloride. Based on Jābir’s methodology, Vakhtang obtains $FeSO_4 \cdot 7H_2O$ and red alum, heats it beforehand for water separation. He adds table salt to dehydrated salt, mixing up with mercury in glass vessels and heating it on sand bath. The king uses sublimation to purify “Darishkani”.

Record #51 describes mercury chloride preparation through different methods, using saltpeter. In addition to $HgCl_2$ nitrate is produced.

Oxide preparation is described in several paragraphs. Vakhtang had gathered some methods of niello preparation. The following was the method used by him: small amount of lead is added to three parts of copper and two parts of silver, after which this mixture is being melted and poured into sulfur powder. As a result, sulfides of those metals can be obtained. The black mass is niello. It is melted once more and powdered. According to the text, powder niello is washed by water, added by ammonia hydroxide and dried on fire.

Paragraph #262 describes the method of small shot preparing, indicating the advantage of adding a small amount of arsenic to melted lead.

“Preparation of colored glasses” is represented in a series of interesting paragraphs (#216-232), describing the method of glass preparation from rock crystal and potassium tartrate.

It is known, that practical chemistry, in particular, metallurgy, silicate production, dye works, and other part of chemical industry were well developed in Georgia. However, the manuscripts on chemical issues have not survived except one - Vakhtang’s book. It can be assumed that the king did not have a precursor in chemistry and all the terminology and the names in Georgian language were elaborated by him. These terms are “slaking lime”, “unslaking lime” and etc.

Vakhtang’s book clearly reflects the level of chemistry development, correctly describing the technology of preparation of many compounds. At the same time, it represented the basis of inorganic chemistry in those times. This book demonstrates Vakhtang’s creative potential, high scientific culture and his wide education.

Vakhtang’s source of information is unknown. Most likely, he got this information as manuscripts or books from Iran and Europe. For instance, the sources confirm that the part of information is translated by

Vakhtang from “The Book of Mystery” by Al-Rāzī. Al-Rāzī’s books greatly influenced the further development of alchemy in the East and West. His works were reflected in the books by Hakim al-kasy and Ahmad ibn ali al-Buni.

As influenced by Al-Rāzī, Vakhtang had grouped compounds into three categories: mineral, animal and plant. The mineral world is divided into six groups:

1. Arva (spirit), which contains Jiva (mercury), ammonia, zirnekh (natural compound of arsenic with sulfur) and sulfur;
2. Metals: gold, silver, copper, iron, tin, lead;
3. Stones: piece of thunder, mauni (stone from Kashan), rus, (iron), zinc, azure, turquoise and others;
4. Salt: sweet salt, bitter salt, pure white salt, salt of oil, salt of India KNO_3 ; Chinese salt and others;
5. Vitriol: black vitriol, yellow vitriol, white vitriol, red vitriol;
6. Borax; borax nan (of bread), borax from Magrib (borax of west), Red borax, borax of Goldsmith, the ground color borax.

Some part of “The Book of Mystery” was translated by Vakhtang word by word.

Vakhtang VI didn’t believe in the ability of metal’s transformation into gold. That’s why he translated only experiments of practical meaning from the book by Al-Rāzī. Vakhtang’s book contains some typical alchemical texts, although he had not believed in that.

It should be reminded that the King was forced to Persia and he was likely to learn the language as well. He could translate from Latin. Supposedly the books were brought by missionaries to Georgia, who visited the country in vast numbers for that period. As already mentioned above, they had their own interests, although in parallel they spread a new type of education and provided the king with the literature.

4. CONCLUSION

Thus, based on this research, it can be concluded that the first chemistry book in Georgia was written by Vakhtang VI. This book is a practical

textbook, aggregating various methods. Some of these methods were elaborated by Vakhtang VI.

The king gave high priority to practical chemistry and he was not influenced by alchemist’s ideas. For instance, he reviewed the substances needed for gold “transmutation” only from practical point of view (for example, he considered cinnabar as dye).

While studying the issue – “The Overview of Chemical Knowledge in 18th Century Georgia according to the Chemistry Book by King Vakhtang VI” , a „comparative method” turned out to be especially effective for usage, enabling to demonstrate the essence of research works carried out by Vakhtang VI, to outline his original findings and define the scale of impact of chemical knowledge/concepts spread in the beginning of XVIII century or in previous epochs, on the King’s scientific positions, to show that more or less he was acquainted with the works of alchemists and chemists, however disagreed with the possibility of gold transmutation. Vakhtang VI did not refer to it directly in his records, although he used the substances intended for transmutation for practical purposes, for instance: for making the Cinnabar paints.

5. REFERENCES AND NOTES

- [1] Javakhishvili, I.: The History of Georgian Nations. Tbilisi National Academy. 2012, pp.66-68.
- [2] Menabde, L.: Vakhtang VI (Life and Work). Printing house of Tbilisi University. 2011, pp. 78.
- [3] Vakhtang VI. Lyrics and Poems. Tb. 1975.
- [4] Lortkipanidze, E.: Vakhtang VI and workers of Georgian typography. Tbilisi, 1962. pp.35-36.
- [5] Chkhenkeli, A.: About one old Georgian manuscript with chemical content. The works of Georgian Medical Society, V.1. 1961. pp. 285-305.
- [6] Chartolani, M.: The Svan niello and its place in Georgian gold-work. “Moambe”, 1962. pp.149-154.
- [7] Shengelia, M.: Studies of the History of the Georgian medicine. Printing house of Tbilisi University. 1963. pp.297, 304.
- [8] Bregvadze, D.: Vakhtang VI in Iran. The work of Kutaisi State Pedagogical University, V. XXVI. 1963. pp.178.
- [9] Vakhtang VI. The Book of mixing oils and making chemistry. Printing house of Tbilisi University. 1991.. pp. 10-88.
- [10] Azimov, A.: History of Chemistry. Press “Мир”. Moscow. 1983. pp.34-50.
- [11] Karimov, U.: The unknown work of Al-Rāzī. The great book of mystery. Tashkent, 1957. pp. 60-62, 156.