ORIGINAL RESEARCH PAPER

Unani

KEY WORDS: *Shibb-e-Yamani,* Phitkari, Alum, Astringent, Unani medicine

PHARMACOLOGICAL INVESTIGATIONS ON *SHIBB-E-YAMANI* (ALUM) – A REVIEW

Umar Hussain Senior Research Fellow, DSRU, Central Council for Research in Unani Medicine, New Delhi.

Zaki Ahmad Research Officer, Central Council for Research in Unani Medicine, New Delhi.

Shah Alam* Research Officer, Central Council for Research in Unani Medicine, New Delhi. *Corresponding Author

ABSTRACT

Shibb-e-Yamani (Alum) commonly known as phitkari is a mineral origin drug. It has been used in Unani system of medicine from time immemorial. The earliest discussion of Alum can be traced back in the works of ancient Greek physician Dioscorides subsequently described by Arab physicians especially by Razi in detail. Alum is a colorless, transparent, odorless crystalline mass with a sweetish astringent taste having astringent, haemostatic, caustic, styptic, antispasmodic and antiseptic properties. It is therapeutically used in various diseases like leucorrhoea, haematuria, haemoptysis, menorrhagia and other haemorrhages. It is externally used in a number of diseases such as uterine and anal prolapse, bleeding from nose, gums, vagina and rectum, excessive sweating in armpits, groins and soles of the feet. This review is an attempt to compile and document information on different aspects of *Shibb-e-Yamani* (Alum) mentioned in classical Unani as well as contemporary literature. The mineral drug has been suggested to be taken up for further scientific investigations so as to validate the medicinal claims presented herein and to utilize its maximum therapeutic potential.

INTRODUCTION

Alum, also known as alumen, white alum, potash alum, aluminium potassium sulphate dodecahydrate is a compound of potassium, aluminium, sulphur, and oxygen. The term alum is applied to a group of hydrated double salts like aluminium potassium sulphate usually occurs as white small crystals or powder characterized by easy solubility in water and strongly astringent taste. The common alum which is commercially the most important refers to potassium aluminium sulphate, also known as potash alum. Alum used to be obtained from alum shales but it is now almost entirely manufactured from bauxite and cryolite.

The ancient Greeks and Romans were familiar with the compound alum. It was mined in early Greece where it was sold to the Turks. Turks used the compound to make a beautiful dye known as Turkey red. Records indicate that the Romans were using alum as early as the first century B.C. Alum was employed by the Egyptians and Romans as a mordant in dyeing and in the treatment of leather. For several centuries now, it has been used as flocculating agent in the purification of water. It has many other important applications such as in medicine and in paper, glass, rubber, paint and sugar industries. Alum is also used in fire extinguishers, in baking powders and in the preparation of various salts.

It is often mixed with impurities and may be rendered fit for medicinal purpose by dissolving it in boiling water, straining the solution and evaporating it so as to obtain crystals, which should be preserved for use. Alternatively, it is to be heated at 400°F and get liquefy which upon drying turned into a white crust. This, in Unani terminology, is called "*Shibb-e-Yamani biryan*" or "*Phitkari shagufta*" (Anonymous, 1972; Nadkarni, 1989; Rafiquddin, 2001).

Vernacular Names And Etymology

(Nadkarni, 1989)

Arabic	:	Zaaj-e-Abyaz, Zaaj
Bengali	:	Phatkiri
English	:	Alum, Alumen
Gujarati	:	Phatkari
Hindi	:	Phitkari, Phitikhari
Kannada	:	Phatikara
Malayalam	:	Tawas
Marathi	:	Phatki, Turati
Persian	:	Shibb-e-Yamani, Zak-e-Safed, Zak-e-Bilor
Sanskrit	:	Sphatikari, Surashtraja, Kamakshi, Tuvari
Sinhalese	:	Shina-karan
Tamil	:	Patikaram, Padikharam
Telugu	:	Pattikaramu, Padikharam
Urdu	:	Phitkari

Natural Sources

Alum occurs naturally in the form of alum shales which are thinly bedded, easily fissile rocks containing varying quantities of small, sometimes microscopic, and well disseminated crystals and grains of iron pyrites. When exposed to the action of the air, the pyrites oxidizes, and the acid solutions so generated react upon the aluminous compounds present, and form sulphates of aluminium or alums. The natural weathering of shales is usually too slow to produce important quantities of alum, but such materials have been worked in the past, at many places, by accelerating normal weathering. Alum used to be obtained from alum shales, found in several countries (Italy, Queensland, Arizona etc.) of the world, but it is now synthetically manufactured from bauxite, bauxitic clays and cryolite. Later on, it is purified by a process of recrystallization. Large reserves of Bauxite are found in Australia, Brazil, Guinea, Jamaica, Russia, and the United States. Alum shales also occur in various states of India viz. Assam, Meghalaya, Bihar, Himanchal Pradesh and Rajasthan. (Anonymous, 1972)

Description

Alum a hydrated double salt of aluminium potassium sulphate is one of the most important of aluminium minerals. Its use in purification of drinking water is well known since Roman times. Aluminium potassium sulphate occurs as white solid crystals or powder at room temperature. It is a hygroscopic material which when exposed to air, absorbs water. Depending on the amount of water molecules present, these hydrates are represented by the chemical formulas $AlK(SO_4)_2.12H_2O$ or $K_2SO_4.Al_2(SO_4)_3.24H_2O$. The powder form, made up of crystals, has a melting point of 92.5°C (198.5°F) and can be readily dissolved in water but insoluble in acetone. It is astringent and acidic. When heated it liquefy; and if the heating is continued, the water of crystallization is driven off, the salt froths and swells, and at last an amorphous powder remains. It fuses at 92 °C (198 °F) in its own water of crystallization. This salt has a property known as astringency which is an ability to constrict body tissues, and restrict the flow of blood. There have been many industrial applications of aluminium potassium sulphate. It is an important part of many

products created by the pharmaceutical, cosmetic, and food industries because of its astringency property. It is also used in the manufacture of paper, dyes, glue, and explosives. Additionally, it helps in the water purification process, and acts as a catalyst in various chemical reactions (Anonymous, 1972).

Chemical Constituents

Alum is a group of hydrated double salts, consisting of aluminium sulphate, water of hydration, and the sulphate of another element. It forms a whole series of hydrated double salts results from the hydration of the sulphate of a singly charged cation *(e.g.* K^+) and the sulphate of any one of a number of triply charged cations (*e.g.*Al^{3+}). Aluminium sulphate can thus form alums with sulphates of the singly charged cations of potassium, sodium, ammonium, cesium and other elements. In similar fashion, sulphates of the triply charged cations of iron, chromium, manganese, cobalt, and other metals may take the place of aluminium sulphate. The most important alums are potassium aluminium sulphate, ammonium aluminium sulphate, and sodium aluminium sulphate. Potassium aluminium sulphate, also known as potassium alum or potash alum, has a molecular formula of $AlK(SO_4)_2 \cdot 12H_2O$; or $K_2(SO_4) \cdot Al_2(SO_4)_3 \cdot 24H_2O$.

Alums can easily be produced by precipitation from an aqueous solution. In producing potassium alum, for example, aluminium sulphate and potassium sulphate are dissolved in water, and then upon evaporation the alum crystallizes out of the solution. A more common production method is to treat bauxite ore with sulphuric acid and then with potassium sulphate. Ammonium alum is produced by the evaporation of a water solution containing ammonium sulphate and aluminium sulphate. It can also be obtained by treating a mixture of aluminium sulphate and sulphuric acid with ammonia. Alums occur naturally in various minerals. Potassium alum, for example, is found in the minerals kalinite, alunite, aluminite, alunogen and leucite which can be treated with sulphuric acid to obtain crystals of the alum (Anonymous, 1972).

Temperament (MIZAJ)

Hot^1 & Dry^1 (Nigwami, 1985; Rafiquddin, 2001); Hot^2 & Dry^2 (Sina, 1998); Hot^3 & Dry^3 (Haleem, 1948); Hot^2 & Dry^3 (Nasir, 1886); Cold & Moist (Ali, 2010; Baitar, YNM)

Dose (MIQDAR-E-KHURAK)

Sawa char Jau - 2 masha, (Ghani, YNM); 125 mg – 3gm (Ali, 2010); 4 grain (Nasir, 1886); 2-4 Ratti (Nigwami, 1985); Phitkiri Shagufta -15 mg (Rafiquddin, 1985)

Pharmacological Actions & Uses (afaal-wa-khawas -wa-Istemal)

Actions and uses	References
Astringent (Qabiz)	Ghani YNM; Bhaghdadi 2005; Majusi 2010; Ali 2010; Baitar YNM; Sina 1998; Nigwami 1985; Nasir 1886; Nadkarni 1989; Anonymous 1972
Calorific (Musakhkhin)	Baitar YNM; Kabiruddin,2007; Haleem,1948
Corrosive agent (Akkal)	Baitar YNM; Hakim HMA, 2002; Rafiquddin, 1985; Kabeeruddin, 2000; Nadkarni, 1989; Anonymous, 1972
Cleansing agent (Jaali)	Baitar YNM; Nigwami, 1985; Nasir, 1886; Hakim HMA, 2002; Haleem,1948; Al-Maghribi , 2007
Desiccative (Mujaffif)	Sina, 1998; Nigwami, 1985; Nasir, 1886; Al-Maghribi , 2007; Kabiruddin,2007; Haleem,1948
Haemostatic (Habis-ud-dam)	Ali, 2010; Baitar YNM; Sina, 1998; Nigwami, 1985; Nasir, 1886; Nadkarni, 1989; Ghani YNM; Rafiquddin, 1985
Antispasmodic (Daf-e-Tashannuj)	Ali, 2010; Nadkarni, 1989; Ghani YNM
Antiseptic (Daf-e-Ta'ffun)	Ali, 2010; Nadkarni, 1989; Rafiquddin, 1985
Irritant (Laazay)	Nadkarni, 1989
Purgative (Mus'hil)	Nadkarni, 1989
Emetic (Muqi)	Nadkarni, 1989; Kabeeruddin 2000; Kabiruddin,2007
Abortificient (Musaqqat-e-Janeen)	Baitar YNM; Kabeeruddin 2000
Contraceptive (Man-e-hamal)	Baitar YNM
Anti intermittent fever (Dafe' naubat-e-Tap)	Kabeeruddin, 2000; Kabiruddin,2007
Antipyretic (Dafe' Tap-e-Larza)	Rafiquddin, 1985
Anti-conjunctivitis (Mane'-Aashob-e-chashm)	Rafiquddin, 1985
Diuretic (Mudir-e- Baul)	Kabiruddin,2007
Lithotryptic (Mufattit-e-Sang-e-Gurda-wa-Masana)	Hakim HMA, 2002
Mughalliz-e-Mani (Semen retentive)	Ghani YNM; Kabiruddin,2007
Anti-inflammatory (Muhallil-e-Auram)	Ghani YNM
Anti-flatulent (Muhallil-e-Riyah)	Hakim HMA, 2002
Stimulant (Muharrik)	Bhaghdadi, 2005; Al-Attar, 1889; Majusi, 2010
Anti obesity (Muhazzil)	Al-Maghribi , 2007
Demulcent (Mulattif)	Ghani YNM; Majusi, 2010
Hair growth agent (Munbit-e- Sha'r)	Al-Maghribi , 2007
Healing agent (Mundamil-e Qurooh)	Rafiquddin, 1985
Teeth and gums strengthening agent (Muqawi Dandan wa Lissa)	Hakim HMA, 2002; Haleem,1948

Adverse Effects (MUZIRAT)

Prolonged and excessive use of *Shibb-e-Yamani* may produce adverse effects and may be injurious to lungs by virtue of its *Quwate Tajfeef* (Bhaghdadi, 2005; Al-Attar, 1889; Haleem, 1948). Inhalation of alum may cause lung damage (Nasir, 1886) while ingestion may induce vomiting. It may also produce *Sil wa Diq* (i.e. tuberculosis) of Stomach & Intestine. (Ghani YNM; Al-Maghribi, 2007; Haleem, 1948)

Corrective (MUSLEH)

To reduce adverse effects on lungs and intestines Roghane zard (ghee) and milk are recommended (Haleem, 1948; Hakim HMA, 2002) while use of Tar ashya (moist dietary articles) –sugar, honey and mucilage advised for cough. (Ghani YNM; Rafiquddin, 1985) Biryan karda Phitkari is advocated for minimising stomach and intestinal affections (Nasir, 1886)

Substitute (BADAL)

Certain drugs like Noushadar i.e. Ammonium chloride (Ghani YNM; Rafiquddin, 1985), Namk-e siyah i.e. sodium chloride (Nasir, 1886), ashkhar / khar / saji (Al-Maghribi, 2007), phitkari surkh (i.e.red alum), and kafe darya i.e. Cuttle fish bone (Rafiquddin, 1985; Hakim HMA, 2002) are considered as substitute of alum.

Formulations (MURAKKABAT)

Shibb-e-Yamani or alum is an ingredient of the several compound formulations viz. *Dawa-e-Suzak, Habbe Siyah, Jauhar-e-Kalan, Kushta Hadtal, Safoof-e-Indri Julab, Safoof-e-*

Surkh, Shiyaf-e-Ahmar, Shiyaf-e-Zufra, Sunoon-e-Zard, Sunoon-e-Kalan, Sunoon-e-Khas, Sunoon-e -Supari, Tila-e-Surkh, Zaroor-e-Bhodal Kushta (Kabiruddin,2010), *Jauhar-e-Naushadar, Kushta Murakkab, Kushta Gaudanti, Kushta Sammulfar, Kushta sang-e -basri, Kushta sang-e-Jarahat, Kushta Seesa, Kushta Shingraf,* (Kabiruddin YNM), *Kuashta Para,* (Firozuddin,2007), *Safoof-e-Istehaza* (Ali,2010)

Pharmacological Activities

Anti-Hemorrhagic:

Patients of malignant hemopathies who developed cyclophosphamide-induced hemorrhagic cystitis were treated by continuous irrigation of the bladder with potassium alum. Hematuria ceased with 75% success rate in the treatment (Gattegno, 1989). In a trial of 45 patients with tonsillectomy, Aluminium potassium sulphate (>99% pure) used as haemostatic agent and gauze pack on the other side in the tonsillar fossae reduced the operation time significantly (28.6%), functioning blood loss by 19.7% and the number of ties used by 33.3% in comparison with control (Al-Abbasi, 2009).The efficacy of alum in intravesical irrigation was analyzed after application to 9 patients with continuous and severe Urinary bladder haemorrhage. The bleeding Causes were radiation cystitis in 4 patients, vesicle invasion by cervical cancer in 3, bladder cancer in 1 and cyclopho sphamide-induced cystitis in 1. Although alum treatment was initially efficient for control of considerable bladder haemorrhage in all patients, eventually it failed to check the bleeding in 2 patients (78% success rate) (Takashi,1988). Continuous vesicle irrigation was performed with 1 per cent alum solution without anaesthesia in 9 patients in whom massive bladder haemorrhage persisted despite evacuation of clots and normal saline irrigation for at least 24 hours. Hematuria ceased promptly in all patients, although the effect was transient in 3. There was no side effect observed. No alteration showed in the histological characteristics in biopsy of the tumour subsequent to alum irrigation. Biopsy of the normal-appearing bladder mucosa also showed no evidence of epithelial damage (Goel, 1985)

Antimicrobial activity:

Antibacterial activity was reported of potash alum when it is added to water, against various epidemic causing enteric pathogens like Vibrio cholerae 01, V. cholera 0139 and Shigella dysenteriae 1, by lowering the pH of water (from 6.0 to 4.0). Potash alum was found to check the growth 10(5) viable counts per ml of most of the organisms examined, particularly V. cholera 01 and V. cholerae 0139 in a dose dependent fashion. Reduction of colony forming units in presence of 0.25 g/dl of alum after 5 h was observed and no growth was noticed after 24 h (Dutta, 1996). A in vitro study on efficacy and safety of Potassium Aluminum Tetra-oxo-sulphate (Alum) in the treatment of tuberculosis using the proportion method revealed that at 0.003g/ml of highest concentration, Mycobacterium tuberculosis showed resistant to the alum extract where as Streptomycin (standard drug) inhibited the growth of M. tuberculosis at the similar concentration. Various organ on histological analysis displayed normal morphology with no sign of inflammation. No significant weight difference was observed and no any mortality recorded during the experimental process. The histological studies revealed that at concentration used alum was relatively safe for mammalian use, but it was insignificant against M. tuberculosis (Osuala, 2009). Antimicrobial activity was evaluated of crude extract prepared from alum and clove against S. aureus, S. epidermidis, E. coli, Klebsiella pneumonia. Over different concentration (10, 20, 30, 40 and 50) w/v %, by in vitro bioassay using agar well diffusion method and minimum inhibitory concentration and the diameter of inhibition zone were determined. It exhibited antibacterial and growth inhibition activity of gram positive and negative bacteria isolated from different sites of infection and the effect was also compared with standard cefotaxime (Bnyan, 2014).Antimicrobial activity of Alum, propolis and plant aqueous extracts at 50% concentration by well-diffusion method was characterized by inhibition zones, the maximum inhibition zone diameters 35mm, 40 mm were found in *Salvadora persica* and alum respectively, for propolis the inhibition zone was 30 mm. (Mohammad,2013)

Spermicidal activity: Spermicidal effect Viability and motility of alum vary with different concentration of potash alum. In case of 15% concentration the death time was 51.9% sec in case of 10% it was 87.2 sec and in case of 5% it was 122.1sec (Singh, 1998).

Anticariogenic effect: The anticariogenic effect of alum containing mouth rinses by measuring the salivary S mutans levels of children showed significant reductions in S mutans levels in children (Mourughan, 2004). In another study children using saturated saline rinse and alum rinse showed significant reductions in salivary S. mutans counts after 10 and 21 days over the placebo rinse group, the alum group showed significant difference over the saturated saline rinse group (Rupesh, 2010).

Anti-obesity effect: In Wistar rats fed on high fat diet, oral intake of potash alum exhibited significant reduction in body weight, food intake, serum triglycerides, total cholesterol and high density lipoproteins, whereas increased the dry weight of feces, total lipids in feces compared to control (Ahmed, 2012).

Ulcer healing activity: Randomized double-blind placebo controlled study was done on 52 patients with recurrent aphthous ulceration divided in 5 groups (1, 3, 5, 7 %) of alum suspension, and placebo (applied topically four times daily for five days). In clinical evaluation of subjective treatment response and duration of lesion healing significant reduction was noted in 3, 5, 7 % of alum concentrations in respect of the time required for complete healing of the ulcer when compared with placebo group (Altaei, 2005).

Larvicidal effect: Larvicidal potential of potash alum was investigated on A. stephensi under laboratory conditions. Potash alum was also found to be effective against all instar larvae. The LC50 and LC90 value of alum among various larvae on 24 hour' exposure ranged between 2.1 to 48.74 ppm and 15.78 to 93.11 ppm, respectively (Preet, 2010).

CONCLUSION

Unani medicine opens avenues in the search for new and alternative drugs. Hundreds of mineral origin drugs listed in the classical text have been in use for various ailments since antiquity. *Shibb-e-Yamani* is one of the important mineral drug which should to be validated for the claims made by Unani physicians regarding its therapeutic efficacy through conducting research studies. Preclinical and clinical studies have demonstrated antibacterial, antiplatelet, haemostatic, healing, larvicidal, anti-obesity and spermicidal etc. activities. Although various scientific studies have proved most of the claims of traditional Unani medicines. However, further detailed clinical research appears worthwhile to explore the full therapeutic potential of this drug in order to establish it as a standard drug.

REFERENCES

1. Ahmed Z, Afzal M, Kazmi I, Gupta G, Ahmad I, Anwar F. Anti-obesity potential of Potash Alum: Pharmacological and Biochemical Approach. Int J Pharm Pharm Sci 2012;4(4):90-93.
2. Al-Abbasi AM. The Benefit of Alum in Tonsillectomy. Gomal Journal of Medical Sciences 2009;7(2):124-127.
3. Al-Attar Z. Ikhtiyarat-e-Badiei. Lucknow: Matba Nawal Kishore; 1889. p.108.
4. Ali S Safiuddin. 2010. Unani Adviya Mufarrada, 5th edition, Qaumi Council Barae Faroghe Urdu Zaban, FC-33/9, Institutional Area, Jasola. New Delhi: p. 298-300.
5. Al-Maghribi ASBI. 2007. Kitab Al-Fatah Fi Al-Tadawa Min Jamie Sunufil Amraz Wa Al-Shakawa (Urdu Translation by Hakim Abdul Bari). 1st ed. New Delhi: CCRUM; p.106.
6. Altaei TS, Al-Jubouri RH. Evaluation of the efficacy of alum suspension in treatment of recurrent ulcerative ulceration. J College Dentistry 2005; 17(2): 45-48.

7. Anonymous.1972. The Wealth of India, Raw Materials-Vol. I (A to Be), Publications and Information Directorate, CSIR, New Delhi: p.209-210.
8. Baitar Ibn. YNM. Jame-ul-Mufaradat Advia-wal-Aghzia, (Urdu Trans) Vol. III, CCRUM, New Delhi: p.118-119.
9. Bhaghdadi AIH. 2005. Kitab Al-Mukhtarat Fit-Tibb (Urdu Translation by CCRUM). 1st ed., Vol. II. New Delhi: CCRUM. p.127-129.
10. Bnyan IA, Alta'ee AH, Kadhum NH. Antibacterial Activity of Aluminum Potassium Sulfate and Syzygium Aromaticum Extract Against Pathogenic Microorganisms. Journal of Natural Sciences Research 2014;4(15):11-14.
11. Dutta S, De SP, Bhattacharya SK. In vitro antimicrobial activity of potash alum. The Indian journal of medical research 1996;104:157-9.
12. Firozuddin M. Madanul Akseer. New Delhi: CCRUM; 2007. p.22, 26, 40, 43, 47-171.
13. Gattegno B., et al. "Treatment of hemorrhagic cystitis caused by cyclophosphamide using intravesical instillation of potassium alum. Apropos of 5 cases." Annales d'urologie 1989;24(3). p. 190-192.
14. Ghani N.YNM. Khazainul-Advia. New Delhi: Idara Kitab Al-Shifa. p. 482.
15. Goel AK, Rao MS, Bhagwat AG, Vaidyanathan S, Goswami AK, Sen TK. Intravesical irrigation with alum for the control of massive bladder hemorrhage. J Urol 1985;133(6):956-7.
16. Hakim HMA. Bustanul-Mufradat Jadid. New Delhi: Idara Kitab Al-Shifa; 2002. p. 176-77.
17. Haleem MA. 1948. Mufradat-e-Azizi (Urdu), Matba Sahitya Mandir Press Ltd, Luckhnow: p.55; p.69.
18. Kabeeruddin HM. Makhzan Al-Mufradat. New Delhi: Faisal Brother; 2000.p. 141, 142.
19. Kabiruddin HM. Bayaz-e-Kabeer Vol-II. New Delhi: Idara Kitab Al-Shifa; 2010.p.60, 35, 23, 112, 212, 139, 179, 56, 158, 72, 78, 160, 79, 114, 116, 13.
20. Kabiruddin HM. Ilmul Advia Nafisi. New Delhi: Ijaz Publishing House; 2007.p. 259.
21. Kabiruddin HM. Kitab Al-Taklees. New Delhi: CCRUM; YNM. p.19, 20, 24, 52, 56-67, 70-204.
22. Majusi ABA. 2010. Kamil Al-Sana'h (Urdu Translation by CCRUM). 1st ed., Part II, New Delhi: CCRUM.p.286.
23. Mohammad HH. In vitro Antibacterial Activity of Propolis, Alum, Miswak, Green and Black Tea, Cloves Extracts Against Porphyromonas Gingivalis Isolated from Periodontitis in Hilla City, Iraq. AJPCT 2013;1(2):140-148.
24. Mourughan K, Suryakanth MP. Evaluation of an alum containing mouth rinse for inhibition of salivary streptococcus mutans levels in children-A controlled clinical trial. J Indian Soc Ped Dent 2004;22(3):100-105.
25. Nadkarni KM. 1989.The Indian Materia Medica, Vol. I, Bombay Popular Prakashan, Mumbai: p.2-7.
26. Nasir. 1886. Mufradat-e- Nasri, Matba Rehmani Press, Delhi: p.67.
27. Nigwami SMH. 1985. Unani Materia Medica, Pub. Fakhruddin Ali Ahmad Committee, Aqabmadah Ganj, Sitapur, Lucknow: p. 275-277.
28. Osuala FI, Ibidapo-obe MT, Okoh HI, Aina OO, Igbasi UT, Nshiogu ME et al. Evaluation of the Efficacy and safety of Potassium Aluminium Tetraoxosul phate (Vi) (ALUM) in the Treatment of Tuberculosis. European Journal of Biological Science 2009;1(1):10-14.
29. Preet S, Seema KC. Mosquito larvicidal potential of potash alum against malaria vector Anopheles stephensi (Liston). J Parasit Dis 2010;34(2):75-78.
30. Rafiquddin M. 1985. Kanzul Advia Mufrada. 1st ed. Aligarh: University Publication Unit, AMU, Aligarh;.p.54.
31. Rafiquddin M. 2001. Minhajus-Saidlah wa Al-Keemiya. Pub. Idara Kitab al-Shifa, Daryaganj, New Delhi: p. 241-242.
32. Rupesh S, Winnier JJ, Nayak UA, Rao AP, Reddy NV. Comparative evaluation of the effects of an alum-containing mouth rinse and a saturated saline rinse on the salivary levels of Streptococcus mutans. J Indian Soc Pedod Prev Dent 2010;28(3):138-144.
33. Sina Ibn. 1998. Al-Qanoon Fit Tibb (reprint), Book II, English translation by Jamia Hamdard. Print. S.W.Nawab, JH Printing Press, Hamdard Nagar, New Delhi: p. 282.
34. Singh HP, Singh CK, Singh RR. Effect of Potash Alum (Alluminium Potassium Sulphate) on Human Semen and Sperm. Indian J Pharmacol 1998;42(2):311-314.
35. Takashi M, Kondo A, Kato K, Murase T, Miyake K. Evaluation of intravesical alum irrigation for massive bladder hemorrhage. Urol Int 1988;43(5):286-8.