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A molecular reinterpretation of Khilt-e-Balgham (Phlegm): A review of literature

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Abstract
The concept of four humours (Akhlat-e-Arba) in the Unani system of medicine is the premise of the concept of health and disease. This paper deals with elaborating the concept of Balgham (Phlegm), which is one of the four humours described in Unani literature. We argue that the structure of the molecule/chemical species cannot be used in the Akhlat-e-Arba, instead the physiological roles of the molecules will decide whether the molecule/chemical species is to be placed in a particular khilt (humour). This review is presented with a noteworthy insight into Unani concepts and a thorough study of classical Unani literature by Ibn Sina (10th century), Zakaria Razi (9th century), Ibn Rushd (12th century), Ibn al-Nafees (13th century), Ali Ibn Abbas Majusi (10th century), and Ismail Jurjani (11th century), and comparative detailed study of modern concepts of humours from literature databases, as well as Google, recent researches, and review articles of about 10 years. Our arguments in this paper are primarily in context of Khilt-e-Balgham.

Keywords: Akhlat-e-Arba, unani, balgham, proteins, molecular, amino acids

Introduction
The Unani System of Medicine was pioneered in Greece and was developed by Arabs into an elaborate medical science based on the frame work of the teaching of Buqrat (Hippocrates) and Jalinoos (Galen). Since that time, Unani Medicine has been known as Greco-Arab Medicine. This system is based on Hippocratic theory of four humours which are blood, phlegm, yellow bile and black bile. The World Health Organization (WHO) has recognized the Unani System of Medicine (USM) as an alternative system to cater the health care needs of human population. Although, Unani Medicine existed much before the time of Hippocrates. But Hippocrates (460-377 BC) was the first person who freed medicine from the realm of superstition and magic, and gave it the status of a science and presented the basic theoretical framework of Unani Medicine. Thereafter, considerable contribution was made by different Greek scholars [1, 2] (Table 1). The Hippocratic classification is based on the Kaifiyat (qualities) of the humours. While the first three humours find experimental/verifiable support, Khilt-e-Sauda remains a matter of discussion to this day [3, 4, 5, 6, 7, 8, 9, 10, 11].

The discussion in this paper will remain primarily on Khilt-e-Balgham and molecules that can be placed under the broad umbrella of Balgham. We will also discuss Tabayee Balgham (physiologically relevant Balgham) has a role in health and disease.

It is absolute pertinent, that the reader takes into account the time point where certain arguments were made by Unani Physicians. The arguments though dated, provide a detailed understanding of the development of this area of enquiry as a legitimate source of knowledge. For certain dated arguments we provide an approximate year/era and the name of the physician before the reference to provide a reasonable historical context to our argument. For instance, Hippocrates (born in 460 BC) made an argument in 5th century B.C regarding Akhlat [2, 4, 8, 9, 12, 17-30].

Khilt-e-Balgham
According to literature of Unani Medicine, the role of Khilt-e-Balgham is to provide building blocks of the body (Ali Ibn Abbas Majusi/930 AD) [4-30]. By this definition it is safe to place proteins, peptides and amino acids in the category of Khilt-e-Balgham. The texts mentioned Kaifiyat of the balgham as Barid & Ratab (Cold & Wet) (Ali Ibn Abbas Majusi/930 AD) [3, 4, 5, 6, 7, 8, 9, 10, 13]. It is said that this kaifiyat comes into existence when foods which have a Barid & Ratab (Cold & Wet) kaifiyat are taken in through diet. Such foods include curds, yoghurt and butter milk, all of which are known to be rich in proteins (Ali Ibn Abbas Majusi/930

AD) [3-10, 13, 18-30].

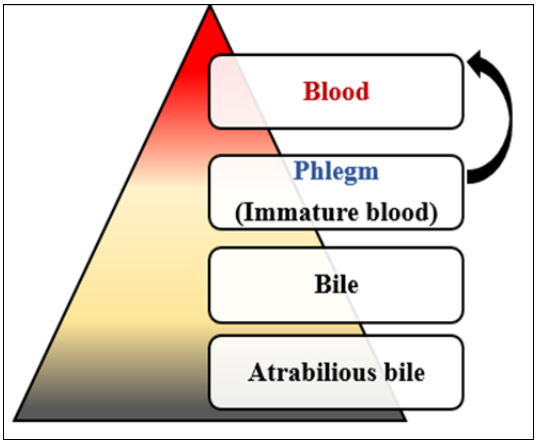

Fig 1: The natural hierarchy of humors (according to *Ibn Sina*) in a healthy human body. *Khilt-e-Balgham* was postulated to be a blood precursor

Tabayee Balgham

Khilt-e-Balgham is said to encompass, mucus like, mucilaginous substances which form the body (Muhammad Kabiruddin/1894 AD) [6-10, 12-32]. The colour associated with this Khilt is white (Muhammad Kabiruddin/1894 AD) [6-10, 12, 13, 17-30] (Table 3). The primary physiological roles associated with Khilt-e-Balgham are:

1. It gets convert into blood in the conditions of starvation and gets utilized in the nutrition of organs (Ibn Sina/ 980 AD) [6-30]. Although the balgham is dam bil quwa (by power) but during conversion it performs functions of dam as well (bil fail/ by action) (Ali Ibn Abbas Majusi/930 AD) [6, 7, 10, 12, 13, 17-30]. Upon being converted to Dam, khilt-e-balgham provides nutrition to organs. The site of maturation of Balgham to Dam is the Liver (Ibn Sina/ 980 AD) [8, 9, 10, 12, 13, 17-30].
2. Balgham does not have an organ associated with it for its storage (Muhammad Kabiruddin/1894 AD) [10, 12, 13, 14, 20-24], like gall bladder for safra and spleen for sauda. Balgham is pooled with Dam in blood vessels and organs, so that organs can utilize it whenever required for nutrition storage (Muhammad Kabiruddin/1894 AD) [6-30].
3. Balgham provides moisture (rutubat) (in addition certain components of Blagham which may serve as nutrients) to the organs, which prevents them from getting dry (Ibn Sina/ 980 AD). In this context it may be noted that cells (*Khalliyat*) have been described in Unani literature [6-30, 33].
4. Another function of Balgham is to provide lubrication for the joints. The synovial fluid in the joints has approximately 25mg/ mL protein i.e., nearly 1/3 of the concentration found in blood plasma. Which further strengthens the argument of Khilt-e-Balgham, being composed of proteins [10, 6-30, 32].
5. Balgham provides nutrition to the brain. The process involves mixing of Khilt-e-Balgham with the blood for the supply of nutrition to the organs which requires it (Ali Ibn Abbas Majusi/930 AD) [6-17, 22, 25-30].
6. Balgham is also said to provide viscosity to the blood, as well as to other akhlat (Ali Ibn Abbas Majusi/930 AD) [6-10, 13, 14-35].

What constitutes Balgham: Balgham has classically been defined in context to its characteristics when it's abnormal (Ghair Tabyee Balgham) [6-30]. We do not contest this description however we wish to discuss the idea of Khilt-e-Balgham in the light of the recent developments in the area of chemicobiology [36].

The Balghami Mizaj (Phlegmatic Temprament) in Unani system of medicine is supposed to occur when Balgham becomes the dominant khilt within the body. People who are assessed to have Balghami Mizaj physically show characteristics of moderate obesity [1-30]. While the classification of obesity is beyond the scope of this paper, we do wish to argue that increase in abdominal fat and a thicker waist line is observed in people with Balghami Mizaj [3, 4, 10-30]. Therefore, in context of the physiotype, deposited fat, could in all probability be classified as Balgham [20, 24]. While some people may argue, that lipids, in their liquid form, can also serve as energy sources for the body, and therefore must be placed in Khilt-e-Dam, we feel placing deposited fats in Balgham is a more fitting classification. By analogy, breast milk is also classified as a blaghami rutubat, but it also serves as the only source of nutrition for the baby [12, 13, 18, 21, 24, 31, 33, 34]. Human milk is a highly complex composite liquid of nutrients for infant growth, consisting primarily of fat, carbohydrates, and proteins, as well as minerals, vitamins, and other nutrients (Table 2). The mean macronutrient composition of milk is estimated to be approximately 0.9 to 1.2 g/dL for protein, 3.2 to 3.6 g/dL for fat, and 6.7 to 7.8 g/dL for lactose. Energy estimates range from 65 to 70 kcal/dL, and are highly correlated with the fat content of human milk.

Yet another classically mentioned role of Balgham is that it is precursor of Dam [6-30]. It is said that Balgham matures into blood. Syed Ishtiaque Ahmad, in Kulliyat-e-Asri, places lymph in Khilt-e-Balgham [13, 14, 18, 24]. It is noteworthy to point out, that lymph drains into the blood providing more substance to blood. We therefore agree that lymph can also possibly be placed in Khilt-e-Balgham.

Table 1: Unani terminology and its english equivalent

Unani Terminology	English Equivalent
Buqrat	Hippocrates
Jalinoos	Galen
Akhlat-e-Arba	Four Humours
Khilt	Humour
Khilt-e-Balgham	Phlegmatic humour
Tabayee balgham	Physiologically relevant balgham
Dam	Blood
Balgham	Phlegm
Safra	Bile
Sauda	Atrabilious bile
Kaifiyat	Qualities
Barid	Cold
Ratab	Wet
Bil quwa	By power/ potential
Bil fail	By action
Rutubat	Moisture
Afaal	Functions
Ghair tabayee	Abnormal
Balghami mizaj	Phlegmatic temperament
Balghami rutubat	Phlegmatic fluid

Table 2: Composition of Human Milk

Components of Human milk
Proteins
Carbohydrates (Lactose)
Fats (Fatty acids)
Lactoferrrin
IgA
Leucocytes
Sodium
Potassium
Magnesium
Calcium
Vitamins
Citrate
Iodine
Stem cells
Macrophages
Growth factors

Table 3: Placement of body fluids on the basis of their colour in the concept of Akhlat-e-Arba

Name of the Humour	Place	Color
Blood	Cells	Red
Lymphatic fluid/ lymph	Lymphatic vessels	White
Yellow bile	Liver, bile duct, gall bladder, blood vessels	Yellow
Interstitial fluid	Tissue spaces	White
Saliva	Mouth and salivary glands	White
Digestive juices	Stomach	White
Pancreatic juice	Pancreas	White
Intestinal juices	Intestines	White
Peritoneal fluid	Peritoneum	White
Pericardial fluid	Pericardium	White
Pleural fluid	Pleural membrane	White
Cerebrospinal fluid	Brain meninges	White
Seminal fluid	Testes, prostate gland, spermatic cord	White
Humours of the Eye (aqueous and vitreous Humour)	Anterior and posterior chamber of the eye	White
Synovial fluid	Synovial joints	White
Mucus like fluids in the body	Mucus secreting membranes of esophagus and trachea	White
Lacrimal secretion/ tears	Lacrimal glands	White
Milk	Mammary glands	White
sweat	Sweat glands	White
Sebum	Sebaceous glands	White
Urine	Kidneys, ureters and urinary bladder	White
Hormones	Endocrine glands	White
Thyroid and parathyroid secretions	Thyroid and parathyroid glands	White
Secretions from adrenal glands	Adrenal glands	White
Thymus secretions	Thymus	White
Secretions from pancreas (insulin and glucagon)	Pancreatic cells (alpha and beta cells)	White
Prostaglandin		White
Growth hormones		White

Conclusion

The scope of this discussion as to what constitutes Khilt-e-Balgham is vast. However, we wish to bring forth two major considerations. First that the Unani literature usually defines and discusses Khilt-e-Balgham in the context of Ghair Tabayee Balgham, and therefore, the classification of Tabayee Balgham is not clearly defined and/or discussed in great detail. This remains an open area of research. Secondly, rather than making the structure of molecules/chemical species the basis of placing molecules in Akhlat-e-Arba, it would be worthwhile to examine the chemico-biological/physiological roles of molecules/chemical species before placing them in the four humours of the human body. It is an attempt to clear the concept that all white colour fluids are not Balgham which was the prevalent thought in ancient era and placing molecules in a particular khilt is not the right approach. But the physiological role played by molecules at a particular point of time can be used to place them in a particular humour. For instance, we previously discussed how Haemoglobin, despite being a protein will be placed in Khilt-e-Dam, not Balgham [23]. Hence it can be said that physiological role will be the deciding factor for placing a molecule in a khilt.

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Author Contributions

All authors conceived the study and wrote the manuscript

Conflict of Interest and other Ethics Statements

Authors declared no conflict of interest. The study is a theoretical study and has no ethical constraints.

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