DISCUSSION

Although the Indian subcontinent occupies only 2.4% of the world's land area, it supports over 15% of the world's population. Only China has a larger population than India. Almost 40% of Indians are younger than 15 years of age. About 70% of the people live in more than 550,000 villages, and the remainder reside in more than 200 towns and cities. Over thousands of years of its history, India has been invaded from the Iranian plateau, Central Asia, Arabia, Afghanistan, and the West; Indian people and culture have absorbed and changed these influences to produce remarkable racial and cultural synthesis. Religion, caste, and language are major determinants of social and political organization in India today. The government has recognized 18 languages as official; Hindi is the most widely spoken one (Majumdar, 1958).

Although 83% of the people are Hindu, India also is the home of more than 120 million Muslims--one of the world's largest Muslim populations. The Indian population also includes Christians, Sikhs, Jains, Buddhists, and Parsis. The caste system reflects the Indian occupationally and religiously defined hierarchies (Hutton, 1961). Traditionally, there are four broad categories of castes (varnas), including a category of outcastes, earlier called "untouchables" but now commonly referred to as "dalits". Within these broad categories there are thousands of castes and subcastes, whose relative status varies from region to region.
Despite economic modernization process and laws countering discrimination against the lower end of the class structure, the caste system remains an important source of social identification for most of the Hindus and also a potent factor in the political life of the country. The exact origin of the caste system as it is today is still obscure (Cavalli-Sforza, 1994).

A genetic study, led by Michael Bamshad of the University of Utah conducted in 2001, found that the genetic affinity of Indians to Europeans is proportionate to their caste rank, the upper castes being most similar to Europeans, whereas lower castes are more like Asians. The researchers believe that the Indo-European speakers entered India from the Northwest, admixing with or displacing the proto-Dravidian speakers. Subsequently they may have established a caste system and placed themselves primarily in higher castes. The study concludes that the Indian castes "are most likely to be of proto-Asian origin with West Eurasian admixture resulting in rank-related and sex-specific differences in the genetic affinities of castes to Asians and Europeans (Bamshad et al., 2001). Since the Indian samples for this study were taken from a single geographical area, it remains to be investigated whether its findings can be safely generalized.

India has a complex ethnic history and different climatic and ecological zones. It offers a rich field for the study of genetic differentiation process in man, and also for the analysis of factors responsible for considerable genetic variability observed among its various populations. The Indian population is divided into a large number of groups with different languages, religions, castes and tribes.
Throughout the ages, many population groups have migrated toward North Eastern and North Western routes. A look at the ethnic history of India reveals that Indians belong to two different categories: the Dravidians (aborigines) and the Aryans or Sanskrit speaking group (with mixed groups known as the Musalmans). The caste system with its language, state and religious base, hence the caste differentiation, can be studied mainly from these three points of views. In North India the state of Uttar Pradesh is historically important because of its old centers of population, learning and administration (Basu, 2003).

According to a 2006 study by Thanseem of the Centre for Cellular and Molecular Biology (India) "the vast majority (>98%) of the Indian maternal gene pool, consisting of Indo-European and Dravidian speakers, is genetically more or less uniform", while the invasions after the late Pleistocene settlement might have been mostly male-mediated. The study concluded that the "lower caste groups might have originated with its hierarchical divisions within the tribal groups, with the spread of Neolithic agriculturalists, much earlier than the arrival of Aryan speakers", and "the Indo-Europeans established themselves as upper castes among this already developed caste-like class structure within the tribes." The study indicated that the Indian caste system may have its roots much more before the arrival of the Indo-Aryan immigrants; a rudimentary version of the caste system may have emerged with the shift towards cultivation and settlements, and the divisions may have become more well-defined and intensified with the arrival of the Indo-Aryan (Thanseem et al., 2006).
The Indian population is divided into a large number of groups with different languages, religions, castes and tribes. Throughout the ages many population groups have migrated toward India along northeastern and northwestern routes (Hunter, 1897). A look at the ethnic history of India reveals that Indians belong to two different categories: the Dravidians (aborigines) and the Aryans or Sanskrit speaking group (with mixed groups known as the Musalmans).

Muslims of India make up more than 12% (Shariff, 1998) of the population and they belong to various linguistic and ethnic groups of different biradaris (so called castes), besides a few tribes. The Muslims originated in one of the two ways, one group came and settled during the various historic migrations and invasions. The other group is believed to have formed through proselytization of the indigenous Hindu population, which was of comparatively lower and middle order in the prevailing caste hierarchy, and of a few tribes living along the fringes of the caste dominated regions (Roychoudhury et al., 2000).

Muslims belong to two major sects: Sunnis and Shias, although each sect has different biradaris, which are grouped under Ashraf and Ajlaf (Ansari, 1959). The Ashraf include higher rank Muslims such as Syed, Sheikh, Pathan and Mughal, whereas Ajlaf include the Qureshi, Ansari and other groups of lower occupations (Ahmad, 1978). A large number of Ajlaf may also be converts from local indigenous populations of other faiths (Afzal, 1984).

The other Muslim castes are represented by the Qureshi, Saifi, Teli, Bhishti, Mewati, Alvi, Abbasi, and Rangrez besides the Lohar, Gujar, Julaha, Ahir, Faqir,
Manihar, Dhobi and Rain. It is said that those who manufactured swords in the past were known as Saifi, because the word Saif in Arabic means “sword”. They are traditionally carpenters and blacksmiths.

Although Islam does not distinguish the groups on any material grounds, the groups, occupational and social isolation may have led to their differentiation over many generations, including the differences in their gene pools (Afzal, 2004). The study of the gene pools can throw some light on the origin, ancestry, health and morbidity status of the groups; for example, there might be either unknown rare mutations or else genetic polymorphism for particular markers (Kirk, 1985). It was with this aim that the present research was designed to study the genetic structure and the microdifferentiation of Muslim populations, including their genetic distances and isolation. We report the genetic composition of the population of Aligarh.

In present study, the patterns of gene differentiation between populations, the genetic distances and the relation of heterozygosity between populations are studied. The extent of genetic divergence ($G_{ST}$) varies considerably from locus to locus. Gene diversity is the most important measure of genetic variability of a population and can be related to the number of codons different per locus (Basu et al., 2003). The highest heterozygosity was observed in $A_1A_2BO$ loci i.e. 0.6245 for all the populations whereas the lowest heterozygosity was found in Transferrin i.e. 0.0255.
Thus it appears that the differentiation with respect to various loci has been quite different in the populations. The heterozygosity is higher for immunogenetic markers viz. A₁A₂BO, Rh subtypes, MNSs, Duffy system; and lower for protein (Hp and Tf) and enzyme (G6PD and AK) markers. The value of $G_{ST}$ in A₁A₂BO (0.0166) gives an estimate of the degree of genetic differentiation present among different populations. The coefficient of genetic differentiation $G_{ST}$ is highest for the loci MNSs (0.0186) and lowest for Duffy (0.0075). The dendrogram shows that the Sheikhs – Brahmins, Pathan - Bania are closer to each other and are comparatively new populations (Fig.1); it is may be due to the conversions of Hindus into Muslims. Jatav and Rajputs making another cluster and are older populations, the cluster Sheikh-Brahmin joins the Syeds while the cluster Pathan – Bania joins the Ansari. The dendrogram clearly shows that there is no significant difference between Hindu populations and Muslims populations, because most of the Muslims of India have been converted from Hindus, and have the same ancestors (Eaaswarkanth et al., 2009).

In case of protein markers used viz. haptoglobin and transferrin to study the genetic diversity among North Indian Population, significant differences exist in the allele frequencies of Hp and Tf in the North Indian population. The Hp2 allele frequency is higher in general, than the Hp1 allele frequencies in the Aligarh population. They display a relative order of the magnitudes, namely, Ansari (0.821) > Jatav (0.758) > Rajput (0.753) > Brahmin (0.741) > Syed (0.725) > Pathan (0.654) > Sheikh (0.634) > Bania (0.578). An excess of Hp2 allele has
previously been documented from the countries geographically as far apart as Jordan and Southeast Asia (Schultze and Heremans, 1966). Similar to Hp2, the allele TfC shows higher frequencies compared to TfB and TfD allele.

The observed heterozygosity is high for the locus haptoglobin as compared to transferrin. The values of $H_T$, $H_S$, $D_{ST}$ and $G_{ST}$ are comparatively higher. On the basis of genetic distances between different populations, dendrogram was constructed using UPGMA clustering method. The dendrogram shows the higher castes of Hindu and those of Muslim biradaris are found closer than the lower castes like jatav of hindus and Ansaris of Muslims. The most recent are Sheikh and Pathan, and Syed, Bania, Brahmin, Rajput and Jatav are of approximately the same time on the basis of their origin. The Syeds and Bania form one cluster; Sheikh and Pathan form another cluster, and together join with Brahmin. All these populations are the so called higher castes (like Syed, Sheikh, Pathan among Muslims and Brahmin and Bania among Hindus). Thus Jatav and Rajput appear to form one cluster, which later on join with Ansaris. This dendrogram also justifies the migration pattern and history of older Indian populations. There is no significant differentiation between Hindu and Muslim populations, as the higher caste Muslims have so called biradaris and lower caste Muslims (Ajla) are quite different from upper caste Muslims, and upper and lower caste Muslims of India are converts from Hindus of upper and lower caste (Eaaswarkanth et al., 2009).
When the population was studied with Enzyme marker viz, glucose 6 phosphate dehydrogenase (G6PD) and adenylate kinase (AK) a different pattern emerges. Despite G6PD being an X-linked trait, phenotypically males and females do not show any difference, perhaps because mainly due to female being regarded as a mosaic with respect to traits controlled by genes on X-chromosome. Thus, the enzyme activity remains same for both males and females (Marks, 1958; Lyon, 1961; Bhasin and Chahal, 1996). The genetic distances between the populations are very low. By using UPGMA method, dendrogram was constructed and it shows that Bania and Rajput are closer and making one cluster which joins the Jatav, joins to Sheikhs. This group joins to another cluster in which Pathan and Ansari are combined. Syed and Brahmin are close to each other and are older populations.

In fourth study i.e. all the markers have been combined and genetic distances have been calculated and presented in the form of matrix. It shows a little difference between Hindus and Muslims; the highest genetic distance was that found between Syeds (Muslim) and Brahmins (Hindu) i.e. 0.04216, between Sheikh (Muslim) and Jatav (Hindu) i.e. 0.03395, between Ansari (Muslim) and Brahmin (Hindu) i.e. 0.03149, though, the difference is not so high. It may be because conversions have taken place many generations ago which means the ancestors are the same and hence genetic difference is very small. However, since the marriage is not allowed between Hindus and Muslims in Indian society, some difference might have been between them.
On the basis of the genetic distances, dendrogram was constructed and it shows that Brahmin is the oldest population of North India and is different from others. While Syed-Bania, and Sheikh-Pathan are closer, Sheikh-Pathan group joins with Jatavs. The Ansari and Rajput are closer, i.e. make a cluster. This dendrogram also shows that conversions have taken place from Hindus to Muslims, and the higher caste and the so called lower castes show the difference. As shown in Plates-2, 3 and 5, Jatavs, Rajputs and Ansaris are closer to each other, while in Plate-4 Jatav and Rajput are closer and all higher castes of Hindus as well as Muslims viz. Brahmin, Bania, Syed, Sheikh, Pathan are closest. To clarify these facts $F_{ST}$ calculations were done and it was found that the difference between Hindu and Muslim populations is very small, it varies from 0.00001(Duffy) to 0.00155 (Haptoglobin), but the difference within Hindu populations and within Muslims are high. It is a well known fact that among Hindus, caste system is very rigid while in Muslims there is no caste system as such, though biradaris are there, Ashrafs (higher occupation) and Ajlafs (lower occupation) are so called upper and lower castes. The marriages within Ashrafs and within Ajlafs are allowed while between Ashrafs and Ajlafs are not permissible.

One more fact to be noted is that among immunogenetic markers, MNSs and $A_1A_2BO$ system and not Rh and Duffy and among protein markers, Transferrin rather than Haptoglobin and for enzyme markers AK than G6PD are the better markers for comparison of gene diversity, because the value of $F_{ST}$ for these markers is higher. In over all comparison, protein and immunogenetic markers are
better to study the genetic diversity of a population as compared to the enzymatic markers (Fig. 23), it may be so because enzymes evolve at different rates. In a study elsewhere, to search for a better marker, DNA sequences from *Helicobacter pylori*, colonizing Ladakhi people was found to be better than either of Mitochondrial DNA marker or Microsatellite marker; the value of $F_{ST}$ for *H.Pylori* marker was 0.031 and for mtDNA it was 0.021 and for microsatellite 0.007. For recent genetic affinity, bacterial strain gave better result than mitochondrial DNA (Wirth et al., 2004).

In the present study, it may be suggested that for Aligarh population of North India, Hindus and Muslims are very similar to each other, and these populations are not yet genetically differentiated. It may be because both the populations have same ancestors and most of the Muslims of North India have converted from Hindus, though these conversions have been made very recently. However, for better results, more marker loci can be taken and Muslim biradaris with older history may be compared with the present Aligarh Muslims populations which appear to be rather new and neosettlers.