SUMMARY

The importance of the balanced diet in maintaining healthy body is an undisputed fact. Recently, a series of experiments (Root & Longenecker, 1989; Tucker, 1989) have implicated the role of proteins and carbohydrates in mental process. Earlier, a number of investigators (Browning, Bennett & Lynch, 1979; Morgan & Routtenberg, 1981) had reported that pyruvate - dehydrogenase, which is critical in the reproduction of cellular energy, is activated after acquisition. Since glucose is the major metabolic fuel in the body and the central nervous system (CNS) relies almost entirely on blood glucose for energy, blood glucose levels might have a major influence on memory.

In fact, glucose has been found to have a dose and time dependent effect at the animal level (Gold, 1986). Further, circulating glucose levels are found to be responsive to the degree of environmental stimulation (Hall & Gold, 1986). Even at the human level, regulation of cognitive functions by circulating glucose level have been demonstrated (Holmes, Hayford, Gonzalez & Weydert, 1983). Also, a
significance improvement on standardized achievement tests has been reported in young students who participated in an enriched breakfast programme as compared to those who did not (Zyla, 1990).

Thus, in view of the apparent importance of glucose in memory and paucity of research at the human level, the present investigation was designed to study the mnemoactive effect of glucose in humans. Further, the role of dietary components, specifically caloric intake and proteins, in memory was also investigated.

On the basis of previous researches, it was hypothesized that:

1. There would be an inverted 'U' shaped relationship between amount of glucose ingested (after fasting of at least 7-8 hours) and memory.

2. The facilitative effect of glucose would be more significant in elderly than young subjects.

3. Glucose tolerance would result in better memory.
4. There would be no significant correlation between total caloric intake and protein levels / performance.

5. There would be a positive correlation between amount of protein and memory.

To test these hypotheses three experiments (multigroup / two - group, repeated testing) and a correlational study was conducted.

A sample of 104 subjects, (60 normals, 35 elderly and 9 diabetic) who voluntarily agreed to participate in the research, were taken on the basis of availability. Additional, 50 subjects were taken for pilot work. The experimenter had to resort to this method of selection as the experiment was rather cumbersome for the subjects (experiment was to be conducted in fasting state on three consecutive days and blood samples had to be taken at least seven times) and therefore, very few subjects agreed to participate. However, the subjects of the various groups were equated with regard to educational qualifications (all were at least graduates). All subjects were non - diabetic (except the sample of 9 diabetics) and free from any known physical or
cognitive dysfunctioning.

In Experiment - I, a multigroup, repeated testing design (n = 43) was used. The experiment was conducted over a period of three consecutive days. Subjects were asked not to eat or drink (except water) after midnight, prior to experimentation on each of the consecutive morning. The blood glucose levels were tested three times (Basal, 15 min. after treatment and after learning) daily except on the third day on which only basal blood glucose levels were measured. Also, the subjects were given 25 g (n₁ = 12) / 50 g (n₂ = 23) / 100 g (n₃ = 8) of glucose in 250 ml of water + orange flavour or liquid saccharine of equal sweetness as the corresponding dose in 250 ml of water + orange flavour on two of the consecutive days, 15 min. prior to learning. Two sub-tests of Wechsler's memory scale [Paired associates (PA) and visual - reproduction (VR)], were used as the learning material as this test is available in two equated forms. Test forms and treatments were given in a random and counter balanced manner. Recall of VR was taken immediately while recall of PA was taken after 24 hours, i.e. on day 11.
after testing of basal glucose level. Similarly on day II learning, recall of VR was taken immediately and recall of PA was taken on day - III.

For Experiment - II, a two - group, repeated testing design was used. The experiment was conducted exactly in the same manner as Experiment I, except that the dose was kept constant at 50g and two groups, young ($n = 15$, mean age 22.13 yrs) and elderly ($n = 10$, mean age 43.5 yrs), were used.

For Experiment - III, a two group design was used. Two groups, diabetic ($n = 9$) and their age matched normal ($n = 9$) were tested for basal blood glucose levels. Learning of PA and VR was done exactly in the same manner as Experiment - 1 & II, subjects were not given any treatment.

For the correlational study, diet charts of seven days ($n = 17$) were obtained and analysed in terms of total caloric intake and amount of protein intake in the morning. On the eighth day blood samples were taken and later they were analysed to determine protein levels in blood. Learning of PA and VR were done exactly in the same manner as in the earlier experiments.
For the statistical analysis of the obtained results, non-parametric techniques were used, since the sample was small and not drawn on random basis. Initially the scores of the multi-group design experiment and blood glucose levels of the various dose groups were analysed by using Kruskal-Wallis test. Further analysis between the two groups was done by using Mann-Whitney U test (uncorrelated data) and Wilcoxon test (correlated data). For the correlational study Spearman's rank difference correlations were computed.

Results indicate that there is an inverted 'U' shaped relationship between dose and memory. The facilitative effect of the intermediate dose was also found to be significantly more in the elderly subjects as compared to young subjects. Subjects with glucose intolerance had significantly poorer memory as compared to normals. However, protein levels and memory was found to be positively correlated caloric intake. Further, a significant correlation was also found between plasma protein levels and memory. However, a very high correlation (.91) was obtained between amount of protein intake in
the morning and memory.

The present study implicates the role of glucose metabolism particularly the circulating levels in memory.