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VARIATIONS IN IONIC CONCENTRATION OF BLOOD SERUM DURING RAMADAN FASTING

MIRZA ARSHAD ALI BEG AND IZHARUL HAQ KHAN

PCSIR Laboratories Complex, Lahore-54600, Pakistan

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Variations in the composition of Na, K, Mg, Ca, and Cu ions have been recorded by analysing blood samples from 40 healthy fasting volunteers during the later days of Ramadan, taken in the morning and late evening. It has been observed that the constituents of the blood serum of fasting volunteers can be strongly correlated with respect to ionic concentration and age groups by using Q-mode cluster analysis technique. The three age groups as identified are: upto 38 years; between 38 and 45, and above 45 years. High concentration of Na and K characterises the age group between 38 and 45 years. The relative decrease in Na and K ions during the morning and evening samples in the first and second age groups is quite significant and it is less so in the third. The Ca and Cu ion level, as shown by R-mode analysis, generally increases while that of Na and K ions decreases towards the evening. It has positive correlation with Mg and a low or negative correlation with Na. The decrease in Na and K ions is of a lower order among the elderly persons. It has been concluded from the study that fasting has a significant effect on the ionic balance. High intake of rich food in the earliest hours of the day raises the Na and Ca levels and lowers the Cu ion level which is restored to normal values (obtained from samples in the post-Ramadan days) towards the breakfast time in the evening.

Key words: Ionic concentration, Blood serum, Ramadan.

Introduction

Small but significant lowering in the glucose level and increase in cholesterol and electrolytes levels, of blood plasma of fasting volunteers during the month of Ramadan have been reported in an earlier paper [1]. In earlier papers Gumaa *et al.* had observed an increase in serum uric acid and lipid concentration [2-4]. Subsequent studies have described the lipid profile, urea, glucose etc. and have observed that there is no significant change in the parameters excepting a rise in the glucose level and that all the changes returned to basal values four weeks after Ramadan [5,6]. A change in quality and quantity of food as well as in the daily routine during the entire period of fasting can be instrumental in causing variation in the composition of blood plasma, which is sensitive to changes in the micro-environment and in the normal metabolic processes [7]. The composition of blood plasma with respect to electrolytes and other metallic ions is, therefore, likely to be altered among fasting Muslims. Detailed investigations for possible deviation from the normal blood picture during Ramadan have received attention only recently. Although a number of studies have been carried out on the effect of Ramadan fasting [2-6], none of these describes in detail the variation in the composition of electrolytes. An attempt has been made in the present paper to describe the variations in electrolytes in blood plasma drawn after considerable time from the start of fasting i.e. Sahar and immediately before its break i.e. Iftar.

Blood plasma contains electrolytes such as H^+, Na^+, K^+, Mg^{++}, Ca^{++}, Cl^-, HCO_3^-, PO_4^{---}, SO_4^{--}, organic acid ions, proteins and some non-electrolytes such as glucose, urea, lipids, etc. The total ionic concentration is generally 310 meq per liter of plasma, with one half being cations and the other anions. The increase or decrease of Na, K, Mg and Ca ions is known to exert profound influence on various physiological processes of plants and is thus of biological significance [8].

It has recently been hypothesised that aging among plants as well as animals is due to biochemical changes involving dehydration processes [9]. There is, during the life span of an organism, a gradual shift in the formation of products from lyophilic to lyophobic compounds and a progressive decrease in the discharge of waste products. Fasting during Ramadan necessarily accompanies a dehydration condition and hence the electrolytic balance is likely to be affected. The consequent adjustments are expected to show up at various points of time during the day. The electrolytic balance is further likely to be influenced by the age of the fasting volunteers as well as their eating habits, *viz.* the intake of the amount of fluid and nutrients, nature and composition of diet, etc., immediately before fasting and at the time of fast breaking in the evening. Samples of blood for analysis of electrolytes and some trace metals have, therefore, been drawn in the morning and evening when the effects of hydration and dehydration are expected to have stabilized.

Materials and Methods

Blood samples were drawn at 9-10 a.m. i.e. about six hours after Sahar and at 6 p.m., which was about one hour before Iftar, from the employees of PCSIR Laboratories, Lahore who volunteered for this study. These blood samples were taken at the end of the second week of Ramadan and again one month after Ramadan. The blood serum was extracted by centrifugation at low revolutions and was then diluted ten times with 1% A.R. grade hydrochloric acid. These diluted solutions were frozen for stroage. Na and K were analysed using Janway PF7 Flame Photometer and the rest of the elements were estimated using Hitachi Z-8000 Atomic Absorption Spectrophotometer.

The biochemical similarities or differences in the analytical data obtained on serum electrolytes were not immediately evident when subjected to the simple observations of mean and standard deviation due to the complex nature of blood chemistry in different individuals. Since there is a wide variation in the amount and type of diet intake during Ramadan, it can obviously give rise to high standard deviation in the values of the chemical constituents in individuals of similar age groups and type of volunteers. The conventional statistical tests, which require a representative or carefully randomized sample having a normal or known frequency distribution, have obvious limitation. Systematic classification of the blood samples using additional statistical parameters is, therefore, required to correlate the different types of sera.

One of the multivariate factor analysis techniques refered to as "cluster analysis' imposes no such requirement for a representative or carefully randomized sample with a known frequency distribution and was, therefore, used in this study. Because of the advantage of data compression, without significant loss of information, dendrograms were used to depict the mutual relationship for (1) different samples with multiple attributes (Q-mode cluster analysis), and (2) different variables measured for a set of samples (R-mode cluster analysis).

The samples were divided according to age group and thereafter statistical analysis using Q-mode clustering method was applied by using a computer which classified the sera according to the composition of the electrolytes on the basis of correlation coefficient. Another programme using R-mode cluster analysis showed the correlation and pattern of variation of the elements in the serum of different classes of individuals.

Results and Discussion

Electrolyte variations. Tables 1–3 show the levels of various electrolytes in the sera samples drawn in the morning and Tables 4–6 record their concentration in the evening samples. The concentration of serum electrolytes after Ramadan, taken as non-fasting control, is given in Tables 7–9.

Table 1. Level of Electrolytes (mg/l) in the Morning Serum Samples of Fasting Volunteers of Below 38 Years Age.

Sample No.	Na	K	Ca	Mg	Cu	Ca/Mg	Na/K	Na/Ca	Na/Mg
21	2880	290	114	17.3	0.6	6.5	9.9	25.3	166
5	2720	270	106	15.9	1.2	6.1	10.1	25.6	170
72	2720	206	111	13.3	1.4	8.3	13.2	24.5	204
65	3200	170	113	18.3	0.3	6.1	18.8	28.2	175
71	3584	180	140	16.0	1.4	8.7	19.9	25.6	224
73	3040	220	121	18.0	0.1	6.7	13.8	25.2	169
27	3520	190	110	14.7	1.5	6.2	18.5	32.0	239
28	3040	160	—	16.7	2.2	—	19.0	—	182
51	3040	180	113	28.0	1.6	4.0	16.9	27.0	108
Mean	3082	207	116	17.6	1.1	6.3	15.6	26.7	182

Table 2. Level of Electrolytes (mg/l) in the Morning Serum Samples of Fasting Volunteers of 38-45 Years Age.

Sample No.	Na	K	Ca	Mg	Cu	Ca/Mg	Na/K	Na/Ca	Na/Mg
10	3520	190	151	18.8	0.6	4.9	18.5	23.3	115
26	3776	240	128	17.3	1.2	5.3	15.7	29.5	158
47	3900	190	122	18.6	0.2	5.6	20.5	31.9	178
55	3900	145	191	19.0	0.6	12.9	26.8	20.4	263
62	2560	120	114	18.6	1.8	5.7	21.3	22.5	128
68	2560	190	166	19.1	1.0	7.7	13.5	15.5	120
Mean	3369	179	145	18.6	0.9	7.00	19.4	23.8	160

Table 3. Level of Electrolytes (mg/1) in the Morning Serum Samples of Fasting Volunteers of Above 45 Years Age.

Sample No.	Na	K	Ca	Mg	Cu	Ca/Mg	Na/K	Na/Ca	Na/Mg
1	2240	290	116	17.1	1.9	6.8	17.7	19.3	131
15	3520	210	106	19.3	0.4	5.5	16.8	33.2	182
16	2240	170	119	18.0	2.0	6.6	13.2	18.8	124
19	3392	160	125	19.6	0.3	6.4	21.2	27.1	173
20	3648	160	115	20.0	0.3	5.72	28.8	31.7	182
30	3520	160	105	28.0	—	3.8	22.0	33.5	126
32	3520	160	139	18.7	3.2	7.4	22.0	25.3	188
35	2560	190	90	16.0	0.3	5.6	13.5	28.4	160
39	3200	210	114	21.3	0.9	5.34	15.2	28.1	150
43	3900	220	164	20.7	1.2	7.89	17.7	23.8	188
45	2560	150	—	—	—	—	17.0	—	—
46	3200	155	116	20.0	0.4	5.8	20.6	26.6	160
57	3840	210	107	18.0	1.5	5.9	18.3	35.9	213
25	3648	190	125	14.7	0.1	8.5	19.2	29.2	247
70	2880	170	117	20.7	0.9	5.7	16.9	24.6	139
Mean	3191	187	118	19.4	1.03	6.2	17.6	27.6	169

Table 4. Level of Electrolytes (mg/1) in the Evening Serum Samples of Fasting Volunteers of Less than 38 Years Age.

Sample No.	Na	K	Ca	Mg	Cu	Ca/Mg	Na/K	Na/Ca	Na/Mg
21	2880	220	106	17.3	—	6.0	13.1	27.4	166
5	2720	220	133	20.0	1.0	6.6	12.4	12.4	136
72	2944	220	120	20.0	1.3	6.3	13.4	13.6	147
9	2880	160	143	18.0	0.7	7.9	18.0	20.1	160
33	2720	160	130	18.0	0.5	7.2	17.0	17.0	151
65	2880	190	153	18.0	0.5	8.5	15.1	15.1	160
66	3360	220	129	18.0	0.7	7.2	15.3	26.0	187
71	2560	220	115	16.0	1.6	7.2	11.6	22.3	160
73	2020	160	140	18.0	0.8	7.8	12.6	14.4	112
6	3040	190	132	17.3	0.8	7.6	16.0	23.1	176
27	3360	210	145	21.3	2.9	7.8	16.0	23.2	158
28	3200	170	102	12.7	1.2	8.1	18.8	31.3	252
Mean	2880	195	129	17.9	1.1	7.3	14.9	20.5	164

Table 5. Level of Electrolytes (mg/1) in the Evening Serum Samples of Fasting Volunteers of 38-45 Years Age.

Sample No.	Na	K	Ca	Mg	Cu	Ca/Mg	Na/K	Na/Ca	Na/Mg
3	3648	230	113	20.0	1.1	5.7	15.9	31.3	182
10	3040	220	106	17.3	0.6	6.1	13.8	28.7	177
26	3200	250	128	17.3	1.3	7.4	12.8	25.0	184
31	3200	160	121	23.9	1.7	5.1	20.0	26.4	134
47	3200	250	127	18.0	0.9	7.1	12.8	25.2	178
48	3200	230	135	15.0	0.8	9.0	13.9	23.7	213
55	2080	120	131	16.0	0.8	8.2	17.3	15.9	130
62	2624	190	130	18.6	0.8	6.9	13.8	20.3	141
68	3880	150	137	20.0	0.8	6.9	29.9	32.6	194
69	4060	190	157	18.6	0.9	8.4	21.4	26.4	218
Mean	3213	199	128	18.5	0.97	7.1	17.2	25.5	175

TABLE 6. LEVEL OF ELECTROLYTES (mg/1) IN THE EVENING SERUM SAMPLES OF FASTING VOLUNTEERS OF ABOVE 45 YEARS AGE.

Sample No.	Na	K	Ca	Mg	Cu	Ca/Mg	Na/K	Na/Ca	Na/Mg
1	2880	200	118	17.3	0.9	6.8	14.4	24.4	166
18	2624	170	122	16.7	0.9	7.3	15.4	2.5	157
19	2720	160	110	16.7	1.0	6.5	17.0	24.8	163
20	3200	180	123	20.7	1.0	5.9	17.8	26.0	155
29	3200	220	132	19.3	1.0	6.8	14.5	24.2	166
30	3360	210	—	—	1.1	—	15.3	—	—
35	3360	—	117	15.3	0.5	7.6	—	28.7	219
39	4060	220	122	16.7	1.0	7.3	18.9	32.2	243
40	4210	200	120	17.3	0.8	6.9	22.4	37.5	243
41	2880	190	113	16.7	0.6	6.8	15.2	25.6	172
42	2880	250	124	20.0	—	6.2	11.5	23.3	144
43	3900	—	—	1.8	—	—	—	—	--
45	2600	160	117	18.7	1.8	6.2	16.3	22.2	139
57	2624	260	139	17.3	1.0	6.3	17.8	28.1	152
25	3200	180	114	18.0	—	6.2	13.4	23.5	178
70	2980	190	136	19.3	0.8	7.0	15.7	21.9	154
Mean	3174	199	122	17.8	1.01	6.7	16.1	26.0	172

TABLE 7. LEVEL OF ELECTROLYTES (mg/1) IN THE SERUM SAMPLES OF NON-FASTING VOLUNTEERS OF BELOW 38 YEARS AGE.

Sample No.	Na	K	Ca	Mg	Cu	Zn	Ca/Mg	Na/K	Na/Ca	Na/Mg
5	3290	200	118	18	0.1	5	6.5	16.4	27.9	183
9	2920	150	110	16	0.9	11	6.9	19.5	26.5	183
33	2600	150	—	—	—	—	—	—	—	—
65	2800	200	130	20	0.6	5	6.5	14.0	21.5	140
71	3100	160	125	23	0.1	6	5.4	19.4	24.8	135
73	2300	230	120	18	0.3	4	6.6	10.0	19.1	128
58	2600	240	—	15	0.2	—	—	10.8	—	173
6	2900	150	120	15	0.1	1	8.0	19.3	24.2	193
27	4200	180	130	22	0.6	4	5.9	23.0	32.3	280
Mean	2968	184	122	18.4	0.36	5	6.5	15.0	25.1	177

TABLE 8. LEVEL OF ELECTROLYTES (mg/1) IN THE SERUM SAMPLES OF NON-FASTING VOLUNTEERS OF 38-45 YEARS AGE.

Sample No.	Na	K	Ca	Mg	Cu	Zn	Ca/Mg	Na/K	Na/Ca	Na/Mg
3	3100	150	130	18	0.3	1	7.2	20.6	23.8	172
10	2650	140	120	18	—	2	6.7	18.9	22.1	147
31	2650	180	125	19	0.2	3	6.6	14.7	21.2	140
47	2560	210	118	16	0.1	3	7.4	12.1	21.7	160
48	2740	150	125	16	0.6	0	7.8	18.3	21.9	171
55	2920	160	140	19	0.3	5	7.4	18.3	20.8	154
62	2370	230	130	16	0.2	7	8.1	10.3	18.2	148
68	3100	150	140	19	0.6	9	7.4	20.7	22.1	163
69	2920	200	126	18	0.6	9	7.0	14.6	23.2	162
67	3160	150	120	17	0.5	0	7.1	19.7	26.3	185
64	3050	160	125	18	0.3	9	6.9	19.0	24.4	169
74	2400	180	120	18	0.6	9	6.7	13.3	20.0	133
75	3100	200	125	19	0.3	4	6.6	15.5	24.8	163
Mean	2824	175	126	17.7	0.38	4.7	7.1	16.8	22.3	159

Table 9. Level of Electrolytes (mg/1) in the Serum Samples of Non-Fasting Volunteers of Above 45 Years Age.

Sample No.	Na	K	Ca	Mg	Cu	Zn	Ca/Mg	Na/K	Na/Ca	Na/Mg
1	3100	150	120	20	1.1	4	6.0	20.6	25.8	155
19	2370	260	125	19	0.7	9	6.6	9.1	18.9	125
30	2560	200	120	19	0.5	6	6.3	12.8	21.3	135
32	2500	210	100	15	0.3	0	6.7	11.9	25.0	167
35	3470	160	125	18	0.9	10	6.9	21.6	27.7	193
40	3100	200	120	21	0.4	10	5.7	15.5	25.8	148
41	3880	240	120	21	1.0	9	5.7	16.2	32.3	185
42	3400	200	118	18	1.0	7	6.6	17.0	28.8	189
45	2700	150	135	18	0.6	7	7.5	18.0	20.0	150
76	2300	170	125	18	1.0	9	6.9	13.5	18.4	128
77	2400	190	120	19	0.6	4	6.3	12.6	20.0	126
Mean	2889	194	121	18.7	0.74	6.8	6.5	15.4	24.0	154

The variation of concentration of Na and K when plotted against one another, as in Fig. 1, brings forward three groups sharply separated from each other with regard to time of sampling and age group as follows: (1A) morning samples of age group above 38 year; (1B) evening samples of age group above 38 years; (2A) morning samples of age group below 38 years; (2B) evening samples of age group below 38 years, and (3) non-fasting samples. However, when the ratios Na/K are plotted against age groups it is observed that the concentration of ions and their variation in sera of fasting volunteers can be categorized into three distinct groups, *viz.* (1) below 38 years, (2) between 38 and 45 years; and (3) over 45 years. Persons in group (2) show high concentration of Na and K ions. The relative decrease in Na and K in the evening samples is significant in of Na and K in the evening samples of group (1)

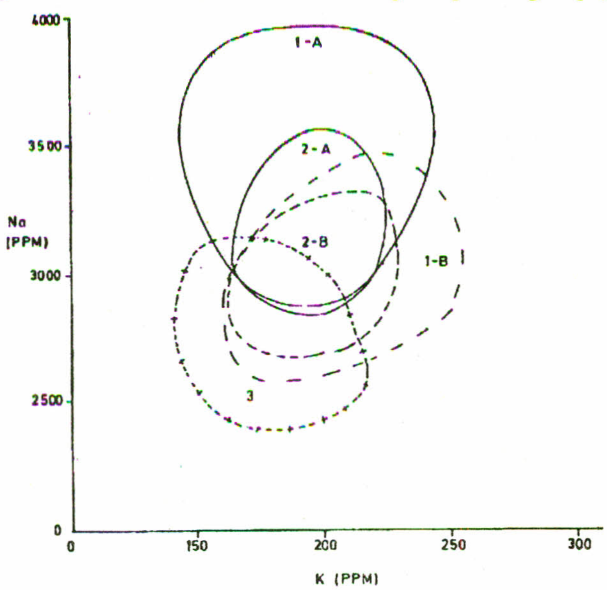


Fig. 1. Concentration of sodium and potassium in 1-A/1B morning/evening samples of older age group, 2-A/2-B morning/evening samples of younger age group and 3-non fasting control.

is also shown by the decrease of Na/Mg ratios, against the increase in group (2) and (3).

The value for Ca is generally high in group (2). It increases towards the evening for groups (1) and (3) and remains in the same order for the three groups during non-fasting days. The pattern of variation of Na/Ca for the three age groups is reverse to Ca concentration during fasting. It is significant that K/Ca ratio has the same trend of variation as for K and not like Ca, probably because of a high depletion rate for K during metabolism in group (1). Mg/Ca decreases towards evening whereas Ca value increases in younger groups and shows a different trend in the middle age group.

Changes in the concentration of electrolytes are shown by R-mode cluster analyses (Figs. 3 and 4). The values of Na and K show negative correlation with other elements in group (1), suggesting a general decrease of both these elements, whereas the serum is concentrated in other elements on fasting. In groups (2) and (3), however, K does not show significant correlation with Na, which on the contrary has an upward trend (Fig. 4). Potassium as well as Ca concentration increases on fasting in groups (2) and (3) and accordingly show strong correlation.

The values for Cu and Mg seem to correlate with one another in each group, and to a lesser extent with K and Ca in group (3) as shown in Figs. 3 and 4.

The Ca and Cu levels generally increase towards the evening. These changes are possibly due to a high intake of rich food at Sahar which is perhaps also responsible for the negative correlation with Na.

Q-mode cluster analysis of data for serum samples affords a further sub-division with regard to electrolyte concentration of sera, and age group and physique of volunteers. The hierarchial diagrams of volunteers of age upto 45 years shown in Fig. 5 give the follwing sub-grouping (i) with low

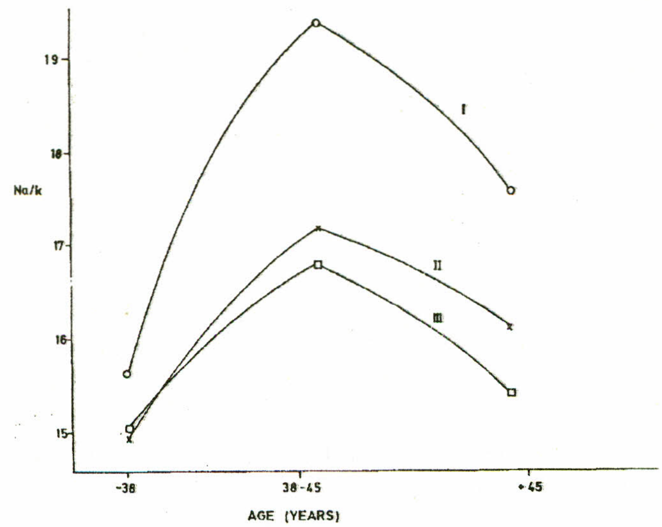


Fig. 2. Variation of Na/K ratio in sera of different age groups. I- morning samples during fasting, II- evening sample during fasting and III-non fasting control.

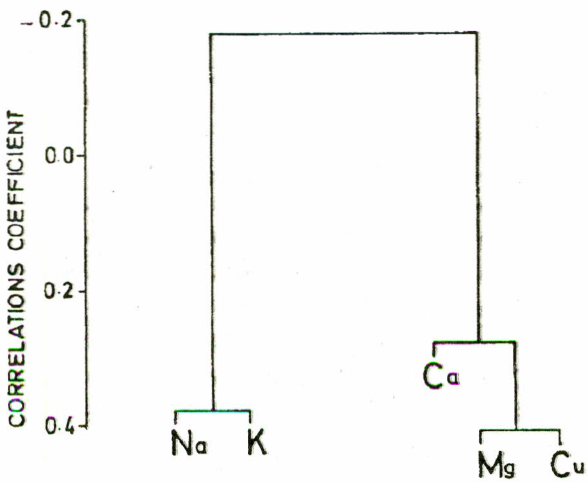


Fig. 3. Hierarchial diagram (R-mode) showing the correlation of different elements in the serum samples of fasting volunteers of under 45 years of age.

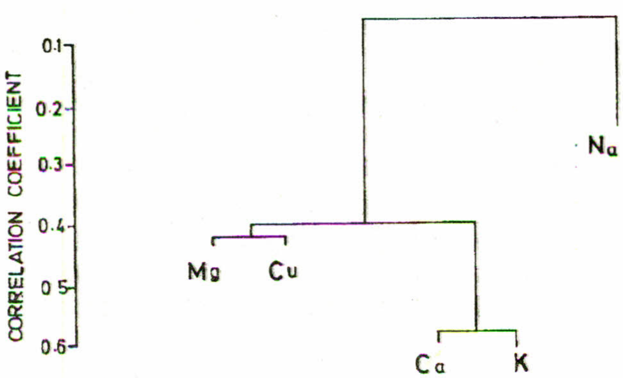
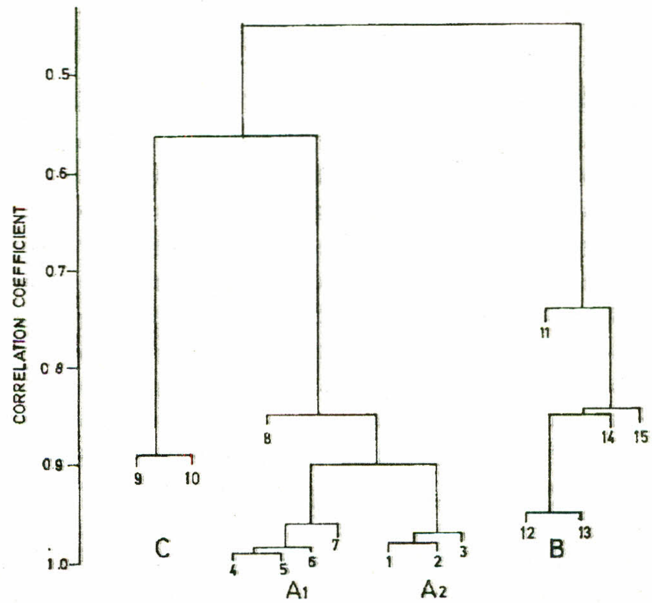


Fig. 4. Hierarchial diagram (R-mode) showing the correlation of different elements in the evening samples of fasting volunteers of over 45 years age.



GROUP	Na	K	Ca	Mg	Cn
(I)	2960	183	138	18	0.6
(II)	2848	220	122	19	1.1
(III)	3322	200	123	18.6	1.5
(IV)	3040	205	119	17.3	0.7

Fig. 5. Hierarchial diagram (Q-mode) showing the cluster analysis relationship in the evening serum samples of fasting volunteers under 45 years of age.

Na and K and high Ca (ii) with low Na but high K and Ca (iii) with high Na and (iv) with moderate Na but low Mg.

The volunteers of sub-group (i) and (ii) are upto 38 years of age while those of sub-group (iii) have an age between 38 and 45 years. The physique of sub-group (i) was slim while that of sub-group (ii) was well-built. The persons in group (1) whereas for individuals in groups (2) and (3) it is found to be less pronounced. The ionic concentration of blood serum of fasting volunteers is correlated strongly according to age group by using Q-mode cluster analysis technique and this places them into different groups.

The present studies indicate that the electrolyte concentration in sera generally increases during Ramadan fasting, probably due to excess food intake. Detailed analysis also reveals that Na values for the three groups are high in the morning samples of fasting volunteers as is also evident from Fig. 1, but they substantially decrease towards the evening for groups (1) and (2) and only slightly for group (3). In each case the values during non-fasting days are much lower than those found for the morning samples during fasting. The decrease is less pronounced in group (2) and not as much in (3). This is in contrast with the non-fasting samples where the values for both Na and K are low for groups (1) and (3) but high for group (2).

The value for K has been found to decrease only in group (1). It increases in groups (2) and (3) towards the evening. For non-fasting samples concentration of K is still lower for groups (1) and (2) as compared with the morning values but there is an increase for group (3). The decrease in K is low compared with Na in the evening samples as also indicated by lower values of Na/K ratios mainly because in groups (2) and (3) the value of K increases in the evening. Figure 2 shows the variation of Na/K in sera of different age groups. The ratio generally has higher values for group (2) and these values are indicated by a peak in Fig. 2 in the morning samples during fasting. This may be due to lower rate of metabolism as a result of which Na and K concentration decreases only slightly as compared with samples of group (1). It is significant that the Na/K ratio decreases substantially after only six hours from food intake i.e. the time of drawing of blood samples in the morning during Ramadan.

The changes in Mg concentration, though not very significant, do suggest that there is an increase towards the evening for group (1) and this trend is kept up when the volunteers are not fasting. For group (2) and (3), there is a decrease in Mg concentration towards the evening and the same is the case again when they are not fasting. The relative decrease data on the concentration of blood electrolytes of fasting volunteers correlates very well with their age, physical nature and state of health of the individuals

The Q-mode hierarchial diagrams of elder group (+45 years) shows strong correlation of data on all the electrolytes. Refinement of analysis, however, brings forward further sub-groups as in Fig. 6 with respect to low, moderate and high Na content.

Effect of dehydration. The mean ionic concentration as presented in Table 10, shows that on fasting Na concentration decreases in each case, substantially for groups (1) and (2) and less markedly for group (3). The difference in the evening samples as compared with the morning samples being -202, -156 and -016 ppm, respectively, shows that there is considerable sodium retention in higher age groups and significant decrease of Na values in the case of groups (1) and (2). On the contrary K concentration decreases in the evening samples on fasting for group (1) only, it increases in group (2) and (3) with a difference in values of -12, +20 and +12 ppm respectively. Calcium concentration on the other hand shows reverse trend to K while Mg shows +0.3, -0.1 and -1.6 ppm difference in evening samples respectively.

In the light of the hypothesis on aging related to plant processes [8,9], dehydration is a key factor and the above results seem to bear it out, at least to the extent of accumulation

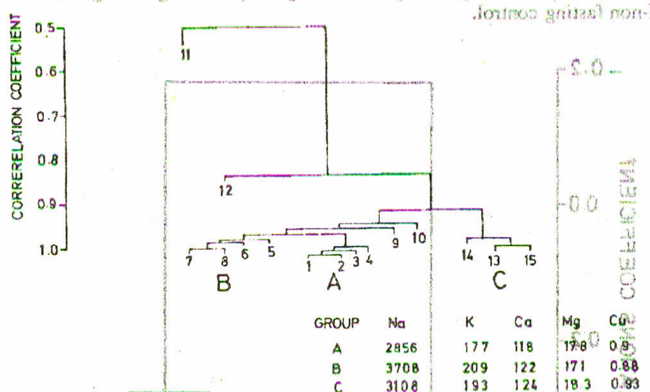


Fig. 6. Hierarchial diagram (Q- mode) showing the cluster analysis relationship in the evening samples of fasting volunteers of over 45 years age.

TABLE 10. AVERAGE CONCENTRATION OF IONS (PPM) IN SERUM SAMPLES OF FASTING VOLUNTEERS OF DIFFERENT AGE GROUP, TAKEN DURING MORNING (MO), EVENING (EV) AND AFTER RAMADAN (NO).

Age group/ timing	Na	K	Ca	Mg	Cu	Zn	Ca/Mg	K/Ca	Na/K	K/Mg	Na/Ca	Na/Mg
–38 years												
MO	3082	207	116	17.6	1.1	—	6.3	1.7	15.6	11.8	26.7	182
EV	2880	195	129	17.9	1.0	—	7.3	1.5	14.9	10.9	20.5	164
NO	2968	184	122	18.4	0.3	5	6.5	1.5	15.0	9.9	25.1	177
38-45 Years												
MO	3369	179	145	18.6	0.9	—	7.8	1.23	19.4	9.62	23.8	160
EV	3213	199	128	18.5	0.9	—	6.9	1.5	17.2	10.8	25.5	175
NO	2824	175	126	17.7	0.3	4.7	7.1	1.4	16.8	9.9	22.3	1794.7
+45 years												
MO	3190	187	118	19.4	1.0		6.2	1.5	17.6	9.6	27.6	169
EV	3174	199	122	17.8	1.0	—	6.7	1.6	16.1	11.2	26.0	172
NO	2889	194	121	18.7	0.7	6.8	6.5	1.6	15.4	10.4	24.0	154

of less hydrogen bondable ions like K and Ca, and depletion of Na and Mg in the evening blood samples of the fasting volunteers. This is indeed in accord with the suggested pattern *viz.* for Na in groups (1) and (2) and less marked in group (3); for Mg in group (3) and less marked in group (2); for K in group (2) and (3) and for Ca in group (1) and (3). The comparison of ionic ratios such as Na/K and Na/Ca shows a general decrease in group 1 to 3 (-0.9, -2.2 and -1.5 for Na/K and -6.2, 1.7, -1.6 for Na/Ca, respectively) while K/Mg and Ca/Mg show a general increase (-0.9, +1.2, +1.6 for K/Mg and +1, -0.9 and +0.5 for Ca/Mg, respectively) on fasting. The overall effect of fasting, is positively correlated to aging to the extent of changes in ionic concentration i.e. physical de hydration through loss of water and the lyophilic materials along with it.

Correlation between fasting during Ramadan and aging, however, is less marked in terms of chemical dehydration which introduces cross-linkages and generates lyophobic materials. Since the concentration of lipids increases while that of the carbohydrates decreases during fasting (1), it seems reasonable to suggest that although the biochemical equilibria are titled heavily towards dehydration to follow the stated trend of aging, the process of intermittent hydration and dehydration through excessive liquid intake helps in flushing out the excess lyophilic ions alongwith some lyophobic compounds.

It is suggested by this study that the former process has some pronounced beneficial effects since there is a correction in the concentration of almost all the constituents of blood samples of the volunteers taken one month after Ramadan. It is found that the values are at an intermediate level between the morning and evening samples during Ramadan. Fasting can thus help in adjusting the electrolyte level and can even bring in the desired level with a control of quality of intake at Sahar and Iftar. However, the comparison of electrolyte ratios in non-fasting control and morning fasting samples shows much less variation as compared to fasting situations. This indicates a corrective measure resultant to fasting. The body system also undergoes severe changes in ionic concentration during fasting and may therefore be better conditioned to withstand minor changes during the subsequent eleven months.

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