DISCUSSION

CHAPTER - V
Discussion

An examination of data presented in Table-1 clearly show that Cr concentration in water samples procurred from pollution prone area was higher. On the basis of permissible limits proposed by National Academy of Sciences and National Academy of Engineering (1972) most of the water samples were found to contain Cr and other metals more than permissible limits. pH and EC of corresponding water samples were also found to be more than normal limits. Effect of EC was almost identical to pH in governing Cr content in water. Significant positive correlation was observed between pH and Cr content of water (Table-2). The increase in Cr indicates the increase in Cr solubility with increase in pH of the medium. Therefore, pH and EC may be considered as important factors in governing the Cr content of water. These findings are in close confirmity to those reported by Alam et al. (1988), and Nag and Das (1993).

Sewage and industrial effluents have also accumulated Cr and other associated metals in more than permissible limits. Disposal of large quantities of untreated sewage and industrial effluents rich in Cr (Table-3) may be the main reason for elevation of Cr of different water resources of the region under
study. This is further supported by the fact that sewage outfalls at sewer-river systems in Varanasi add enormous quantities of Cr and other heavy metals as evident from the data presented in Table-5, 6 and 7. Palprasert (1982); Prasad et al. (1989); Israili et al. (1990), Joshi (1990) and Brij Mohan (1991) also reported similar results while working with similar types of experiments related to aquatic environment.

A number of workers have reported higher concentration of heavy metals in sewage and in a number of industrial effluents but references in context of Cr content of carpet industrial effluents are unavailable. However, in context of present investigation samples of effluents from carpet industrial area were found to contain exceptionally higher amount of Cr (Table-3). This is possibly due to the fact that carpet industrial effluents contain Chrome dye residue originated from the washings of the carpets and associated environment.

Water samples taken from ponds, hand pumps, dug wells, tube wells etc., contained large amounts of Cr (Table-8 and Fig.1). Therefore, these water samples may be considered as unsafe as per the permissible limits proposed by WHO (1971) and ICMR (1987). Pond water contained much more Cr than other resources. Presence of large amount of Cr in these water resources may be due to
their direct contamination by poor quality water rich in Cr. It seems that surface as well as ground water had got contaminated by untreated sewage and industrial effluents of the area under study as a result of direct or indirect mixing of these effluents with surface and ground water of the region. The reason behind comparatively high concentration of Cr in pond water may be stagnancy as well as regular catchment of Cr rich effluents from carpet industries. During stagnancy there are chances of elevation in concentration of Cr\(^{3+}\) and Cr\(^{6+}\) as a result of oxidation and reduction reactions in the aquatic environment in the presence of other pollutants. But in present case possibilities of Cr reduction is more as sewage and industrial wastes that pollute pond water are rich in organic matter. Discharge of industrial effluents, decomposition of organic matter and sulphate reduction provide dissolve sulphides which can be involved in Cr (VI) reduction. Weathering of Fe (II) containing minerals (Biotite, hematite and some clays etc) and some industrial wastes generate dissolve Fe (II) ions. These ions may be involved in Cr (VI) reduction as follows:

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3[\text{FeO}] + 6\text{H}^+ + \text{Cr (VI) (aq)} = \text{Cr (III) (aq)} + 3\text{H}_2\text{O} + \text{Fe(III) (aq)}
\]

From hematite or biotite
Hexavalent Cr can also be reduced by organic matter such as simple amino acids or humic or fulvic acids. Trivalent Cr is generally expected not to significantly migrate in natural system because Cr (III) minerals readily precipitate in neutral to alkaline pH range and maintain low Cr (III) dissolved concentrations as in the case with the present investigation where pH is towards alkaline side and salt concentration is also high (Table-3). Under high alkaline pH range Cr was possibly present as Cr (VI) a more toxic form than Cr (III). A positive significant statistical correlation between pH (alkaline) and Cr content of water observed in present investigation also confirm this view that Cr (VI) is possibly the major form present in the water resources of the carpet industrial area. In alkaline environment Cr (VI) is more mobile because sorption by aquatic sediments (solids) is not strong enough to keep Cr (VI) from moving through sediments. As a result amount of Cr (VI) in alkaline aquatic environment is elevated. Mn also play significant role in influencing the mobility and solubility of Cr in aquifer.

Aquous geochemistry of Cr and Cr cycling in the aquatic environment (Figure A and B) given by Richards and Bourg (1991) throw still more light on migration and solubility of the metal in aquatic environment.
Fig. A: Aqueous geochemistry of chromium

Cr Input (natural or anthropogenic)

*Availability of electron donors or acceptors
*Kinetics of redox transformations

Cr(III) + Cr(VI) in natural waters

Redox processes
Homogeneous reactions
Heterogeneous reactions

Hydrolysis Complexation (organics)

Protonation

Precipitation/dissolution

Adsorption/desorption
Fig. B: Chromium cycling in the aquatic environment

input

Cr(III)

+Fe(II) or org. matter

Cr(VI)

+MnO_2(s)

weak adsorption

settling

diffusion

Cr(VI)

adsorption or precipitation

Cr(III)

settling

diffusion

Cr(III)(s)

sedimentation

diffusion

Cr(III)

+MnO_2

Cr(III)-org

+organic matter

Cr(III)-org

dissolved organics
Monthly and seasonal variations in Cr content of water further support the findings that Cr concentration is increased with increase in pH. Tripathi et al. (1990) have also observed higher contents of Cr and other metals in pond water. Higher contents of Cr observed in dug well and different water resources resemble with the findings of Kudesia and Sharma (1981), Handa et al. (1983), Rao and Rao (1988), Nand Kumar (1990), Singh et al. (1991) and Nag and Das (1993). Therefore, presence of Cr in all the water resources under study is clear indication that Cr have entered in different segments of hydrosphere and become constituent of water resources of the carpet industrial area. Eutrophication also appears to be one of the main reason for regular increase in Cr concentration.

As mentioned earlier monthly and seasonal variations occur in Cr concentration of the water resources (Table - 9 and 10 and Fig. 2 & 3). Lowest concentration of the metal was observed in August and highest in May in water resources of carpet industrial area during all the three years of study. Lowest concentration in rainy season may be due to dilution effect of rain water on Cr content. Highest content of Cr during summer may be attributed to high concentration of water due to increased evaporation. It was also found that pH and salt concentration of
summer water samples were higher than other seasons. As increase in pH above 7 has an escalative effect on Cr content of water, therefore, increase in Cr content with corresponding increase in pH of water samples taken in summer months is possible. Identical to other water resources, content of Cr and other associated heavy metals in river water samples at sewage out falls were highest in summer season (Table-5, 6 & 7) possibly due to the same reason applicable for other water resources i.e. due to drying effect of hot winds, blowing in summer over river water and heavy metal loaded sewage water mixing with the river water at sewage out falls. Hourly variations in content of metals were also observed in river water samples. It was found (Table-5) that samples taken during morning hours contained higher amount of metals which was possibly due to output of large volume of metal enriched sewage effluents in morning hours, ultimately mixing with river waters of the area under study.

A small amount of Cr (III) in soil may be oxidized to Cr (VI), become mobile and remain as Cr (VI) for several months. It can be leached from the soil to the ground water as reported by Bartlett and James (1979). So, leaching of Cr via soil to water strata is possibly the main reason for high level of Cr in different water resources of the carpet industrial area under
study. This is a possible reason that water resources near to carpet industries contain comparatively higher amount of Cr than those away from carpet industries (Table-13 Fig.4 and 4a).

Cr content in aquatic environment of carpet industrial area presented in Table-11 reveal that Cr is accumulated in aquatic weeds (Eichhornia crassipes) and aquatic sediments. These findings indicate that Cr is migrated from one component to the other component of the aquatic environment. Cr from aquatic sediment migrate to water to aquatic weeds etc. It is further confirmed by highly positive significant correlations found between Cr of water, aquatic weeds and aquatic sediments (Table-12).

Amount of Cr extracted by four different methods of extraction and physico-chemical properties of surface soils as presented in Table-15 reveal that the order of Cr extraction is as: 4 M HNO₃ > 1 N NH₄OAc > DTPA > 0.1 N HCl

HNO₃ is possibly able to extract most of the fractions of the metal present in the soil as compared to other extractants. Williams et al. (1980) also reported almost similar results. Ammonium acetate possibly extracted only exchangeable form of the metal. So, the amount of metal extractable by ammonium acetate was lower than HNO₃ extractable. This finding is
in accordance with the finding of Soon and Bates (1982), who reported lesser extraction of the metal by ammonium acetate. DTPA extracted even lesser amount of the metal than ammonium acetate. It possibly extracted only available form of the metal present in soil. Low extractability by 0.1 N HCl is because, it is able to extract only freshly adsorbed Cr present on surfaces of Fe & Mn oxides and organic matter under different stages of decomposition. Beckette (1989) also reported similar results.

In order to determine the impact of Cr polluted water resources on Cr content of soils of the carpet industrial area, a number of soil samples were analysed for Cr and other heavy metals. A number of soil physico-chemical properties (Table 15 & 17) were also determined. The soil profiles contain large amount of Cr. The concentration of Cr in soils decreased with increasing distance from factories (Table-14 & Fig.5). Data reveal that soil irrigated by carpet industrial effluents had higher Cr content than those away from carpet industries. Farmers near carpet industries are bound to allow these untreated effluents to pass through their fields. As industrial effluents used for irrigation of the soils of the area contain large amounts of Cr as reported elsewhere, therefore, escalation in Cr content of corresponding irrigated soils can not be overruled. Presence of
Cr in soils away from carpet industries in lower amounts may be due to migration from area having large quantities of the metal in soils and under ground water to soils away from the carpet industries. The amount of the metal has increased from year to year in both the area also confirm the view that migration of the metal has taken place. Flooding during rainy season may also have assisted the movement of Cr ion from polluted to non polluted area soils. Blind application of fertilizer and agricultural chemicals in the area may also be a reason for Cr accumulation as a number of fertilizers and agricultural chemicals contain appreciable amount of Cr as impurities. Baerug Martinson (1977) and Watanabe (1984) have also reported identical results.

Data presented in Table-17 reveal that surface soils contained highest amount of available Cr (DTPA extractable) and associated metals such as Cu, Zn, Mn, Fe and Al. Lowest amount of Cr and other metals were seen in lower most horizon. The concentration of metals decreased with depth. This is possibly due to low mobility of Cr from upper horizon to lower horizons (Chang et al. 1984 & Williams et al. 1980). Higher concentration of Cr in surface layer is possibly due to reluctant use of sewage and carpet industrial effluents rich in heavy metals. These effluents are not only rich in Cr but also loaded with organic
substances. These organic substances might have formed chelates with Cr and restricted the mobility of the metal to lower layers. As a result major portion of Cr would have been retained in the surface horizons. Higher amount of Cr in surface layers have also been reported by Sidle and Kardos (1977), French et al. (1984) and Shuvalov (1989). Close relationship that exists between organic carbon and Cr is a clear indication of metal chelation with organic matter.

Significant negative correlation was found to exist between DTPA extractable Cr on the one hand and pH, CEC, CaCO₃ and clay on the other hand (Table-18). Clay minerals, fulvic acid and biological residues possibly have also restricted the mobility of Cr in deeper horizons. Cr might have formed complexes with humic acid fractions of organic compounds present in soil profiles receiving large amount of organic substances through sewage sludge and industrial wastes and turned the metal less mobile.

On the other hand significant positive correlations were also observed between different forms of Cr and other associated heavy metals such as Mn, Fe, Cu, Zn and Al (Table-18). Therefore, it may be inferred that distribution of different forms of Cr in soil is also influenced by the amount of other heavy metals.
The correlation coefficient between physico-chemical properties and different forms of Cr in polluted surface soils have been presented in Table-16. It is evident from this Table that available Cr bears significant positive correlation with organic carbon \( (r=0.830) \) and clay \( (r=0.790) \). The findings clearly indicate that availability of Cr is influenced by organic matter of the soil under study. The availability of the metal is increased with corresponding increase in organic matter of the soil. It is possibly due to the fact that organic matter in the soil, use to supply a number of complexing agents which increase the availability of the metals by checking its fixation in the concerned soil. Correlation data also indicate that pH had adverse effect on the availability of the Cr \( \text{(DTPA extractable fraction)} \). However, this finding is in contrast to that observed in case of water. So, it is inferred that environment in the soil is entirely different from that of water. In water high pH was able to increase the solubility of Cr but in polluted soil it was not able to do so, rather it decreased the availability of the metal. It was possibly due to the fact that a number of inorganic and organic constituents in the concerned polluted soil might have converted the metal in such a form that could not be present in the concerned soil water environment.
extracted by DTPA in such an amount which could bear a positive correlation with pH. Other forms of Cr also exhibited identical correlations with pH, except HNO₃ extractable Cr, which could not show significant correlation with pH. Further, existence of significant positive correlation between total Cr & organic carbon and clay indicate association of total Cr with these soil fractions.

Data regarding concentration of Cr and associated metals in plants (used by milch animals) and corresponding soils of polluted and non polluted area as presented in Table -19 & Fig. 6 reveal that all samples of grasses, forage crops and weeds contained large amounts of Cr and associated metals (Pb & Cd). Metal contents were comparatively three times higher in vegetation of polluted area than non polluted area. Corresponding soils of both the area under study were found to contain large amount of Cr and associated metals. These findings are in close confirmation with Tjell et al. (1979) who reported that plant growing in land affected by heavy metals may accumulate elevated levels of heavy metals.

Highest accumulation of Cr in forage crops was found in mustard whereas lowest in oats. In case of grasses and weeds, highest amount of Cr was found in aquatic weed, namely water-
hyacinth of polluted area. Among other grasses and weeds Euphorbia hirta was found to contain highest amount of Cr whereas, Dichanthium annulatum the lowest. Almost identical trend was observed in context of accumulation of other associated metals like Pb and Cd. Metal concentration in corresponding soil was found to be highest in mustard growing soils and lowest in oats growing soils. Corresponding aquatic sediments contained highest amount of Cr and associated metals. On the other hand soils corresponding to Dichanthium annulatum were found to contain lowest amount of Cr and associated metals. Therefore, it is evident that Cr and other metals content of plants are directly associated with the amount of metals present in the growth medium. These findings are in accordance with the findings of König (1986) and Cary & Kubota (1990). So, Cr content of forage crops, grasses and weeds mainly depend on the metal concentration in the soil and in case of aquatic plants, it depends on the metal concentration of water and aquatic sediment.

Large amount of Cr in plants of Cr polluted carpet industrial area fields have also been reported by Singh et al. (1992). On the other hand plant samples collected from land and aquatic environment away from the influence of carpet industrial effluents were also found to contain Cr and other metals but in
lesser amount. The presence of Cr and associated metals in vegetation of non-polluted area may be due to massive use of fertilizers and agricultural chemicals. The finding is in close conformity with Mortvedt and Giardano (1975, 1977). Highly positive statistical correlations observed between plant Cr and soil Cr (Table 20) also reveal that there is close relationship between soil Cr and plant Cr. This finding is in accordance with the findings of Cary & Kubota (1990) who reported similar statistical relationships between these parameters.

The chemistry of Cr in respect of accumulation of Cr by plants from the soil and water (aquatic) environment existing in carpet industrial belt possibly revolves around the reduction of Cr (VI) to Cr (III), the oxidation of Cr (III) to Cr (VI) and the relative stability of Cr (III) compounds once formed as already discussed elsewhere. These explanations find support from the findings reported by Cary (1982).

It is also evident that the change in the oxidation state may be the only most important reason for controlling Cr uptake by plant. Cr (vi) and Cr (iii) both are readily available in oxidation states in biochemically significant conditions, however, chemistry of the metal in these two states is different. As evident from Table -19 almost all samples of forage crops,
Grasses and weeds have accumulated large but variable amounts of Cr. The order of Cr accumulation as observed was Mustard > Berseem > Bajra > Maize > Jwar > Oats in forage crops. It is evident that different crops accumulated different amounts of Cr. So, on the basis of these findings, it can be said that different plant species differ so far as Cr absorption and accumulation behaviour from identical growth medium and environment is concerned. Similarly, Cary et al. (1977a & b) also reported that plants vary in their Cr accumulation capacity. Physiological control of plant species over the rate of Cr absorption may be the main reason for differential accumulation pattern of Cr by plants. Cr accumulation pattern in grasses and weeds was observed as Eichhornia crassipes > Euphorbia hirta > Chenopodium album > Cyperus rotundus > Dolichos lablab > Phaseolus calcaratus > Stylosanthes gracilis > Mililotus indica > Cynodon dactylon > Dichanthium annulatum. Lahouti & Peterson (1979) have also observed the differential accumulation pattern by plant species. They concluded their observations about cauliflower (a crucifer) as high Cr plant and barley (a plant of gramineae family) as low Cr plant. In the present investigation almost identical trend of Cr accumulation by plant was observed, where mustard (a crucifer) was found to be highest Cr forage crop and oats (gramineae
As presented in Table 21, 23 & 27 samples of milk from the area under study contain large amount of Cr, identical to water, soil, forage crops, grasses, weeds etc. The amount of Cr in milk of indigenous breeds of cows was more than the milk of improved breeds of cow (Table 27). Presence of Cr in milk of cows may be due to consumption of polluted feed and water by the concerned milch animals. Cr via feed, water, milch animals ultimately secretes in the milk. So, it may be inferred that Cr accumulation in milk is due to contamination of animal feed and drinking water of the carpet industrial area by Cr rich wastes. Presence of higher amount of Cr in the milk of indigenous breeds than improved breeds of cows is possibly because indigenous breeds are more exposed to polluted grasses, feeds, fodders, aquatic resources, soils etc. during regular course of grazing than the improved breeds of cows. The finding is in confirmity with those of Reppel and Vickova (1983) who found that milk of cows receiving polluted grasses hay contained more amount of heavy metals than those receiving non polluted grass hay.

It was also found that the ability to accumulate high concentration in milk appears greatest in case of buffaloes (0.57 to 2.47 ppm) because possibilities of exposure of buffaloes to
polluted segments of environment is comparatively more than other species of milch animals such as cows and goats.

Accordingly, the amount of Cr was found to be much more in buffalo milk than cow or goats milk. The main segment of the environment responsible for contamination of buffalo milk is possibly polluted aquatic environment as evident from Table-23. This Table clearly indicates that almost all samples of buffalo milk and segments of aquatic environment to which corresponding milch buffaloes were associated, contain large amount of Cr and other heavy metals. Highest amount of Cr was present in aquatic sediments followed in decreasing order by water-hyacinth (aquatic weed) > water > buffalo milk (Table 23). Therefore, it is evident that content of Cr of buffalo milk varied with the variation in the content of Cr of aquatic environment to which buffaloes were exposed. Compared with the samples of the other area under investigation, samples of buffalo milk and aquatic resources collected from carpet industrial area contained more Cr. So, differences in Cr content of buffalo milk may be due to regional dietary differences for the buffaloes. Degree of contamination of aquatic environment to which milch buffaloes were exposed is one of the main reason for differences of Cr content of the buffalo milk sample as contaminated aquatic weed (water-hyacinth)
also form a part of buffalo feed of the area under study. Similar findings were observed by Pogorzeki et al. (1987) in metals of cows milk which differed with nature of feeding.

Significant positive correlations between the Cr content of segments of aquatic environment and buffalo milk (Table 24) confirm that polluted aquatic resources have definitely affected the Cr content of buffalo milk. So, sources of Cr in milk of buffalo is possibly polluted food components of the buffalo. Contamination of the milch animals through polluted water, aquatic weed, aquatic sediments etc. during their long duration contact with polluted aquatic environment seems to be one of the main reason for accumulation of Cr in buffalo milk.

Bioaccumulation of Cr in different body constituents of goats was also observed (Fig. 16 & 17). The data (Fig. 16 & 17) reveal that like milk, liver, kidney and blood samples of corresponding areas also contain metals in proportionate amount. It clearly indicates that Cr content of goat milk is affected by Cr content of liver, kidney and blood. As forage crops, grasses, weeds, water, soils, etc., of the corresponding area also contain Cr, therefore, close relationship exist between Cr content of water, soils, crops, grasses, weeds, animals and animal products including milk. Pronounced monthly and seasonal variation was
observed in Cr concentration of milk (Table 25 & 26 and Fig. 9 & 10). Highest Cr content was found in the month of May, whereas lowest in the month of September (Table 25 & Fig. 9). Under the seasonal pattern Cr content of milk was highest in summer season, lowest in rainy season and medium in winter season (Table 26 & Fig. 10). Almost identical trend of monthly and seasonal variation was seen with soil, aquatic environment, forage crops, grasses, weeds, etc. Therefore, these findings further confirm the results discussed elsewhere, that Cr content of milk samples of the area under study is influenced by Cr content of water, soils, crops, grasses, weeds etc. Lower concentration in rainy season in milk and substances influencing the Cr concentration of milk is possibly due to effect of dilution by monsoon rains. The reason behind highest Cr contents obtained during summer season may be due to effect of escalation of level of Cr in different segments of environment due to increased rates of transpiration, evaporation and concentration by hot winds. These findings are in close confirmity with the findings of Mitchell (1981) and Milhaud & Enriquez (1982).

Correlation coefficients existing between Cr content of milk, water, water-hyacinth and aquatic sediment have been presented in Table 24. Significant positive correlation existing
between aquatic environment and milk confirm the findings already reported earlier that polluted aquatic environment definitely influenced the Cr content of concerned buffalo milk samples.

Average phasic distribution of Cr in milk has been presented in Table 21, Fig. 7. It was found (Table 21) that dissolved phase contained less amount of Cr than colloidal phase. Therefore, it is evident from these results that major fraction of Cr is present in colloidal form. It is possibly due to adsorption of Cr by colloidal substances present in milk. Casein is the major protein present in milk which is able to attract and adsorb Cr on its surface. In the present case buffalo milk proteins have adsorbed the concerned metal to the extent of 82.24 per cent of the total Cr. Significant positive correlation existing between milk protein and Cr (Table 22) also indicates that major portion of Cr in milk is attached to casein. It was also found that the samples of market milk contain more amount of Cr than milk samples taken from actual sites (in-situ) of milking. This is possibly due to adulteration of market milk by polluted poor quality water of the area as evident from presence of nitrates in the market milk samples (Fig. 13). Infact, pure milk should be free from traces of nitrates. If a milk is found to contain nitrates, addition of dirty poor quality water is
certain as polluted poor quality water contain nitrates. Unfortunately, all the water samples under study have been found to be of poor quality and contain large quantities of different heavy metals including Cr (Table 8). It was observed that all samples of raw milk obtained from different markets of the area under study have been found to be adulterated by water of different quality and quantity. Most of the adulterated samples contain nitrates showing adulteration of poor quality water. These milk samples have been found to contain more Cr than samples without nitrates. It was observed (Fig. 13) that nitrate content of adulterated milk is closely related with the Cr content of the milk. Close relationship existing between nitrate and Cr content of milk ($r = 0.8679$) is also an indication of adulteration of market milk by poor quality water rich in Cr. This finding is in conformity with the findings of Bruhn & Franke (1974).

It is apparent (Table 27) that performances of different extractants was not alike. It was found that amount extracted by dry ashing was lower than wet digestion method, possibly due to loss of metal during ashing. Therefore, wet digestion method may be considered better than dry ashing specially for extraction of Cr from milk. The value obtained by trichloro acetic acid (TCA)
method is lower than dry ashing and wet digestion method. As major portion of Cr exist in colloidal form therefore, after addition of TCA, it becomes the part of coagulum. So, a large portion of Cr is bound with milk coagulum and do not harm part of the filtrate. So, filtrate that is injected through capillary tube of the AA do not contain this form of Cr. As a result lower readings are obtained through this method of extraction. Even then this method is good for estimation of Cr of milk because it is simple and less time consuming. As significant positive linear correlation existed between TCA and other methods of extraction (Table 28) and this method is also simple, therefore, TCA method may be used for rapid testing of milk for Cr. Useful regression equations were also worked out for prediction of total Cr of milk (Table 29). On this basis TCA extractable Cr procedure may be applied for rapid milk testing.

Status of Cr and other associated metals were also determined in different indigenous milk products of the area under study to find out the interaction between different segments of environment and milk products. It was found (Table 31 and Fig. 14 & 15) that identical to milk and local environmental segments namely water, soil, crops, grasses, weeds etc. milk products also contain large amount of Cr and other heavy metals.
Therefore, it is clear that carpet industrial wastes and other types of wastes of the locality not only enhance the Cr status of milk but also contaminate indigenous milk products.

So, it may be inferred that contamination of soil, grasses, weeds, water, crops and animals etc. by Cr rich industrial wastes is possibly the main reason for accumulation of Cr in milk products. These findings are in close confirmity with the findings of Losi et al. (1982) and Papajova & Hermanova (1990). In order to confirm the possible interaction existing between different segments of environment and milk products of the locality, Cr and other heavy metal content of water, water-hyacinth, Aquatic sediments and milk obtained from buffaloes which were exposed to these polluted aquatic weeds have been presented in Table 23. Metals content of khoa prepared from corresponding buffaloes milk have also been presented in Table 31 and Fig. 14. The data clearly reveal that Cr and other heavy metal content of buffalo milk and Khoa (prepared from these milks) are closely related with the content of the Cr of water-hyacinth and other aquatic segments. These findings further confirm the view that polluted aquatic environment of the concerned area is one of the main source of milk (specially buffalo milk) and milk products by Cr.
So, on the basis of important experimental findings, it may be said that most of the milk and specific milk products have accumulated large amount of Cr and other heavy metals due to interaction existing between milch animals and polluted environmental segments of the area such as sewage and industrial effluents, particulate matter, road side soils and crops, aquatic sediments & weeds, forage crops, grasses, weeds, polluted water (used for adulteration of milk) etc.