

# Assessment of environmental impact on physico-chemical parameters and heavy metals content of bovine milk available in Malir District

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**Abstract:** This work designed to investigate the physico-chemical properties (pH, conductivity, salinity, TDS, DO and specific gravity) and level of essential heavy metals (Fe, Cu and Zn) and deleterious metal (Cd) were analyzed in fresh bovine milk samples available for the consumers of Malir District, Karachi. Results of most of the samples revealed that the magnitude of conductivity below the range of reference. The concentrations of metals were determined after wet digestion of samples using atomic absorption spectroscopy. The ranges of average concentrations of Fe, Cu, Zn and Cd were found as 0.262-1.104mg/l, 0.001-2.740mg/l, 2.800-5.600mg/l and 0.001-0.034mg/l in identical order. Approximately 54% samples were noticed as highly contaminated with Cd.

**Keywords:** Malir District, fresh bovine milk, physico-chemical characteristics, essential and non-essential elements, cluster analysis

## INTRODUCTION

Milk is a mult nutritive wholesome diet in food commodities because of its valuable ingredients ideally quantized and makes it precious alone or a part of food globally. Despite the fact that milk can transmit several diseases such as tuberculosis, brucellosis, diphtheria, scarlet fever, and Q fever to humans especially children (Goldberg *et al.*, 1990). Vidovic *et al.* (2005) proved the reality subsequent to three years study that local atmosphere has a major role in heavy metal prevalence in chain soil-cattle feed-milk.

Many issues like geographical particularly anthropogenic factors like urbanization and industrialization causes fluctuations in the levels of elements in bovine milk. Dobrzanski *et al.* (2005) reported higher levels of Al, Ti, Mn, Ga, Se Ge, and Co (aluminum, titanium, manganese, gallium, selenium, germanium, and cobalt) in bovine milk from Lower Silesian in contrast to Upper Silesian, Poland region, although some metals (Zn, Ba, Cu, Cr, V, Ni, As, Mo, Pt, Sb, Au, Hf, Ce, U, Re, Tl, Ru, Rh, Ir, Ta, Be) did not show wide variation in different geographical circumstances.

Malir District of Karachi city located northern and eastern part of the city consists of 67.3 percent urban areas. It has three towns namely Malir Town, Bin Qasim Town and Gadap Town (PWD, 2013). Malir Town is densely colonized near to Malir farms of fruits, vegetables and forage crops. In current studies physico-chemical analysis and identification of fungal species have been carried out

subsequently, focused nutritive and toxic factors of milk available in Malir District of Karachi city and evaluate to what extent these contaminants present and compared samples.

## MATERIALS AND METHODS

### Sampling

Manual sampling methods were applied for collection of milk samples in accordance with the AOAC (2000) procedure. In this regard two separate sets of 250ml of fresh milk (total 26 samples) in polyethene pouch were taken from milk shops chiefly, homes and direct dairy farms (LDC) of different localities of Malir District of Karachi city. Samples were transported to the Laboratory of Dendrochronology and Plant Ecology (LDPE) for the examination of physico-chemical properties. Samples stored by freezing at -20°C until required for metal analysis.

### Physico-chemical Characteristics or intrinsic factors observations

Certain physico-chemical characteristics of milk like pH, conductivity, TDS, salinity, DO and temperature were recorded through calibrated Hach multiparameter (model Sension TM<sup>105</sup>) as reported by Perween *et al.* (2013), whereas specific gravity of each sample was calculated by the standard method (AOAC, 2000).

### Estimation of metals

For the analysis of nutritional and toxic elements, the samples were prepared according to low cost digestion method (Perween *et al.*, 2013; Mehmood *et al.*, 2004). An aliquot of 10ml of each milk sample treated with concentrated HNO<sub>3</sub> in 2:1 sample to acid ratio, heated on

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hot plate at 105°C for about 45minutes or until the solution became transparent. The cold clear samples solution filtered in 25ml volumetric flask, made the volume up to the mark with deionized water, labeled as stock solution and diluted whenever required with deionized water. A blank was also prepared similarly under identical conditions. Heavy metals including toxic metals and essential metals were estimated through Atomic Absorption Spectrophotometer (AAS). For this purpose a Perkin Elmer A Analyst 700 Atomic Absorption Spectrophotometer, USA equipped with standard burner and air-acetylene supply. For radiation source of respective metal, standard hollow cathode lamps were employed.

### STATISTICAL ANALYSIS

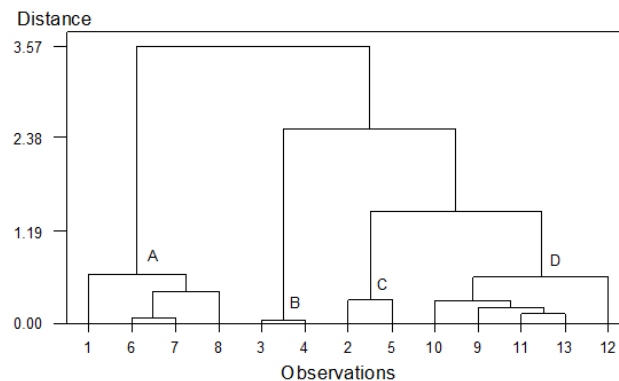
Cluster analyses, Ward's linkage strategy applied with Euclidean distance organize data into groups based on their similarity. For this purpose, multivariate statistical technique performed employing the Minitab Version 11.

### RESULTS

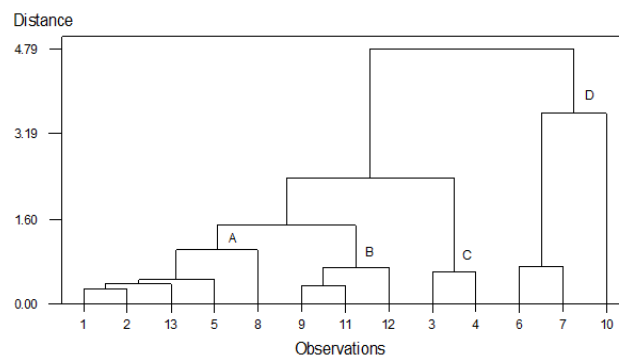
The recorded mean values of physico-chemical characteristics (pH, conductivity, salinity, TDS, DO and specific gravity) of 13 samples collected from various points of Malir District were clustered as shown in fig. 1. Refer to representative Dendrogram for this study exposed in fig. 1, which showed four distinct clusters (A, B, C and D) with corresponding linkage distances. Cluster A consisted observations of four samples (1, 6, 7 and 8) characterized by the lowest pH, the highest conductivity, salinity, TDS and specific gravity. Cluster B comprised of profiles of two samples (3 and 4), pH values higher as compared to cluster A, while conductivity, salinity and TDS were the lowest. Cluster C contained observations of two samples (2 and 5), where the values of pH found intermediate with respect to clusters A and B, though conductivity, salinity and TDS measured intermediate with respect to cluster B and D. However, the values of specific gravity found middle of clusters A and B. Finally, Cluster D composed of the observations of the five samples (9, 10, 11, 12 and 13) represented the highest values of pH and DO, intermediate values of conductivity with reference to clusters A and C, whereas salinity showed the values close to cluster C. The values of TDS found alike the cluster C. By contrast, the lowest values noticed for specific gravity. Eventually, the value of DO in clusters A, B and C showed insignificant differences.

The ranges of measurements of pH, conductivity, salinity, TDS, DO and specific gravity of individual groups were depicted in the table 1. The pH, conductivity and salinity ranged as 6.62-6.99, 2.30-3.73 mS/cm and 2.0-2.8 o/oo in the same order. The ranges of TDS, DO and specific gravity were found as 1.89-2.70g/l, 0.25-0.91mg/l and 1.024-1.046 in the similar order.

The levels of essential/non-essential metals (Fe, Cu, Zn and Cd) in fresh milk samples gathered from Malir District were grouped as clarify in fig. 2. Four distinctive clusters (A, B, C and D) were identified following relation distances. Group A recognized as largest group composed of the profile of five samples (1, 2, 5, 8 and 13) differentiated by the lowest levels and middle level of Cu; and Zn respectively and the highest level of two metals (Fe and Cd). Group B included three samples (9, 11 and 12) described the lowest concentrations of two metals (Fe and Cd), middle level of Cu and Zn. Nevertheless, group C contained two samples (3 and 4) represented the least levels of Zn and intermediate levels of Fe, Cu and Cd). Finally, group D included three samples (6, 7 and 10) characterized by the intermediate concentrations of Fe and Cd and the highest concentrations of two metals (Cu and Zn). The ranges of mean concentrations of Fe, Cu, Zn and Cd were noticed as 0.262 -1.104mg/l, 0.001-2.740mg/l, 2.800 -5.600mg/l and 0.001-0.034mg/l respectively as depicted in table 2.



**Fig. 1:** Dendrogram derived from Ward's cluster analysis of mean values of physico-chemical parameters of fresh milk samples from Malir District, Karachi.



**Fig. 2:** Dendrogram derived from Ward's cluster analysis of mean concentrations of heavy metals in fresh milk samples from Malir District, Karachi.

### DISCUSSION

The lowest value of pH showed by sample no.1 but found within the reference range (table 1), on the other hand the peak value showed by sample no.9. However, hundred

**Table 1:** Ranges of physico-chemical properties in groups derived from Dendrogram of fresh milk samples from Malir District, Karachi (Temperature 19.0±3.0 °C).

Group	pH	Conductivity mS/cm	Salinity o/oo	TDS g/l	DO mg/l	Specific gravity
A	6.62-6.67	3.54-3.73	2.3-2.8	2.27-2.70	0.29	1.042-1.046
B	6.81-6.83	2.30	2.0	1.89-1.90	0.27-0.29	1.033
C	6.78-6.79	3.0	2.2-2.4	2.15-2.37	0.25-0.29	1.040
D	6.92-6.99	2.89-3.26	2.2	1.94-2.20	0.79-0.91	1.024.1028
Reference	6.3-6.9 <sup>a</sup>	4 -5 <sup>b</sup>	--	--	--	1.023-1.040 <sup>c</sup>

<sup>a</sup>: Hui, 1992; <sup>b</sup>: Hussain *et al.*, 2012; <sup>c</sup>: Macrae *et al.*, 1993

**Table 2:** Ranges of concentrations (mg/l) of heavy metals in groups derived from Dendrogram of fresh milk samples from Malir District, Karachi.

Group	Fe	Cu	Zn	Cd
A	0.420-1.104	0.001-0.038	3.902-4.498	0.010-0.034
B	0.262-0.464	0.001-0.104	3.556-4.024	0.001-0.006
C	0.538-0.838	0.001-0.042	2.800-3.072	0.022
D	0.370-0.792	0.048-2.740	4.522-5.600	0.001-0.024
Reference <sup>*</sup>	0.210	0.052	4.200	--

<sup>\*</sup>: Renner *et al.*, 1989

percent values of pH found within the reference range. The least value of conductivity measured in sample no.4 but nearly two folds lesser than the reference level as depicted in the table 1 whilst the upmost value obtained in sample no.7 but slightly less than the reference range. Moreover, hundred percent values of conductivity found lower than the reference range. The smallest value of salinity measured in 23% samples whereas the highest value observed in samples no.1. The smallest value of TDS recorded in sample no.4 whereas the peak value measured in sample no.1. The least assessment of DO was shown by two samples numbered as 1 and 2 while the topmost level observed in sample no.12. The smallest value of specific gravity was shown by sample no.12 but did not show deviation from the reference range (table 1) whereas the highest value observed in sample no.6 which was slightly above than the reference range.

Cent percent samples showed above level of Fe in contrast to reference level. Amongst all samples of Malir District, the least concentration measured in sample no.7, whereas the highest level was found in sample no.8 which was five to six times above against the reference. For Cu, around 31% samples showed lowest concentration; on the other hand sample no. 10 gave the highest measurement that was found fifty two to fifty three folds above than the reference. Daily intake of copper in adults varies between 0.9 to 2.2mg while in children has been estimated to be 0.6 to 0.8mg/day (Gropper *et al.*, 2005). In the case of Zn, most of the samples about 70% showed below than the reference level. Despite the fact that the highest level measured in sample no.7, which was ~1.3 times more than the reference.

The minimum level of Cd was estimated in 31% samples while sample no.1 showed the maximum; approximately

three to four times above than the tolerable limit (0.010 mg/l) as set by the Croatian legislation (Novine, 1994). However, ~ 54 % samples exhibited the Cd contamination more than the tolerable limit. Cd is an identical metal to Zn, located just below the Zn in periodic table and makes compounds in the oxidation state II. Being similar, it replaces to Zn (II) from the active site of zinc- dependent enzymes and proteins which in turn lose their biological activities. A widely occurring pollution caused by Cd was manifested in a malady called “itai-itai” disease and it causes a symptom of severe osteoporosis (Ochiai, 2011). The plausible increased levels of Fe, Cu and Cd in fresh milk proved the suggested factors reported by other researchers (Kazi *et al.*, 2009; Zodape *et al.*, 2012) related to utensils employed for milking which are normally made up of steel and aluminum alloys but another significant contamination source of milk occurs through higher level in cattle drinking water and feed. The high intake of Cd is also concerned in high blood pressure, cancer of the breast, lung, large intestine and urinary bladder, mutations and fetal death (Newberne, 1987; Perry *et al.*, 1979; Pitot and Dragan, 1996). The foremost path of access of cadmium to the organs of an individual is the digestive system and intestinal assimilation.

## CONCLUSION

Nearly all samples showed the values of pH and specific gravity within the reference limit however, majority of results revealed the magnitude of conductivity below the range of reference. Approximately 54% samples were found highly contaminated by Cd.

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