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Heavy metals as valuable contaminants and assurance measure of bovine milk for health prospects: An update

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ABSTRACT : Heavy metals being a perceptible contaminants positions imperative toxicological impacts to human life and exist ecological backgrounds. Physical properties of heavy metals having, relative a high atomic weight along with binding abilities with additional elements etc. Toxicity depends on many associated factors including doses and types, ingested, route of exposure as well as the human concern factors. The diverse components be present in bovine milk, it is an involved foodstuff which may have negative or positive health issues. The foremost plan of this review is to thrash out the impact of heavy metals on contamination of bovine milk that mainly concerned for human health, and to give an outline of the alteration of bovine milk quality. Due to consumption of bovine milk and bovine milk concern products containing relatively high density of heavy metal traces such as Cd, Cu, Zn, As, Cr, Pb, Fe, etc. causes serious health issues to mankind. Quality checkup and assurance measure of bovine milk for health prospects is also essential for human welfare as per the National Residue Program (NRP).

Keywords: Bovine milk, heavy metal contamination, toxicity, dairy products, National Residue Program

I. HEAVY METALS

Heavy metals being a perceptible contaminants grounds important toxicological effects to human life forms and ecological backgrounds. Mercury, Lead, Chromium and Cadmium have been main concern because they live in a larger fraction out of the additional metallic pollutants. The hazard is that the food and intake water can be severely contaminated by means of such toxic heavy metals as they are richly present in various forms in soil content, natural water and directly and indirectly in ambient air also. Their ingestion via food or drinking water, they can affect in the negative aspects on the ongoing metabolic responses of cellular system once the status of such metals exceed their maximum tolerance levels [1].

Physical property of heavy metals is characterized, as that having the relatively a high atomic weight evaluated to additional metallic elements. Toxicity depends on many associated factors including the dose and types, ingested, route of exposure as well as the human concern factors like age, gender, genetics and nutritional status of such exposed characters [2]. Numerous ongoing anthropogenic activities, basically centralizing with fast expanding industrial areas are playing a major contribution. Their wide distribution in the surroundings has been caused as a result of domestic disposals and associated with technological uses. The extensive distribution of heavy metals also possible due to the agricultural activities which indirectly play a significant part in favor of excessive extends of such toxic heavy metals into the soil content and water. Increase status of these toxic heavy metals worldwide concerns with their potential influences as the injurious impacts of human health [3].

Heavy metal contents in environments have been gradually raised due to expansion of the global economy along with the advent of modern technologies. Their wide distribution, Strong latency, irreversibility and remediation hardness are the matters arising when remediation techniques are supposed to be executed. The natural asset that facilitated and exercise possessions on human survival and subsistence is encompassed by phrase environment. All such natural assets are individually utilized by human to gain their requirements commencing the sunup of their evolution [4, 5]. With the inauguration of the industrial mutiny environmental pollution is a subject of matter that well thought-out as a significant global change that's why it amends the

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subsistence of the ecosystem [6]. Environmental pollution enrolled much attention among people about the health issues linked in the midst of it and have been extensively studied [7].

It expresses amassing of incongruous matter and energy in environments chiefly due to human activities. Environmental resources like soil/land, water, air get obstructed by pollution that makes worse impacts on living beings. The subscribers that charge environmental pollution are called as environmental pollutants. Pollutant being harmful to humans and other existing organisms on globe directly or indirectly, it may be a chemical, physical or biochemical compounds that got discharge within the environment causing pollution [8].

The common pollutants in soil be insecticides, heavy metals, organic chemicals, oils, tars, and fertilizers. Nitrogen oxides, carbon monoxide, sulfur dioxide and nitrates that discharged from industries and vehicles are some of common air pollutants even as phosphorous and animal manure causes harsh declining of hydrosphere. Research evidences had shown as enduring coverage to omnipresent environmental toxins can badly affect humans from their preliminary embryonic juncture and right through the postnatal life [9]. Implementation made by international and local regulatory bodies for environmental instructions with principles is extremely significant as it arbitrate for minimizing the undesirable environmental issues and thus help to protect human and animal physical condition. Perceptibly pollution affect the social, economic, and development across the nation and environmental pollution cannot be utterly vetoed thus its regulation is very important [10].

II. BOVINE MILK

Diverse components be present in milk, it is an intricate foodstuff of which may have negative or positive health issues. Feeding regime is able to diversify milk opus. The foremost plan of this review is to thrash out the impact of heavy metals on contamination of bovine milk that mainly concerned for human health, and to give a synopsis of the alteration of bovine milk.

Milk is a key foundation of nutrients intended for newly born mammals, it white colored dietetic liquid secreted by the mammary glands of mammals. To accomplish the nutritional supplies to their progeny at the time of evolution, the composition of milk may fluctuates in different mammals as goat, sheep, camel, cows, buffaloes and all that. Bovine milk holds a variety of biomolecules like amino acids, vitamins lipids, proteins, and mineral deposits required for growth and development of individuals. The composition of milk varies through juncture of lactation, rear; grow old, nourishment, plus energy poise in addition to health standing of the animal that's why we can say milk opus has a vibrant nature.

Premature expansion of immune response and non-immunological security got develop besides nutrition by several specific milk proteins [11]. Being a chief aspect of growth and development, consumption of milk and milk harvest for instance whey, curd, cheese, yoghurt and milk powder has increased in recent years [12]. Diversified crucial nutrients that be significant en route for sustain healthy life of each creature including humans, be present in bovine milk [13]. Environmental contamination and toxicity diminish the healthy circumstances, even though dairy harvests inhabit a noteworthy part in balance diet [14].

Some of the contaminants introduced in bovine milk and milk products are benzyl penicillin, gentamycin, cypermethrin, albendazole, cypfluthrin and all such that. As per report of FAO and WHO (1995-1998) the maximum daily acceptable limit and maximum residue limit of various contaminants are described in the table 1.

TABLE 1. COMPOSITION OF VARIOUS VETERINARY AND INSECTICIDAL CONTAMINANTS IN BOVINE MILK.

CONTAMINANTS	ACCEPTABLE DAILY INTAKE	MAXIMUM RESIDUE LIMIT	REFERENCES
Benzyl penicillin	30	04	FAO/WHO (1995) [15].
Gentamycin	0-4	200	FAO/WHO (1995) [15].

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Cypermethrin	0-50	50	FAO/WHO (1997) [16].
Albendazole	0-50	100	FAO/WHO (1998) [17].
Sulphonamidine	0-50	25	FAO/WHO (1998) [17].
Cypfluthrin	0-50	40	FAO/WHO (1998) [17].
Thiabendazole	0-100	100	FAO/WHO (1998) [17].

III. HEAVY METALS IN BOVINE MILK

Food security has received much attention among people by now and be an all-inclusive concern. Strict quality standards have to be executed to guarantee the commerce and human welfare as dairy harvest being a crucial food product here human diet are highly susceptible to contaminations. In view of the fact that they consume large amount of dairy products habitually, toxicity and contaminations in dairy harvest boast created unsympathetic health tribulations by the side of any age boundary of mankind including infants, teenagers along with aged people. Toxic metal contamination in milk plus additional dairy harvest to a large extent be outstanding of irrigation through H_2O having noxious metal, weedicides, insecticides, exercise of drugs and fertilizers [18]. Milk and other dairy harvest have two different kinds of metal traces. Fe, Cr, Mn, Zn, Cu, and Co are essential metals even as Hg, Cd and Pb are non-essential metals. But the limited concentration of these heavy metals is required by human health in milk and milk harvest. After that if their concentrations surpass above the ceiling permissible limits, they may have grave lethal effects on patrons with pilot variety of health issues [19].

Accumulation of heavy metals in human and animal tissues be capable of deriving from foodstuff along with water. Growing practices of foodstuffs on soil which involve with heavy metal contamination or irrigated by means of deteriorated water, increases toxicity of heavy metals [20]. Those animals related of existing criteria, supply milk and meat products in farms are greatly prone to the ecological toxicants and heavy metals. Recent evidences often highlight to heavy metal residues that clearly present in milk to such extent which exceed the ceiling permissible concentrations recognized by international establishment [21].

Through continuous application of bulk amount of fertilizer, disposal of industrial garbage and interchange emissions, Pb and Cd contaminate the grazing land owing to such anthropogenic activities. In milk wrapping and further hitech processes are also important fact to enhance the net concentration of heavy metals drastically [22]. The trendiest dairy artifact that is pulverized milk holds together fundamental and supplementary nutrients desired by regulars. That's why how it can be also a good source of heavy metals that ultimately causes ill effects to mankind. To ensure the consumer's safety authentication and regular checkup of the presence of such noxious heavy metals in milk and their supplements are necessary to be quantified under supervision of biochemist [23].

IV. HEAVY METAL CONTAMINATION AND ASSOCIATION WITH HUMAN HEALTH

Due to consumption of milk and milk harvest or products containing relatively high density of heavy metal traces such as Cd, Cu, Zn, As, Cr, Pb, Fe, etc. causes serious health issues to mankind. As heavy metal act as toxins with its high concentration in milk harvest and may cause injurious diseases like nervous disorders, weakness in immune response, cancers, liver weakness, heart problems, inverse effect in genital system, and digestive problem. Ceiling concentration of lead is responsible for disorder of nervous system, anemia, and hepatitis. Cadmium is a carcinogenic agent and responsible for development of tumor. Nickel poisoning causes serious cancers of bloods, infections, disruption of biological activities and hindrance in absorption of iron [24]. On the way to avoid the contamination of such heavy metal during different stages of handling, wrapping, dispensation and storage of milk and milk harvest special care should be taken. For such fact animal and cattle fodder and food materials ought to be away as of heavy metal unhygienic pollution.

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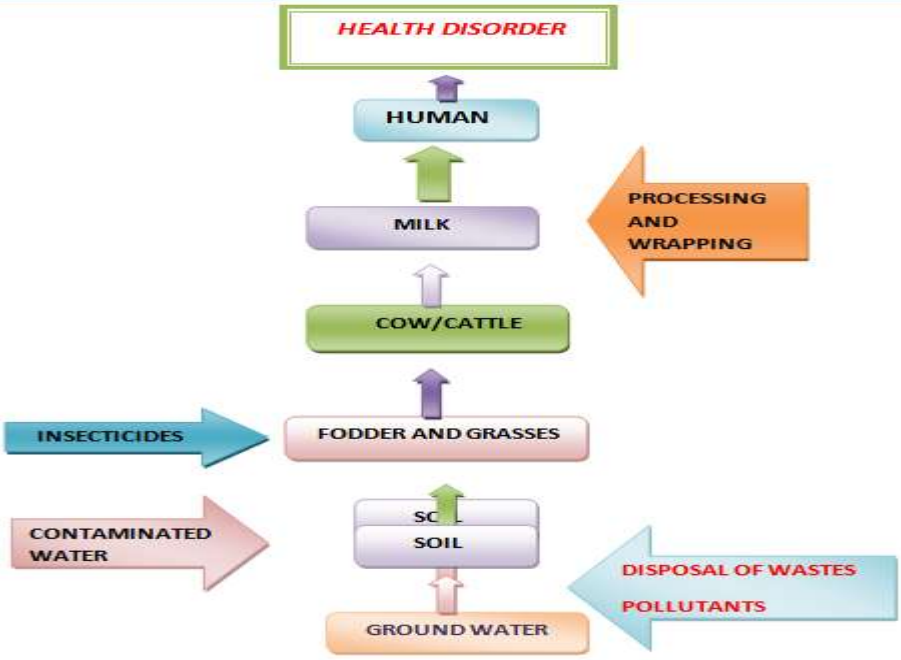
TABLE 2. AN OVERVIEW OF VARIOUS RESEARCHES AND SAMPLE TESTING OF MILK AND MILK PRODUCTS.

COUNTRY	METALS	SAMPLES	OUTCOME	REFERENCES
Brazil	Pb	Raw milk	Pb concentrations ranged from 2.12 to 37.36 µg l-1.	Oliveira., et al. 2017 [25]
Bangladesh	Pb, Cd	Cow Milk	Cr > Fe > Cu>Mn > Cd> Pb, Cr > Fe > Mn > Cu > Cd > Pb and Fe > Cr >Mn > Cu >	Mohibe., et al. 2016 [26]
Argentina	As, Cd, Cr, Ni and Pb	Raw milk from cows	Cd, Cr, Ni, Pb, and Se: High Concentration in milk samples	Perez-Carrera., et al. 2016 [27]
Pakistan	Cd, Co, Pb, Cu, Ni	Milk	Mean concentrations were 0.001, 0.061, 0.014, 0.738 and 0.028 mg/kg.	Ismail., et al. 2015 [28]
Egypt	Pb, Cd, Zn, Cu, Fe	Dairy Product	Pb, Cd, Zn, Cu and Fe concentrations were respectively 0.044-0.751, 0.008-0.179, 0.888-18.316,0.002-1.692 and 1.3208-45.6198 ppm	Meshref., et al. 2014 [29]
Hungary	Cd, Pb	Milk of ewes	Concentrations of Pb, Cd and Cr were 0.023 mg, 0.012 mg and 0.290 mg/wet weight kg within milk samples	Poti et al.,2012 [30]

FIGURE 1. PATHWAY FROM MILK CONTAMINATION TO ITS CONSUMPTION [31] .



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Quality Checkup And Assurance Measure Of Bovine Milk For Health Prospects

The National Residue Program (1967) was begun in order to protect the consumer against impairment arising from chemicals in foodstuff. Governments have liability for building regulation toward consumer protection. The regulation of prohibited residues in foods is controlled under 'Food Safety and Inspection Services' by 'Food and Drug Administration' and 'Environmental Protection Agency'. Food and Drug Administration be responsible of firm related to maximum limits on such drugs that may be in the tissues of such animals, veterinary residues are regulated through maximum residues levels which are tolerable in milk and dairy products.

Control over chemical contamination in milk and dairy harvest is the liability that lies by way of all contributors involve in different segment of production process from farmers to regulars. Regular consumers with government's organization concern over the potentials intended for the preface of chemical contaminants. Antibiotics residues in raw milk shipped from the farm and to prevent the occurrence of chemical contaminants are goals of total quality management [32].

V. CONCLUSIONS

In view of present review, heavy metal residues in dairy products have been drastically increased causing direct and indirect toxicities to humans. Consumption of milk and milk harvest or products containing relatively high density of heavy metal traces such as Zn, Cd, Cu, As, Cr, Pb, Fe, etc. causes serious health issues to mankind. Since livestock species are being reared on lands associated contaminated with toxic heavy metals along with some pesticides residues, they can possibly acquire accumulation within living tissues of humans and indirectly causing the safety of consumers at a higher risk level. Therefore, strict rules and regulations must be assured by local and international authorities to ensure the health and safety of consumers.

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