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Detection of Heavy Metals in Goat Milk in Bani Waleed City-Libya

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ABSTRACT

The goal of this study was to is to detect of some heavy metal in milk samples taken from goat herds that were grazing close to Bani Waleed City, Libya. After gathering ten milk samples, the samples were immediately taken to the lab and refrigerated for further examination. Using a flame-atomization absorption spectrometer (FAAS), the concentrations of lead (Pb), cadmium (Cd), copper (Cu), and irons (Fe) in the samples were measured. While lead (Pb), cadmium (Cd), and copper (Cu) were lower than instrumental detection limits in all samples, the results showed that Fe was detected in all ten samples, though this level was almost below the recommended limit by The World Health Organization's (WHO). That meant goat's milk is suitable to consume.

الكشف عن المعادن الثقيلة في حليب الماعز بمدينة بني وليد-ليبيا

محمد عمر عبدالله سالم[1] ,الياس عامر سعيد سالم[2]

الهدف من هذه الدراسة هو التأكد من تركيز بعض المعادن الثقيلة في عينات الحليب المأخوذة من الماعز التي ترعى بالقرب من مدينة بني وليد ، ليبيا. بعد جمع عشر عينات من الحليب ،تم أخذهاعلى الفورإلى المختبروتبريدها لمزيد من الفحص. باستخدام مطياف امتصاص اللهب (FAAS) ،تم قياس تركيزات الرصاص (Pb) والكادميوم (Cd) والنحاس (Cu) والحديد (Fe) في العينات. في حين كان الرصاص (Pb) والكادميوم (Cd) والنحاس (Cu) في جميع عينات الدراسة أقل من حدود الكشف الآلي في جميع العينات،أظهرت النتائج أنه تم اكتشاف الحديد (Fe) في جميع العينات العشر،على الرغم من أن هذاالمستوى كان أقل من الحد الموصى به تقريبًا من قبل منظمة الصحة العالمية. (WHO) هذا يعني أن حليب الماعز مناسب للاستهلاك.

INTRODUCTION

Many nations, particularly those in the Mediterranean and Middle East areas, rely heavily on the dairy goat industry for their national economies (Boyazoglu, Hatziminaoglou, and Morand-Fehr, (2005). For kids who are allergic to cow's milk, goat milk offers a nutritious and well-balanced diet since it may alleviate symptoms (Muehlhoff, & Bennett, 2013). While the composition of goat milk is similar to cow milk in terms of lactose, protein, fat, and total solids, there are notable differences in the size, content, and structure of casein micelles (Domagala, 2009). Special qualities of goat milk include its high digestibility, unique alkalinity, strong buffering capacity, and potential medical benefits (Ribeiro, & Ribeiro (2010), Getaneh (2016).goat milk contains lipids with more favorable physical properties than cow milk. The two primary ways that heavy metal pollution enters the human body are by ingestion and breathing (Tripathi *et al.*, 1997).Important elements included in animal milk include phosphorus, calcium, potassium, magnesium, sodium, and chloride. Trace

elements include iron, cadmium, nickel, copper, zinc, manganese, and manganese (Coni *et al*., 1996). When high concentrations of heavy metals such as Cu, Cd, Zn, Ni, Hg, Pb, Fe As, and Cr are introduced to lactating animals, the metals accumulate in their milk and when consumed by humans, can have major health consequences (Onundi *et al*., 2010). Microelements thought to be critical for human growth, such as copper (Cu), iron (Fe), zinc (Zn), and selenium (Se), are found in milk. However, if levels of heavy metals including arsenic (As), cadmium (Cd), and lead (Pb) exceed maximum allowable levels, it can negatively affect human health and welfare (Aslam *et al*., 2011).

Due to the major impact on human health, it is now required to Detect and assess the amounts of heavy metals in milk as a result of rising environmental contamination (Caggiano *et al*., 2005). Heavy metals have been found in milk and other food products, according to numerous investigations (Rahimi, 2013, Starska *et al* 2011, Ben-Hander *et al*., 2020, Balli *et al*., 2023). Determining trace elements is a difficult task because of the low concentrations of heavy metal ions and complex emulsions in milk.

Sources of heavy metal pollution can come from fertilizers polluted with cadmium, which is linked to the buildup of cadmium in animal offals, or through direct exposure to grass and crops raised for animal feed (Bramely, 1992). On the other hand, industrial pollution has been caused by contaminated water from factory waste discharge. Environmentally, as well, from the fumes released during mining or from cars running on leaded gasoline. According to Onundi *et al*. (2010), prolonged or excessive exposure to heavy metals can cause a variety of health problems, including cancer, behavioral issues, hepatotoxicity, neurotoxicity, vomiting, ulcerative colitis, Alzheimer's disease, and tissue damage and lung irritation.

Small levels of some metals, including lead, can have varying effects on people's health when they are regularly consumed. Since milk and dairy products are considered the primary sources of nutrition for children, it is crucial to monitor the level of trace elements in them. Complete removal or prevention of chemical contaminants from milk is not possible because the lipophilic contaminants will find their way into the persistent fat compounds from where heavy meta-bolic acids are found. For example, regular consumption of small amounts of lead may cause various impacts on the health of growing infants and children. These impacts include impaired concentration, retardation of mental development (such as reading and learning disabilities), adverse effects on kidney function, blood chemistry, and cardiovascular system, and degradation of hearing. In addition, heavy metals accumulate in food chains through biotransformation, bioaccumulation, and biomagnifications because they are not biodegradable in the natural world (Aslam *et al*., 2011). Thus, the purpose of this study was to ascertain the impact of certain heavy metals (Pb, Cd, Cu, and Fe) on public health.

MATERIALS AND METHODS

SAMPLES COLLECTION:

Ten milk samples from goats were randomly selected from various locations, particularly in the vicinity of Bani Waleed City in Libya. In order to be evaluated, Milk samples were collected in sterile polypropylene bottles of 50 ml then moved as quickly as possible in an ice box to the chemical laboratory at the Bani Waleed University Faculty of Education and they were frozen under −20 °C until their analysis (Balli *et al* .,2023).

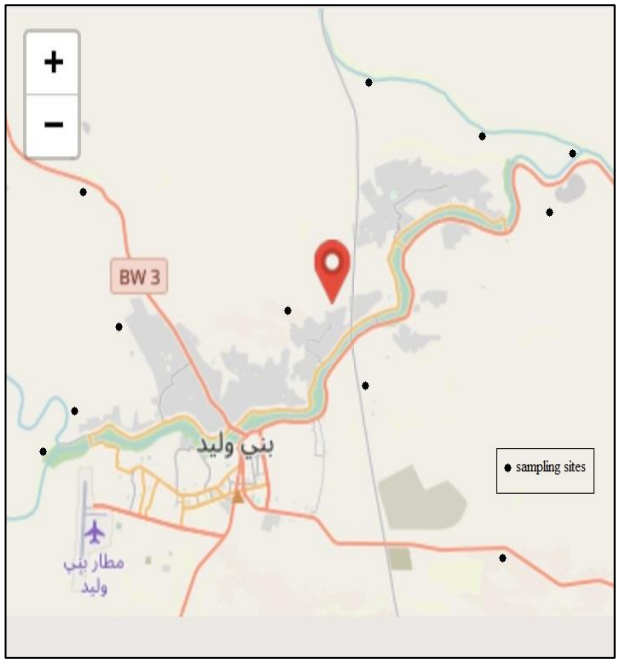

Fig. 1 Bani Waleed City map shows sampling sites.(Google maps)

DETERMINATION OF SOME HEAVY METALS

PREPARATION OF SAMPLES:

2ml of milk was digested using a 1:3 ratio of H_2O_2 to HNO_3. On a hot plate, the samples were heated until their volume dropped to two millilitres. The 2 ml sample solution was then turned into a clear solution by diluting it with 20 ml of deionized water. Using distilled water, the beaker's contents were increased to the necessary volume (25 ml), and a Flame Atomic Absorption Spectrophotometer was used to analyze the results (Richards, 1968).

RESULTS AND DISCUSSION

The physiological state of each lactation stage, as well as nutritional and environmental circumstances, can affect the mineral content of milk. Preliminary data suggests that consuming ovine and goat milk can provide valuable content in the heavy metals necessary for various metabolic activities. This is supported by comparisons with literature data related to these milk products. The obtained results in Table (1) illustrated that the minor essential element Fe was found in a range of (0.400-0.501ppm). Meanwhile, heavy metals (Pb, Cu, and Cu) could not detected in examined goat milk because were lower than instrumental detection limits in all samples.

Table (1): Results of some heavy metals (ppm) in goat milk.

Heavy metals	Min	Max	Mean±SEM	WHO
lead	< 0.01	< 0.01	-	0.02
Cadmium	< 0.01	< 0.01	-	0.50
Copper	< 0.01	< 0.01	-	0.40
Iron	0.400	0.502	0.451±0.01	0.50

0.01 = Detection limit

It appears from a more thorough examination of the data that the lead levels in the milk sample are lower than the experimental detection limits (Table 1). And those reported by other Authors sincthere are limited published data on harmful metal concentrations in goat milk. Lower Pb values of 7.37 lg/L were previously recorded in Iran (Rahimi 2013) in comparison to the current results. However, exceptionally high Pb concentrations of 42.69 mg/L were discovered in Pakistani industrial sites (Javed *et al*. 2009). The high Pb levels in the blood of goats grazing near highways or mining areas in Spain, which were 2.2-4.5 higher than in animals grazing in rural areas, illustrate the impact of Pb contamination in the environment (Garcı´aFerna´ndez *et al*. 2003).Previous investigations on Pb contents in cow milk in Croatia found higher Pb values in the range of 23.06-70.56 lg/kg (Sikiric *et al*. 2003). In addition, mean Pb concentrations in Croatia's northern and southern regions were substantially higher, at 58.7 and 36.2 lg/L, respectively (Bilandzic' *et al*. 2011). Low Pb concentrations in milk are almost definitely related to the fact that grazing pastures are located in rural locations, away from main road routes.

In terms of Cd, all samples exhibited levels of the metal that were below the limits of instrumental detection, showing that the Bani Waleed region is not at risk for toxicological consequences associated with Cd. While Licata *et al*. (2004) and Triphathi *et al*. (1999) reported Cd levels in caw milk as 0.0228 and 0.00007 mg/L, respectively. Different researchers, like Baldini *et al*. (1990), Cerutti (1999), and Martino *et al*. (2001), observed Cd concentrations in cattle milk ranging from 0.0002 to 0.03 mg/L, which is significantly lower than the levels determined in this study, Hussain (2000) examined metal ion concentrations in goat milk and discovered that it was more polluted with Cd than cattle milk, 0.084 vs. 0.076 mg/L, respectively. The values of Cd in goat milk in the current investigation are supported by the values found by Coni et al. (1996) in goat milk (0.15 mg/L). Caggiano et al. (2005), on the other hand, detected 0.05 mg/L Cd residues in goat milk.

It is crucial to emphasize that, in terms of Cu values, all milk samples displayed concentrations that were lower than those discovered by other authors. Low levels of copper in milk samples are most likely caused by the zinc concentration of the feed, which messes with the animals' copper absorption mechanism (Balduini, *et al*., 1990). These results are consistent with what other writers have reported (Baldini *et al*. 1990; Cerutti 1999).

As a necessary trace element, iron catalyzes a number of metabolic processes. Plays an important function in the transportation, storage, and consumption of oxygen as a component of hemoglobin, myoglobin, cytochromes, and other proteins. Moreover, it functions as a cofactor for several enzymes, and a shortage of it causes anemia (Meshref *et al*., 2014). It was observed that the Fe (0.400-0.502 ppm) content in goat milk was lower than that found in some previous studies, Ahmad *et al*. (2017) found that the mean concentration of Fe in goat milk was higher at 0.95±0.30 mg/kg compared to sheep milk's 0.59±0.32 mg/kg. Conversely; Meshref *et al* (2014) found that the range of Fe content in goat milk was (1.320–45.619).

Finally, the concentration of heavy metals (Pb, Cd, Cu, and Fe) in this study in all samples is still less than the permissible limit by WHO standards and LNCSM. (2016).

In any case, the levels of heavy metals discovered in goat milk samples from Bani Waleed suggest that the milk is safe for consumption, this is my due to low/no pollution of these metals in these areas since Bani Waleed is a location with little industrial activity and, low levels of heavy metals are generally associated with this feature.

CONCLUSION

In conclusion, based on the findings of this study, it is possible to conclude that all tested goat milk samples contained low quantities of lead (Pb), cadmium (Cd), and copper (Cu), which did not exceed the WHO-approved level and LNCSM.(2016). While iron (Fe) was

detected in some samples, the quantities did not surpass the allowable limit. However, the number of heavy metals and samples evaluated in this study was restricted.

As a result, more research into "toxic" heavy metals in a larger number of fresh milk samples from different parts in Bani Waleed City is strongly advised.

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