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CONCENTRATION OF HEAVY METALS FOUND IN CANDIES AND TOMATOES PASTE

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ABSTRACT

This study became initiated as considered revision on some impounded merchandise tomato paste (Samples A and B) sweets and sweets (Samples C, D, E and F) imported from China, and offered in Nigerian markets. This results as their failure to fulfil National Agency for Food and Drug Administration and Control (NAFDAC) regulatory standard. Samples A, B, C, D, E and F were gathered in five markets from six states inside the six geo-political Zones in Nigeria which includes: North-west zone (Kano), North-East zone (Bauchi), North-crucial zone (Kogi), South-West zone (Lagos), South-East area (Abia), and South-South region (Rivers) consider revising with a purpose to evaluate the best of the products, the degrees of a few heavy metals (Cu, Mn, Cd, Ni, Na, Zn, Lv, Mg and okay) have been evaluated in the samples using X-ray fluorescence (XRF). Concentrations of metals in both tomato puree ranged 4.0 – 4.5mg/g for Cu, 18.0 – 42.5mg/g for Mn, 4.0– 56.0mg/g for Ni, 27.0 – 35.2mg/g for Zn, and at the same time as concentrations of metals in both goodies and chocolates ranged 3.0 – 4.2 mg/g for Cu, 40.0 – 50.7mg/g for Mn, ND – 305.0mg/g for Ni, ND – 42.5mg/g for Zn. The concentrations of all the metals studied have been usually higher in samples A and B as compared to encouraged ranges of those metals in vegetable plants. Additionally, the facts showed that those metals are at higher tiers in samples C, D, E and F in comparison to other studies in chocolates and goodies in Nigeria. Correlation evaluation among metals revealed wonderful correlations, which suggests similar sources of these metals. Also, evaluation of nutritional intake of those merchandise each day discovered that sample A (besides for Cu and Fe), B, C (besides for Cu), D and E are above the daily nutritional endorsed limit for all the metals studied in food. Consequently, frequent consumption of these infected products is probably to set off fitness effects bobbing up in large part from Cu, Mn, Cd, Ni, Lv, Mg, ok, Na and Zn.

Key Words: Concentration, Heavy Metals, Candies and Tomatoes Paste.

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I. INTRODUCTION

These days, there's a growing challenge about the imported ingredients and food associated merchandise in numerous components of the arena (Maxwell and Neumann, 2009). This, as discovered by way of the Nigerian Congress, became because of the large size of shipments, the many special routes of access, the variety of ingredients imported, and the massive numbers of potential contaminants make powerful interdiction of contaminated foods difficult (Congress research carrier document, 2008).

Additionally, the Nigeria Congress located that many merchandise had been introduced into the Nigeria. with the aid of guests in particular citizens visiting back and forth other countries to Nigeria. Most of the common products imported had been canned tomatoes, candies, chocolates, biscuits, bean paste, bean curd, teas and diverse nuts and spices (CRS report, 2008). In line with the Nigerian Congress studies carrier file (2008), in early 2007, proof emerged that adulterated puppy food ingredients imported into Nigeria had prompted the deaths of many puppies and cats. But toxicological and environmental studies have hobby within the willpower of toxic elements in food. "Food protection" implies absence or ideal and secure tiers of contaminants, adulterants, evidently happening pollutants or some other substance which can make food injurious to health on an acute or continual basis. Food pleasant can be considered as a complex feature of meals that determines its value or acceptability to purchasers. besides safety, high-quality attributes include nutritional fee, organoleptic homes which include look shade, texture, taste and functional properties (WHO, 2007) thinking of those products exceeded through one of a kind commercial approach and are packaged to provide a means of protection, advertising or managing, and most of them have printed coloration inks at the outer cowl (Kim, 2008).

Importantly, food merchandise including chocolates which can be possibly to be ate up frequently through small children are wrapped in colourful programs so one can result in them to purchase the goods. Heavy metals, inclusive of lead, Chromium, Titanium, Zinc and Copper can migrate from the broadcast floor to the meals contact surface thru four mechanisms: blockading, rubbing, peeling and diffusion (Bradley, 2005).

Infection of imported food merchandise with heavy metals may cause a extreme danger to human health because of the intake of even small range of metals can cause great concentrations in human frame. Metals that can't be metabolized like cadmium, lead and mercury persist within the frame and exert their poisonous effects by mixture with one or more reactive companies critical for normal physiological characteristic and mobile disturbances or medical manifestation can also appear (Friberg and Elinder, 2011; Skerfving, 2010). The unfavourable poisonous effects resulting from lead (Subramanian, 2010), cadmium (Friberg, 2005), mercury (Manahan, 2010) and tin (Reilly, 2008) are broadly identified. Regardless of the hazard outcomes of heavy metals on public health, some of them are crucial for everyday physiological features which include copper and zinc (Zaki, 2010; Hays, 2011). Also, copper sulphate famous clean reduction of cadmium residues in animal tissues (Ahmed, 2008).

The dietary deficiencies of copper, zinc, calcium, iron, protein and an excess dietary fat cause damage within the absorption and toxicity of lead (Gold frank et al., 2005). although there are requirements set via the excellent control bodies which include National Agency for food and Drug administration and control (NAFDAC) and standards organization of Nigeria (SON) for permissible concentrations of those contaminants in imported merchandise, the trouble still exists due to the fact many producers have two or more variations of their products: one in particular designed to fulfill requirements set via the import and a less

expensive and poorer version for the local market (Medlin, 2004). Coupled with the reality that path of access differs; consequently, monitoring of heavy metallic content material in these products is crucial particularly with their associated health implications. The potential for publicity, even though, isn't completely understood due to the lack of records regarding heavy metal stages in diverse products and the quantity of use inside Nigerian communities. Canned tomatoes and sweets, however, are of specific concern because of their potential for children intake

II. AIM AND OBJECTIVES

The purpose of this to determine some heavy metals together with Lead (Pb) and Cadmium (Cd), which might be vital at low concentrations in some canned tomato paste (Sarah tomato paste and Gino tomato paste) and candies (lollipop with pencil, and milk sweet) received from essential markets and stores within Makurdi city and to provide data that can be used as the basis for preventive measures.

This turned into set to be carried out thru the subsequent goals:

i. To decide the metal contents of canned tomato pastes, lollipop, and milk candy inside

ii. To compare the tiers of the metal's concentrations in canned tomato paste, lollipop, and milk sweet with global requirements.

iii. To determine the threat associated with the intake of those merchandise.

III. LITERATURE REVIEW

3.1 Environmental Contaminants

Environmental contaminants are materials that originate from diffuse assets and can appear in meals primarily based on their ubiquitous presence in the surroundings (Klaus et al., 2011). In current years, it's been emphasized that meals protection and transparency of the food-related regulatory process is of pivotal significance to beautify purchaser's self-belief in food (Horton, 2001). Heavy steel (HMs) is appeared as one of the most dangerous and lethal environment contaminants. They're biodegradable and tend to build up in living organisms via the food and chain turning into chronic natural contaminants (Fan et al., 2002; Buccolieri et al., 2006). At positive stages, they may motive poisonous impact to the organisms (Bryan and Langston, 2002), and are serious chance to the ecological safety and human fitness. One of the prices paid via humans inside the path of development is pollution in a single shape or the opposite. Even though no longer conspicuously alarming, the gradual and regular pollutants via heavy metals inside the environment is quite dangerous (Baskar et al., 2009). Heavy metals rise up from unorganized industrial growth and are taken into consideration as most important pollutants of herbal water bodies. Anthropogenic activities like business procedures, unsafe disposal of industrial wastes, agricultural wastes, and so on launch heavy metals into the environment. Once launched they contaminate water, soil, flora and input the meals chain, posing fitness problems to people. Those recalcitrant pollution acquired good sized interest due to their inherent toxicity to residing organisms. After they reach the aquatic surroundings and, being non-degradable stay suspended or in part dissolved in water and finally acquire in aquatic lives. Considering the intake of meals substance, it's far sizeable to display the extent of heavy metals found in them (Sharma et al., 2008).

3.2 Toxicity of Environmental Contaminant (Heavy Metals)

The presence of toxic hint metals inside the environment maintains to generate numerous difficulty (Awofolu, 2005). This is due to the health implications in their presence considering they are non-important metals that aren't required for any characteristic either via flora or animals and are generally monitored for fitness purposes. This class of metals isn't always required by way of man even in small amount (Tyler, 2010; Borgmann, 2012). but metals consisting of Cu and Zn are categorized as critical to existence because of their involvement in positive physiological methods, although accelerated degrees of these metals were observed to be toxic (Spear, 2008). Copper is one of the heavy metals this is essential to each vegetation and animals but will be poisonous at multiplied tiers. it's far toxic at low attention and is thought to purpose brain harm in animals (Awofolu, 2005). but, symptoms of acute copper toxicity in guy include hypertension, anaemia and cardiovascular disintegrate whilst persistent toxicity leads to sporadic fever, vomiting, diarrhoea and jaundice. it is also suspected that copper is carcinogenic due to excessive occurrence of cancer among coppersmith (Luckey and Venugopal, 2007). Chromium is found in human tissues in variable concentrations and its deficiency is characterized via disturbance in glucose, lipid and protein metabolism (Anthony et al., 2007). It also performs an critical role in enhancing the activity of insulin in human frame. However, its compounds are widely known toxins specially Cr6+ which, because of its oxidizing potentials, without difficulty permeates biological membranes and also can purpose renal damage and numerous forms of most cancers (Bae et al., 2000). Nickel is a certainly going on detail determined in a number of mineral ores which include nickel phosphates, oxides and silicates. it's miles gift within the enzyme urease and as such is considered to be critical to plants and some domestic animals (Awofolu et al., 2005). However, the essentiality of Ni to fitness has not been validated, however Ni associated fitness outcomes which include renal, cardiovascular, reproductive and immunological results weresaid in animals. Also, its poisonous outcomes are associated with dermal, lung and nasal sinus most cancers (Holynska et al., 2006). Zinc is a critical element to vegetation and animals. despite the fact that, Zn has been located to have low toxicity to man, prolonged consumption of massive doses can result in a few fitness complications together with fatigue, dizziness, and neutroeria (Awofolu, 2005). In addition, Luckey and Venugopal (2007) suggested that acute Zn toxicity in many reasons diarrhea, despair of vital worried device leading to tremors and paralysis, even as chronic Zn toxicity reasons increase retardation, defective reproduction and anaemia in man. Audu and Lawal (2005) also noted that Zn is a crucial element that is concerned in metabolic capabilities, and is crucial for both animal and plant health increase. Zn content material of everyday plant tissues varies consistent with species, but it is usually in the range of 5 – 300mg/kg. Zinc is an element observed in genuinely each cellular of the human frame and plays critical roles inside the improvement and healthful increase of human frame and has a recognized motion on greater than 300 enzymes by collaborating in their structure or in their catalytic and regulatory motion. in step with Nnorom et al (2007), zinc wealthy meals tend to be highly-priced, and so Zinc (Zn) fortification is a crucial consideration especially because daily intakes appear like extra beneficial physiologically than in intermittent doses. Zinc deficiency can result in bad boom, issue in wound recuperation, and loss of urge for food, unwanted pores and skin changes, and unfavourable consequences at the immune gadget. also zinc deficiency is related to sexual maturation, fertility, immunity, tastes and appetite. The present-day Reference every day intake for Zinc (Zn) is 15mg/day. Overload of Zinc (Zn) (> 100mg/day) can also be dangerous. It is able to depress the immune machine, or motive anaemia (Nnorom et al., 2007).

3.2 Heavy Metal Contain in Food Substance

3.2.1 Heavy Metal Content in Tomato Paste

Tomato paste is an instance of canned meals that is used for the instruction of stews and soaps. Examples of heavy metal found in tomato paste encompass copper, zinc, lead and iron. these heavy metals when gift within normal range as advocated with the aid of NAFDAC and SON i.e Copper (4.0-4.5mg/g), Zinc (27.0-35.2mg/g), Mg (18.0-42.5mg/g) and iron (26.0-62.5mg/g), Ni (4.0 -56.0mg/g) poses no harm to the frame system however while found in immoderate or deficient concentration poses a wonderful or good sized danger to human life.

Cadmium and Lead attention in our concentrate had been in the worldwide maximum permissible restriction. The unmarried factor index of cadmium for milk candy, strawberry lolli pop, serah tomato paste and gino tomato paste have been discovered to be 2.9, 4.3, 0.8 and 0.95 respectively. If the SFI is extra than 1, the sample is considered polluted via the heavy metal; otherwise, the sample is taken into consideration not polluted through the heavy metal. The result of this takes a look at indicates that all the goodies beneath were polluted via cadmium while the tomato pastes had been now not polluted but as an alternative infected via cadmium. Candies are suitable for eating, candy-tasting confectionery containing sugar or now and again artificial sweeteners and often flavoured with culmination, chocolate, nuts, herbs and spices. Heavy metals observed in candies encompass Zinc, lead, Nickel and Cadmium. The frequent concentrations for those heavy metals in sweets consistent with NAFDAC are Zinc (Zn) (2.52 ± 2.59µg/g), Lead (Pb) (2.0 ± 1.20µg/g) Nickel (Ni) (0.84± 1.35 µg/g) and Cardium (Cd) (0.17 ± 0.22µg/g). Those concentrations whilst altered should cause serious fitness troubles for this reason a want to reveal their concentrations in candies.

IV. METHODOLOGY

MATERIALS AND METHODS

Chemicals/ Reagents

i. Concentrated Nitric acid (HNO_3)
ii. Distilled water
iii. Sulphuric Acid (H_2SO_4)

Apparatus

i. Glass ware e.g beakers
ii. Weighing balance
iii. Mortar and pestle
iv. Stirring rod
v. Filter paper
vi. kjeldal digestion flask
vii. Flame Atomic Absorption Spectrometer

Collection of Samples

Tomato paste sample had been accrued from two (2) fundamental market (North financial institution market and high-degree market) whilst chocolates have been acquired from foremost wholesale/store outlets (Togo's supermarket and D.O brothers' grocery store) all within Makurdi city.

Sample preparation and analysis

The digestion process changed into used to pre-deal with the pattern for the willpower of Cd and Pb because it presents a quick, easy and safe technique without changing the element content material inside the pattern to be analysed. The sweets were sundried, pounded and sieved into powdered form. 10g each of homogenous tomatoes pastes and 2g powdered sweet

were weighed into 100mL kjelbal digestion flask. After addition of 40ml focused nitric acid, the flask changed into positioned on heating mantle machine at the same time as still heating 4ml of Sulphuric Acid turned into add into it and the mixture become boiled very lightly till the nitrous oxide formed disappears. After cooling, the digested solution became diluted to a very last volume of 50ml with distilled water and the concentration of heavy metals gift become determined the use of flame atomic absorption spectrometer at numerous wavelengths of the metallic.

Atomic Absorption Spectrophotometer

In analytical chemistry, atomic absorption spectroscopy is a spectro-analytical procedure for the quantitative dedication of chemical factors the usage of the absorption of optical radiation (mild) by unfastened atoms inside the gaseous kingdom. toxic absorption spectrometer popularly known as AAS is primarily based on the absorption of mild by unfastened metallic ions. This method is used to decide the concentration of a selected detail (analyte) in a pattern to be analysed. it's miles able to figuring out over seventy (70) different factors in answer or without delay in stable samples.

Principles of Atomic Absorption Spectroscopy

The method uses absorption spectrometry to evaluate the awareness of an analyte in a sample. It is based heavily on Beer-lambert regulation of absorption spectrometry: A= ebc where A= Absorbance, b= route period, c= concentration of the absorbing specie, e= molar absorptivity with the intention to examine a pattern for its atomic constituent, it needs to be atomised with the useful resource of an atomizer thereafter, the atomized samples are illuminated via light. The transmitted mild is sooner or later detected by way of a detector. The most commonly used atomizer nowadays are the flame atomizer (used to examine dissolved sample or liquid sample) and electro-thermal atomizer (used to examine liquid/dissolved sample, stable and gaseous samples).

V. RESULTS AND DISCUSSION

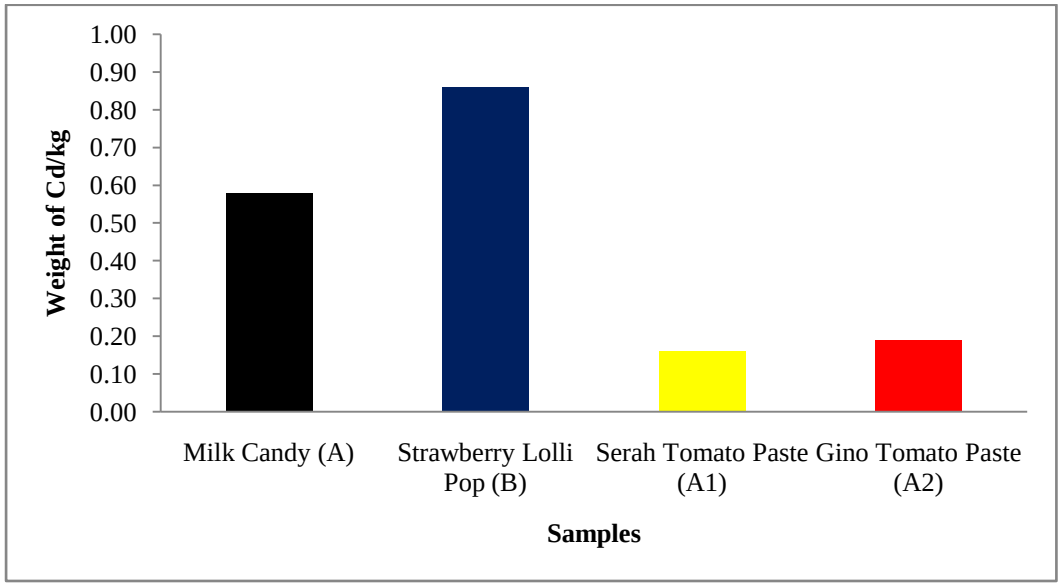
Concentration of Cadmium and Lead in Selected Candies and Tomato Pastes

The raw effects of the Atomic Absorption Spectrophotometer (AAS) for the quantification of heavy metals in the two selected candies and tomato pastes are respectively illustrated in Appendix I. but, the weight of metal consistent with kilogram (mg/kg) of cadmium and lead are as offered in table 1 at the same time as the figure 1 presents the histogram of the amount of cadmium in step with kilogram within the samples analysed.

Table 1: Levels of Heavy Metals in Selected Candies and Tomato Pastes Sold in Makurdi Petropolis

	Heavy Metal (mg/kg)	
Sample	**Cd**	**Pb**
Milk Candy (A)	0.58	BDL
Strawberry Lolly Pop (B)	0.86	BDL
Serah Tomato Paste (A_1)	0.16	BDL
Gino Tomato Paste (A_2)	0.19	BDL

Key: BDL=Below Detection Limit



Keywords: Milk Candy, Strawberry lolli pop, Serah tomato paste, Gino tomato paste

Figure 1: Concentration of Cadmium in Selected Candies and Tomato Pastes Sold in Makurdi Metropolis

Table 2: Some Human Health Risk Indices for Cadmium in Selected Candies and Tomato Pastes

Samples	DIR(mg/kg-day)	THQ (Adults)	THQ (Children)	ILCR	HRI	SFI
Milk Candy (A)	0.018	5.20	22.76	3207.26	1160.00	2.9
Strawberry Lolli Pop (B)	0.027	7.71	33.74	4755.59	1720.00	4.3
Serah Tomato Paste (A_1)	0.005	1.43	6.28	884.76	320.00	0.8
Gino Tomato Paste (A_2)	0.006	1.70	7.46	1050.65	380.00	0.95

Key: DI=daily Intake Rate; THQ=Target Hazard Quotient; ILCR=Incremental Lifetime Cancer Risk; HRI=Health Risk Index; SFI=Single Factor Index. Field work.

VI. DISCUSSION OF RESULTS

The concentration of cadmium (mg/kg) become found to be 0.58, 0.86, zero.16 and 0.19 in milk candy, strawberry lolli pop, serah tomato paste and gino tomato paste respectively. In general, the concentration of this steel in the samples were of the order of strawberry lolli pop>milk sweet>gino tomato paste>serah tomato paste. Those values were all above the FAO/WHO permissible degrees prescribed for all foods and canned foods of zero.05 mg/kg and 0.0030 mg/kg respectively for cadmium as pronounced by means of Devi, Bajala and Garg (2016). Those effects are suggestive of cadmium pollution in all of the samples studied which poses risk to the purchasers. However, Ochu et al. (2012) opined that better tiers of metals in processed meals may want to stand up from risky garage situations or at some point of manufacturing chain (i.e., uncooked materials, processing, packaging, transportation, storage or advertising.

The end result of this study can be in comparison in element to the ones pronounced via Devi, Bajala and Garg, (2016) who evaluated the heavy metallic content material in various kinds of sweets and their everyday nutritional intake by children and said that specially cadmium ranged now not detectedto0.68 mg/kg and that lead concentrations ranged from now not detected to eight.04 mg/kg.

The awareness of lead in all the samples studied become observed to be below detection restriction. The FAO/WHO permissible levels prescribed for all ingredients and canned ingredients of 0.1 mg/kg and zero.01 mg/kg respectively for lead as pronounced with the aid of Devi, Bajala and Garg, (2016). As such, there's no hazard related to the intake of these sweets and tomato pastes to the customers.

In standard, the result of this examine is not in settlement with results of Onwuka et al. (2019) who analysed distinct samples of tomato pastes (in tin and sachet) and sparkling tomatoes in Umuahia for some of heavy metals and determined the cadmium was always absent in all the samples studied even as lead ranged from 0.01 – 0.18 mg/kg in tinned tomato pastes; Adegbola (2013) pronounced a similar trend of consequences distinctive samples of processed tomato pastes and clean tomatoes in Ibadan.

Daily Intake Rate (DIR): The daily intake rate for milk candy, strawberry lolli pop, serah tomato paste and gino tomato paste respectively were found to be 0.018, 0.027, 0.005 and 0.006 mg/kg-day for cadmium. The values for candies were all above the upper tolerable intake of 0.240 while the values for the tomato pastes were all below the upper tolerable intake for cadmium.

Target Hazard Quotient (THQ): The target hazard quotient (cadmium) for adults and children were respectively found to be 5.20, 7.71, 1.43 1.70 and 22.76, 33.74, 6.28, 7.46 for milk candy, strawberry lolli pop, serah tomato paste and gino tomato paste. When the exposure is greater than one, then the exposure is likely to cause obvious adverse effects. The results of this study suggest the consumers of the studied candies and tomato pastes are faced with the likelihood of adverse effects from the cadmium. Since lead was not detected, target hazard quotient was evaluated for it.

Incremental Lifetime Cancer Risk (ILCR): US-EPA recommended the safe limit for cancer risk below 1 chance in 1,000,000 lifetime exposure (ILCR< 10^{-6}), threshold risk limit (ILCR> 10^{-4}) for which chance of cancer is above 1 in 10,000 exposure where remedial measures are considerable and moderate risk level (ILCR> 10^{-3}) is above 1 in 1,000 where public health safety consideration is more important (Sultana *et al.*,2017).ILCR for Cd violated the threshold risk limit (>10^{-4}) in all the studied candies and tomato pastes. The trend of risk for developing cancer as a result of consuming studied candies and tomato pastes showed: strawberry lolli pop-milk candy-gino tomato paste-serah tomato paste.

Health Risk Index (HRI): The health risk index evaluated for cadmium on milk candy, strawberry lolli pop, serah tomato paste and gino tomato paste were respectively 1160, 1720, 320 and 380. All these values are above one for cadmium indicating that the consumer population faces a health risk.

Single Factor Index (SFI): The single factor index of cadmium for milk candy, strawberry lolli pop, serah tomato paste and gino tomato paste were found to be 2.9, 4.3, 0.8 and 0.95 respectively. If the SFI is more than 1, the sample is considered polluted by the heavy metal; otherwise, the sample is considered not polluted by the heavy metal. The result of this study

indicates that all the candies under study were polluted by cadmium whereas the tomato pastes were not polluted but rather contaminated by cadmium.

VII. CONCLUSION

Cadmium and Lead concentrate had been in the worldwide maximum permissible restriction. The unmarried factor index of cadmium for milk candy, strawberry lolli pop, serah tomato paste and gino tomato paste have been discovered to be 2.9, 4.3, 0.8 and 0.95 respectively. If the SFI is extra than 1, the sample is considered polluted via the heavy metal; otherwise, the sample is taken into consideration not polluted through the heavy metal. The result of this takes a look at indicates that all the goodies beneath concentrate were polluted via cadmium while the tomato pastes had been now not polluted but as an alternative infected via cadmium.

VIII. RECOMMENDATIONS

After this research further human bio monitoring study to correlate environmental exposure of this heavy metals with biological remark is to be carried out.

Therefore, the following are recommended.

1. Availability of analysing machine for easy detection of the heavy metals before packaging.
2. Standard comparison should be considered before distribution and consumption.

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