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DETERMINATION OF THE LEVEL OF SOME ELEMENTS IN EDIBLE OILS SOLD IN ZARIA, NORTHERN NIGERIA

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ABSTRACT

The human body uses oils and fats in the diet as an energy source, as a structural component and to make powerful biological regulators. The significance of trace metals and toxicological effects of heavy metals on human health and nutrition have been increasingly studied in recent years. Micronutrients play a role in cellular defences, acting both as 'sinks' for free radicals or by being involved in the activity of the enzymes required to deal with the oxidative products e.g. zinc and copper in superoxide dismutase. Presence of metals in edible oil could be from soil or during the manufacturing process. In this present study, the levels of some metals were determined in vegetable oils sold in Zaria, Nigeria. The concentration ranged from 19.10-110.6, 0.34-2.77, 0.01-0.34, 0.05-0.84, 0.02-0.25, 0.01-0.08, 0.14-0.91, 0.34-0.97 mg/kg for sodium, cadmium, lead, chromium, aluminium, copper, manganese and nikel.

KEY WORDS: oil, metals, human body

INTRODUCTION

The human body uses oils and fats in the diet for three purposes, as an energy source, as a structural component and to make powerful biological regulators (Mendil et al, 2009).

Vegetable oils are beneficial and popular due to their cholesterol-lowering effect. In contrast to animal fat, which are predominantly saturated and hence do not react readily with other chemicals, especially oxygen, unsaturated vegetable oils are more reactive (Naz et al, 2004; Lankmayr et al, 2004). The levels of trace metals like Fe, Cu, Ca, Mg, Co, Cd, and Mn are known to increase the rate of oil oxidation while other elements such as Cr, Cd, and Pb at certain levels are toxic (Anthemidis et al, 2005).

Presence of metals in edible oil could be from soil or during the manufacturing process (Benincasa et al, 2007; Jamali, 2008).

Metals arrive in plants via deposition as well as bioaccumulation from the soil due to natural metal sources and environmental pollution (Mendil et al, 2009). Nikel and copper determination is important in the industrial production of vegetable oils because of the use of these metals as hydrogenation catalyst (Mendil et al, 2009). Copper and Iron are potential contaminant of the oil deriving from processing equipment (Zeiner et al, 2005; Laurent and Multon, 1997).

The significance of trace metals and toxicological effects of heavy metals on human health and nutrition have been increasingly studied in recent years. Some elements such as Cu, Zn, and Fe can act as nutrients and are important for health, while others such as Ni, Pb, Cd, As and Hg may be harmful for humans if excessive amounts are consumed (Guldas, 2008). Heavy metals are considered as serious inorganic pollutants because of their toxic effects to life (Arain et al, 2008). The heavy metals enter the human body through inhalation and ingestion. The intake via ingestion depends upon food habits. It is well established that Pb and Cd are toxic and children are more sensitive to these metals than adults. The metals namely Cu and Zn are essential micronutrients and have a variety of biochemical function in all living organisms. While Cu and Zn are essential, they can be toxic when taken in excess; both toxicity and necessity vary from element to element (Tripathi et al, 1999).

In this present study, the levels of some metals were determined in vegetable oils sold in Zaria, Nigeria.

MATERIALS AND METHODS

Eight varieties of vegetable oils sold in Zaria

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Market were collected. The collected oil samples were packed in polyethylene bottles and stored below –20°C until analysis.

All reagents were of analytical grade unless otherwise stated. De-ionized water was used for all dilutions. All plastics and glassware were cleaned and soaked in 10% nitric acid solution over night and rinsed with de-ionized water.

The element standard solutions used for calibration were produced by diluting a stock solution of 1000mg/L of given element, supplied by Shimadzu. 1gram samples were digested with 10ml of concentrated Nitric Acid. 2ml of hydrogen peroxide was added to the sample and heated until a clear solution was obtained. The resulting solution was made up to 50ml and transferred into a plastic bottle for analysis by AAS.

RESULTS AND DISCUSION

From the results in fig I to VIII shows the concentration of metals (Na, Cd, Pb, Cr, Al, Cu, Mn, and Ni) in the different variety of oils. The concentration ranges from 19.10-110.6, 0.34-2.77, 0.01-0.34, 0.05-0.84, 0.02-0.25, 0.01-0.08, 0.14-0.91, 0.34-0.97 mg/kg for sodium, cadmium, lead, chromium, aluminum, copper, manganese, and nickel respectively.

Vegetable oils and fats contain trace levels of various metals depending on many factors, such as species, soil used for cultivation, irrigation water, variety, and stage of maturity, pollution (Onianwa et al 2001; Mendil et al 2009).

The highest and lowest metal concentrations were observed in sodium and copper in all samples respectively.

Copper is known to be both vital and toxic for many biological systems and may enter the food materials from soil through mineralization by crops, food processing or environmental contamination, as in the application of agricultural inputs, such as copper based pesticides which are in common use in farms in some countries (Onianwa et al, 2001; Koc et al, 2008). The lowest copper levels were in pure soy and Grand soy oil (0.01 mg/kg) and a highest copper level is 0.08mg/kg in palm oil. The recommended daily intake of copper in adult is 1.5-3.0 mg (Onianwa et al, 2001). The average copper content of edible oil samples in the literature has been reported in the range of 12.71-50.5 µg/kg (Buldini et al 1997). The FAO/WHO (1999) has set a limit for heavy metal intake based on body weight. For an average adult (60kg body weight), the provisional tolerable daily intake (PTDI) for lead, iron, copper, and zinc are 214µg, 48mg, 3mg and 60mg respectively (FAO/WHO 1999).

Fe, Ni, Pb, Cd, and As are the most often determined elements in edible oils (Mendil et al, 2009). According to Kowalewska et al (2005) the approved contents of these metals in oils are 1-1.5mg/kg (Fe), 0.2mg/kg (Ni), 0.1 mg/kg (Cu, Pb As), and 0.05 mg/kg (Cd).

From Fig II, Kernel oil has the lowest cadmium value of 0.34mg/kg and solive vegetable oil with the highest value of 2.77mg/kg. Cadmium may accumulate in the human body and may induce kidney dysfunction, skeletal damage and reproductive deficiencies. The maximum permissible dose for cadmium per week is 0.5mg (FAO/WHO 1976).

From Fig III, Lead level is lowest in pure soy oil (0.01 mg/kg) and highest in groundnut oil (0.4mg/kg). FAO/WHO (1976) gives the permissible dose of lead for adult at 3mg per week.

From fig. IV, Grand soy oil and solive vegetable oil have the lowest levels of chromium of 0.05mg/kg while kernel oil has the highest value of 0.84 mg/kg. Chromium is considered as an essential trace element. The amount of chromium in the diet is of great importance as Cr is involved in the insulin function and lipid metabolism (Anderson 1997 and Bratakos et al 2002). The daily intake of chromium is 50-200µg (National Research Council Recommended Dietary Allowance, 1989).

From Fig. I the highest sodium level is 110.6 mg/kg in Oki vegetable oil, 0.25 mg/kg of aluminum in pure soy oil (Fig V), 0.91 mg/kg Mn in Grand soy oil (Fig VII), cotton seed oil have the highest nikel concentration of 1.1mg/kg (Fig. VIII).

Metals play important negative and positive roles in human life (Mendil et al, 2009; Ghaedi et al, 2008). The results on Fig. I to VIII shows that the metals are within tolerable limits for human consumption and toxic levels. Trace metals from literature can bioaccumulate in human system (Onianwa et al, 2001); hence the level of these metals can be reduced or checked by careful handling practice and processing of the raw materials (Mendeli et al, 2009).

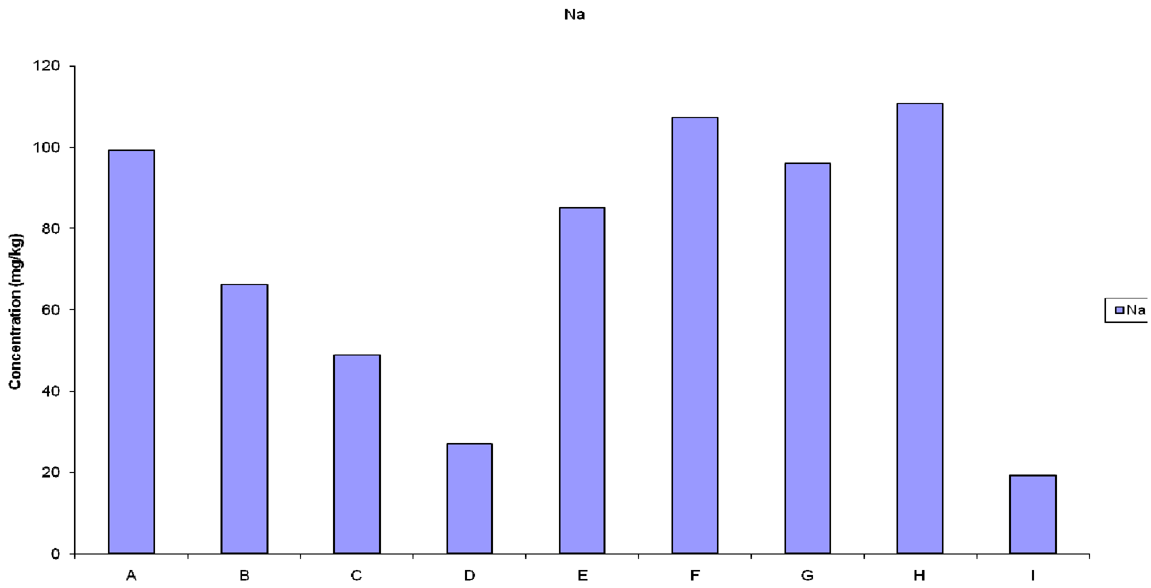

Fig.I. Levels of sodium in edible oil. (A) pure soy oil: (B) Grand soy oil: (C) cotton seed oil: (D) solive vegetable oil: (E) Magerine: (F) palm oil: (G) kernel oil: (H) Oki vegtable oil: (I) Groundnut oil

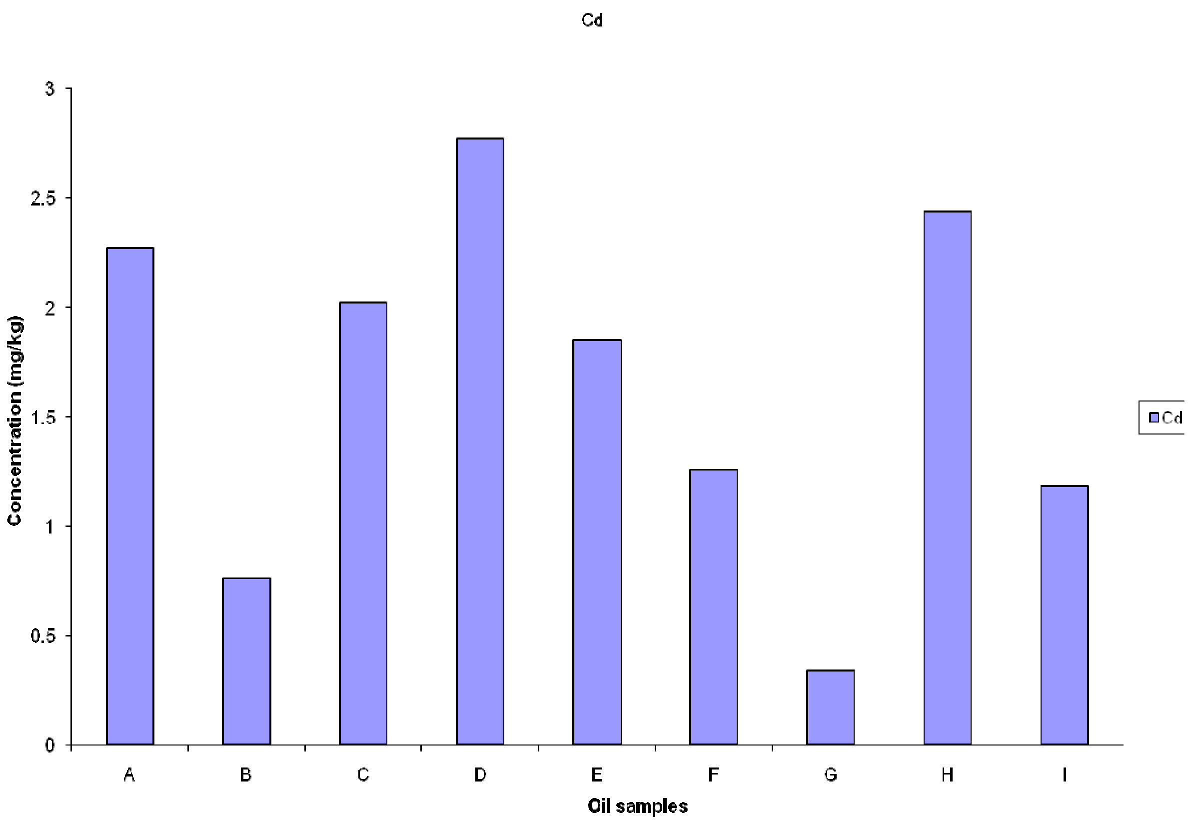

Fig.II. Levels of cadmium in edible oil. (A) pure soy oil: (B) Grand soy oil: (C) cotton seed oil: (D) solive vegetable oil: (E) Magerine: (F) palm oil: (G) kernel oil: (H) Oki vegtable oil: (I) Groundnut oil

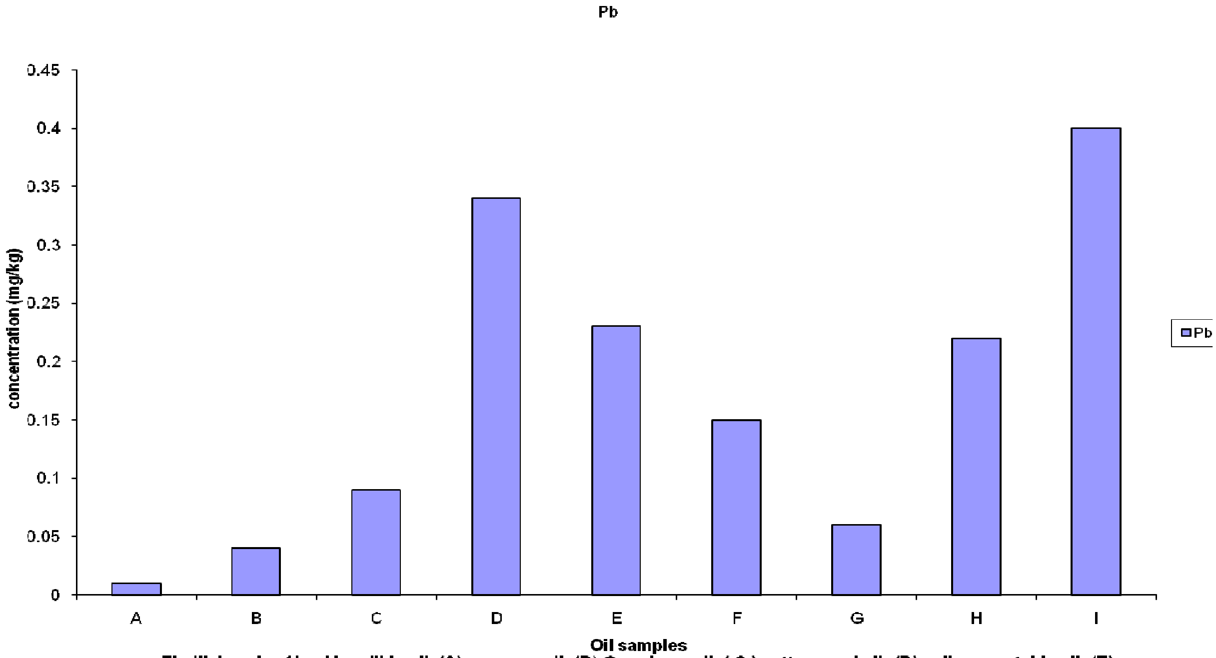

Fig.III. Levels of lead in edible oil. (A) pure soy oil; (B) Grand soy oil; (C) cotton seed oil; (D) solive vegetable oil; (E) Magerine; (F) palm oil; (G) kernel oil; (H) Oki vegtable oil; (I) Groundnut oil

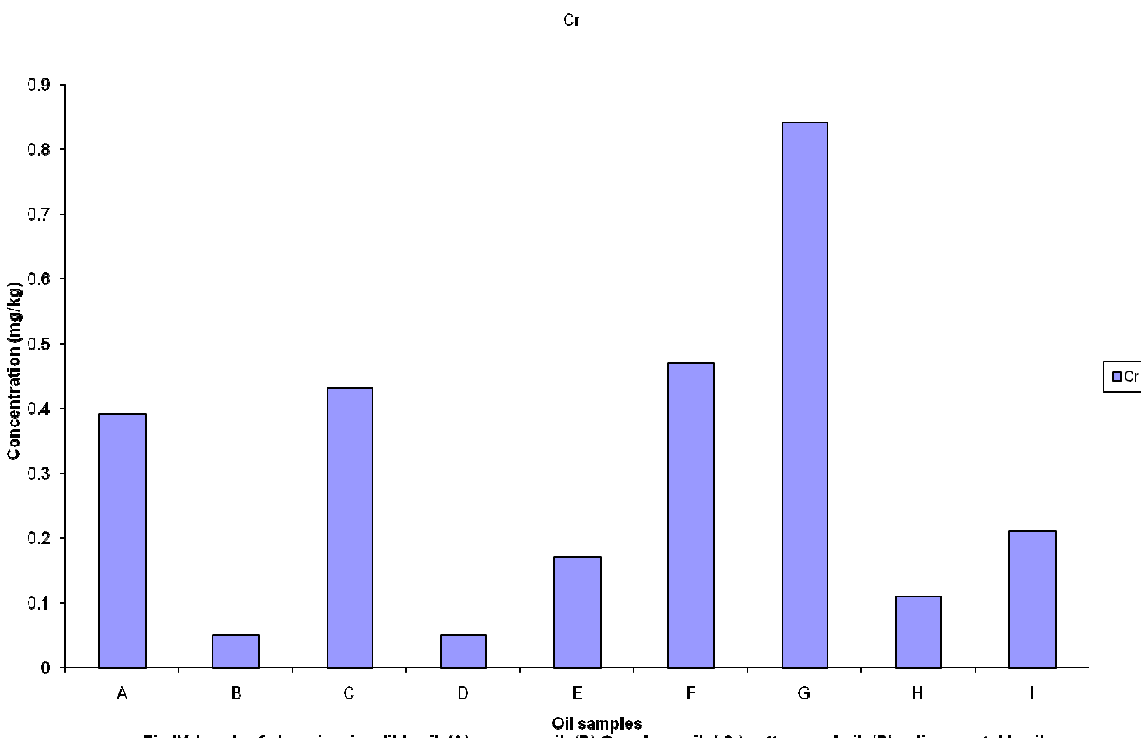

Fig.IV. Levels of chromium in edible oil. (A) pure soy oil; (B) Grand soy oil; (C) cotton seed oil; (D) solive vegetable oil; (E) Magerine; (F) palm oil; (G) kernel oil; (H) Oki vegtable oil; (I) Groundnut oil

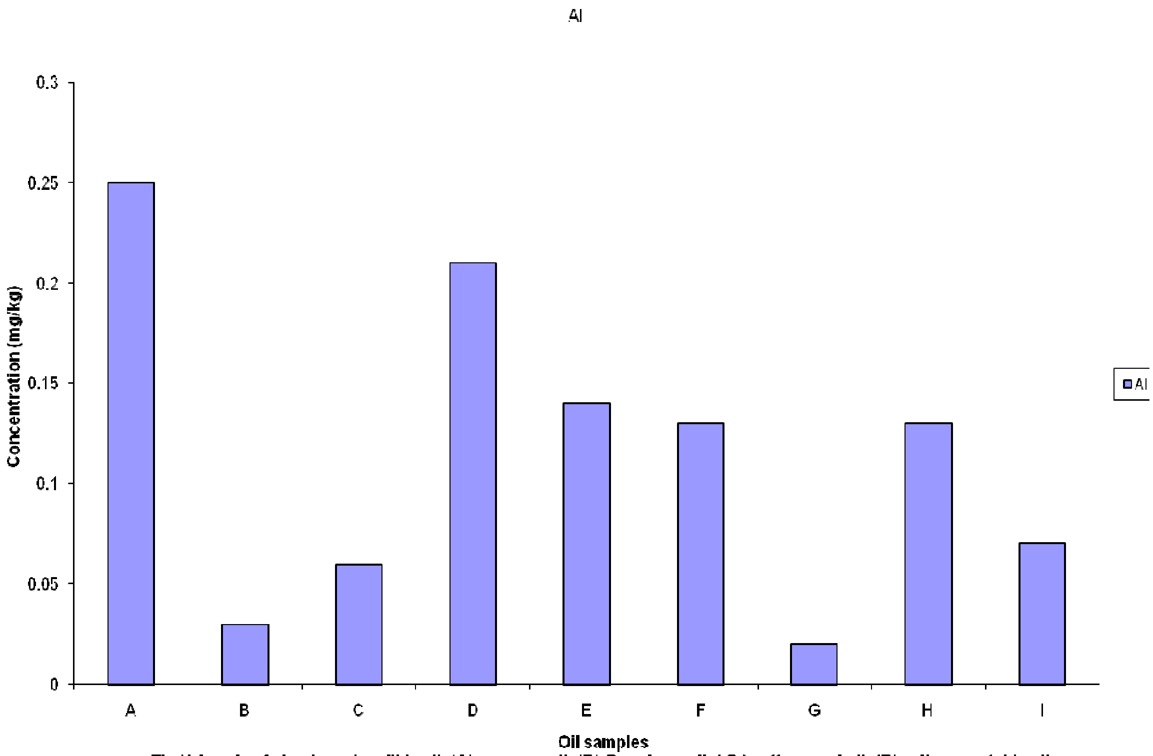

Fig.V. Levels of aluminum in edible oil. (A) pure soy oil: (B) Grand soy oil: (C) cotton seed oil: (D) solive vegetable oil: (E) Magerine: (F) palm oil: (G) kernel oil: (H) Oki vegtable oil: (I) Groundnut oil

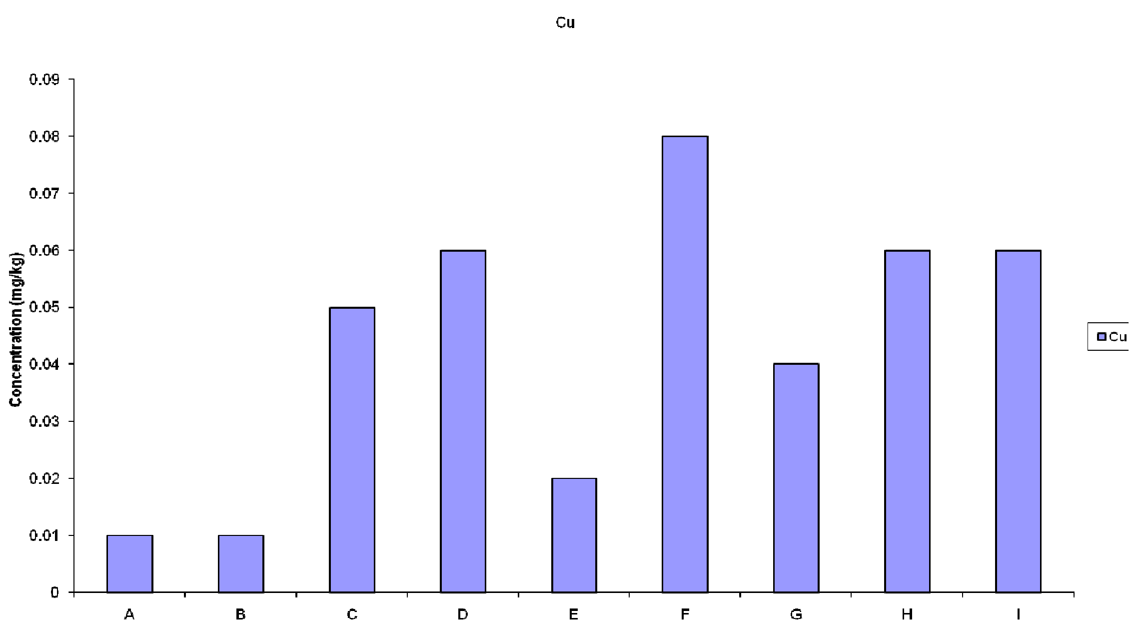

Fig.VI. Levels of copper in edible oil. (A) pure soy oil: (B) Grand soy oil: (C) cotton seed oil: (D) solive vegetable oil: (E) Magerine: (F) palm oil: (G) kernel oil: (H) Oki vegtable oil: (I) Groundnut oil

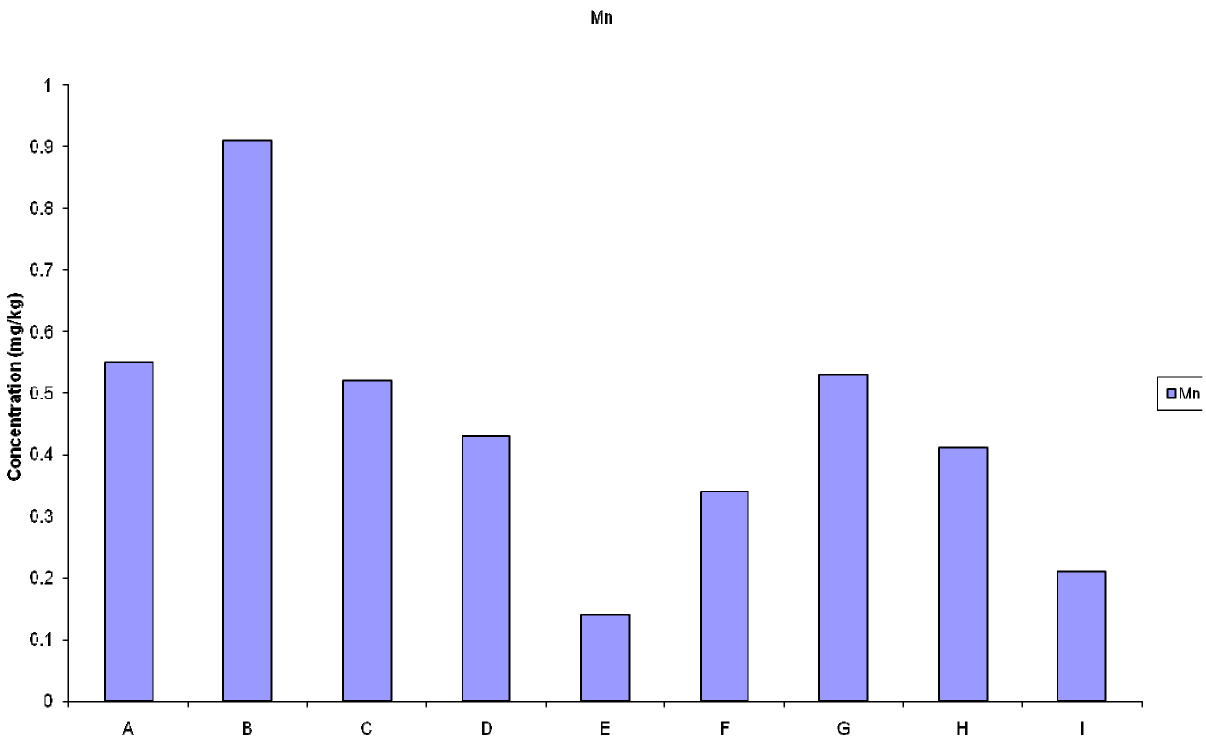

Fig.VII. Levels of manganese in edible oil. (A) pure soy oil: (B) Grand soy oil: (C) cotton seed oil: (D) solive vegetable oil: (E) Magerine: (F) palm oil: (G) kernel oil: (H) Oki vegtable oil: (I) Groundnut oil

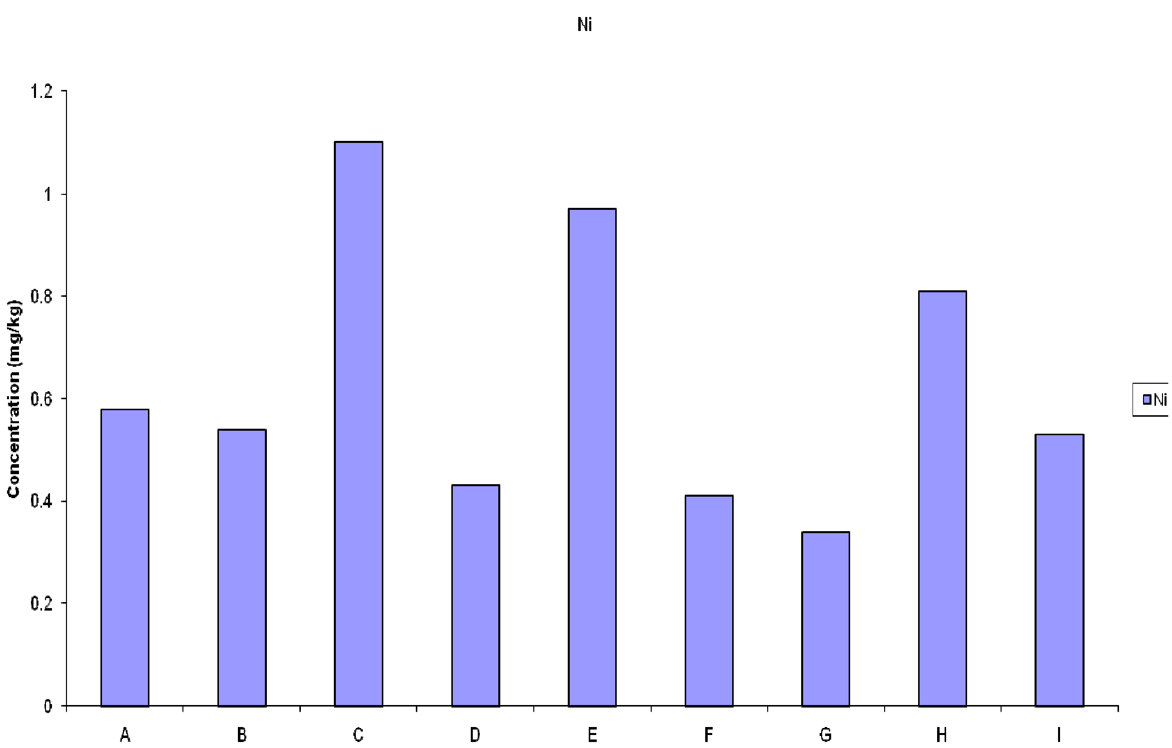

Fig.VIII. Levels of nikel in edible oil. (A) pure soy oil: (B) Grand soy oil: (C) cotton seed oil: (D) solive vegetable oil: (E) Magerine: (F) palm oil: (G) kernel oil: (H) Oki vegtable oil: (I) Groundnut oil

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