The second International Conference for Pure and Applied Sciences (2SICPS)-2024

Samarra Journal of Pure and Applied Science

www.sjpas.com

p ISSN: 2663-7405
e ISSN: 2789-6838

Detection of some heavy metals in meat cooked in different utensils

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https://doi.org/10.54153/sjpas.2024.v6i3(2).870

Article Information

Received: 31/03/2024
Revised: 30/04/2024
Accepted: 02/05/2024
Published: 01/10/2024

Keywords:

heavy metals, meat, utensils, iron, zinc

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Abstract

This study, conducted at the laboratories of the Department of Food Sciences, College of Agriculture - University of Tikrit, aimed to estimate the presence of selected heavy elements (iron, zinc, copper, cadmium, lead, and aluminium) in meat samples cooked using different utensils, including clay pots, iron utensils, copper utensils, aluminium utensils, Tefal/Teflon utensils, and glass/Pyrex utensils. The research was carried out between February 15 and March 20, 2023 ,The results revealed significant variations in metal concentrations among the cooked meat samples. Cooking meat in copper utensils led to a significant increase in iron concentration (0.7 ppm), compared to aluminium utensils (0.5 ppm). Zinc concentration showed a significant increase in meat cooked with aluminium (0.26 ppm) and copper utensils (0.18 ppm). Moreover, cooking meat in copper and Tefal utensils resulted in a significant increase in copper concentration (0.60 ppm and 0.30 ppm, respectively). Cadmium concentration exhibited a significant increase in meat cooked with Tefal (0.4 ppm) and aluminium utensils (0.20 ppm). The concentration of lead was higher in meat samples cooked with iron utensils, while aluminium utensils exhibited a higher concentration of aluminium, These findings highlight the potential influence of different cooking utensils on the presence of heavy metals in cooked meat. Further research and considerations are needed to assess the implications of these findings on food safety and human health.

Introduction:

The pollution of human food sources by contaminants and toxic substances is a consequence of environmental pollution, manifested in insecticides, herbicides, heavy metals, and various industrial wastes. Over time, this pollution has evolved into a peril that threatens human health, prompting an increased focus on food safety through the examination of pesticide concentrations, heavy metals, and toxins in their various forms [1]. Heavy elements are defined as those whose density exceeds five times that of water, exerting adverse effects on the environment when excessively employed. also impact health of human, animal, and plant. the most significant heavy elements: lead, mercury, cadmium, arsenic, selenium, zinc, and copper, as hazardous toxins polluting soil, air and water, causing harm to human, animal, plants [2]. Contamination of meat with elements has given rise to Poisoning, even at low concentrations. Meat, is a source of sustenance widely consumed by human Mineral are transferred to meat through water and air ،Meat contamination occurs as a result polluted animal feed or the husbandry of cattle near polluted environments, such as industrial waste, Meat contain residues heavy metal, including lead, cadmium, mercury, and copper, These are dangerous compounds that affect humans health [3]. Toxicity of metals attributed their ability to bind with functional group like sulf hydryl and carboxyl [4]. Heavy metals have the ability to evade the capabilities of the body's propulsion system and thus cause disruption in vital processes by interfering with the functions of essential mineral elements. The oxidative degradation of biological molecules is essentially due to the binding of heavy metals to DNA and nuclear proteins. The disability that arises from contamination with heavy metals includes: Intellectual disability in children, dementia in adults, central nervous system disorders, kidney failure, liver disease, and depression [5].

Materials and Methods:

Sample Collection:

A required quantity of meat was procured from butcher shops in the city of Tikrit. Subsequently, the meat was meticulously sliced into approximately 2 cm segments. These fragments were then stored in sterilized and refrigerated plastic containers at 4°C post a thorough washing process with distilled cold water. Following this, they were transported to the laboratory and subjected to freezing at -18°C until utilization.

Estimation of Heavy Metals:

The assessment of heavy metals in the cooked meat samples was conducted utilizing various cooking utensils, namely earthenware, ironware, copperware, aluminum ware, Teflon or Teflon-coated utensils, glassware, and Pyrex. The determination was executed through the utilization of the Atomic Absorption type E LCO device, in accordance with the methodology outlined in [6].

The results and discussion:

1- **Concentration of iron in cooked meat using different utensils.**

Figure 1 illustrates the rate of iron concentration in cooked meat using various cooking vessels, namely earthenware, iron, copper, aluminium, Teflon, and glass. The results indicate a significant increase in the concentration of iron in vessels made of copper, reaching 0.7 ppm, compared to 0.5 ppm in aluminium vessels. The findings also reveal a decrease in iron concentration in earthenware, Teflon, and glass vessels, registering values of 0.02, 0.08, and 0.09 ppm, respectively.

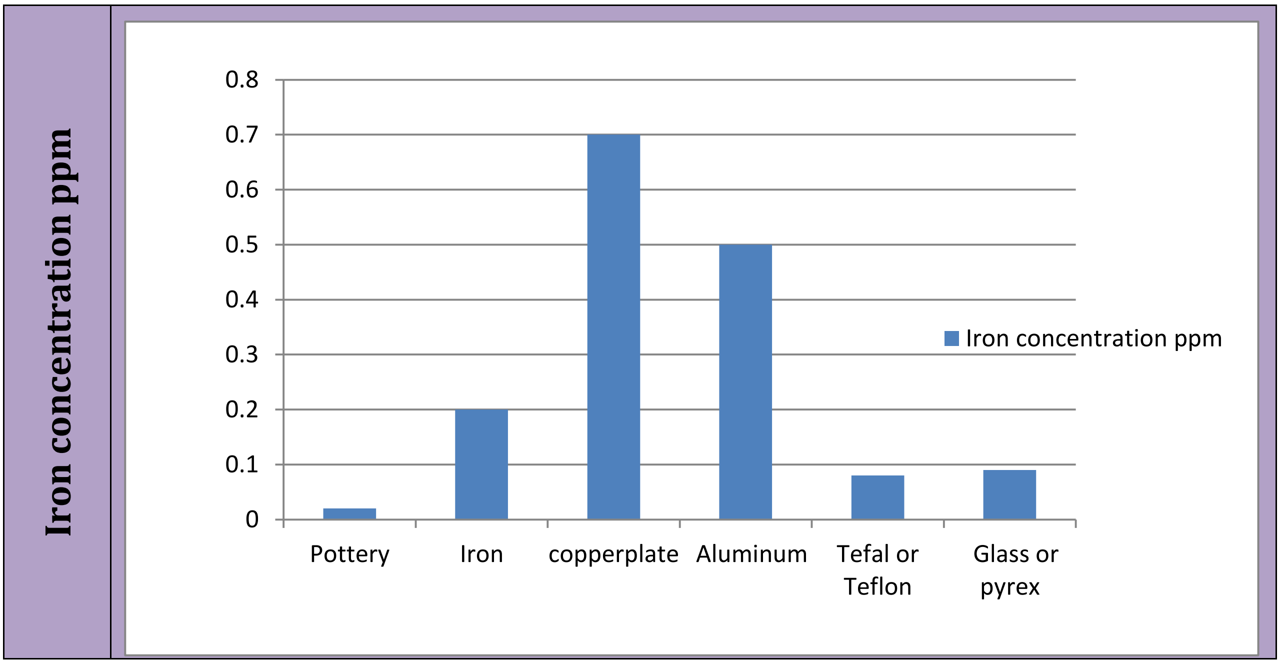

Fig. 1 *Average concentration of iron in meat cooked in different utensils.*

2- Concentration of zinc in meat cooked in different utensils

The concentration of zinc in cooked meat using various culinary vessels is elucidated in Figure 2. The findings illustrate a statistically significant elevation in the zinc concentration within samples of cooked meat in vessels crafted from aluminium and copper, registering 0.26 and 0.18 ppm, respectively. In contrast, the zinc concentration measured 0.01, 0.012, 0.03, and 0.05 ppm in samples of cooked meat utilizing vessels fashioned from earthenware, iron, Teflon, and glass, respectively.

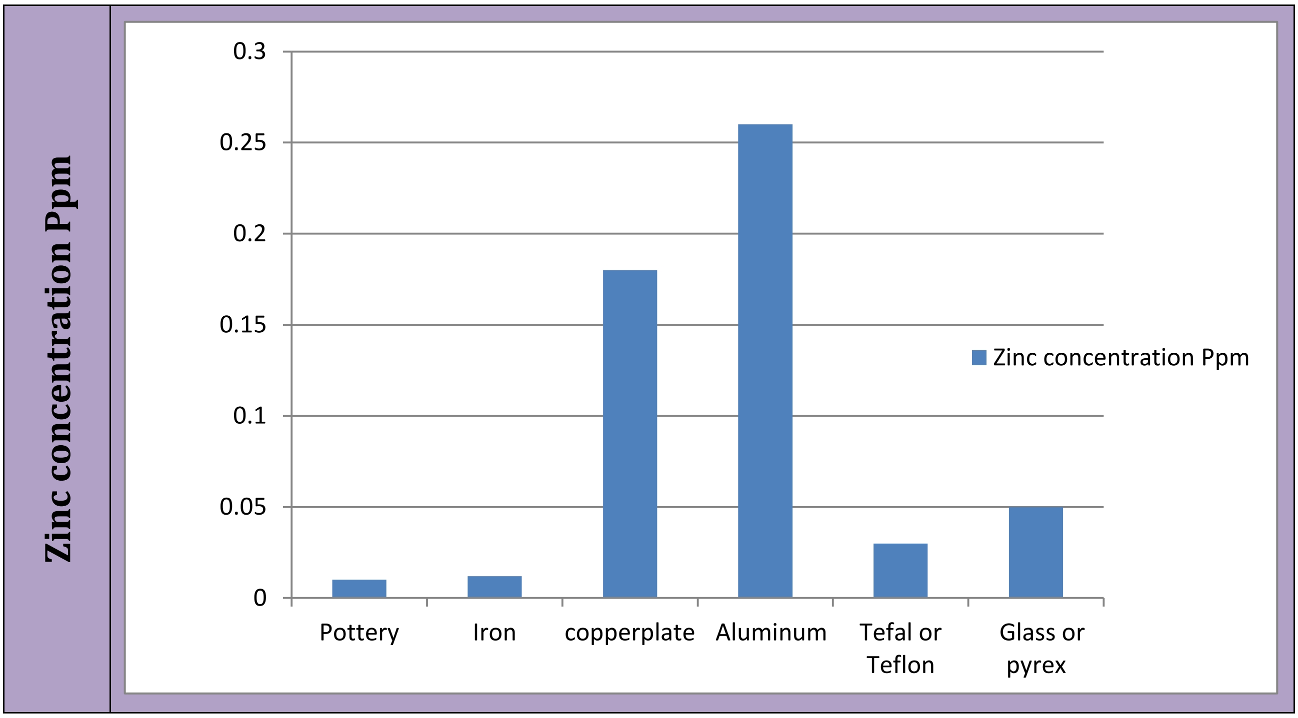

Fig. 2 *Average concentration of zinc in meat cooked in different utensils.*

3- Concentration of copper in meat cooked in different utensils

Figure 3 illustrates the concentration levels of the copper element in cooked meat across various cooking utensils, including earthenware, iron, copper, aluminum, Teflon, and glass. The results demonstrate a statistically significant increase in the concentration of this element in samples of cooked meat using copper and Teflon utensils, with concentrations of 0.60 and 0.30 parts per million (Ppm), respectively. In contrast, concentrations were 0.01, 0.11, 0.20, and 0.10 Ppm in samples cooked with utensils made of earthenware, iron, Teflon, and glass, respectively.

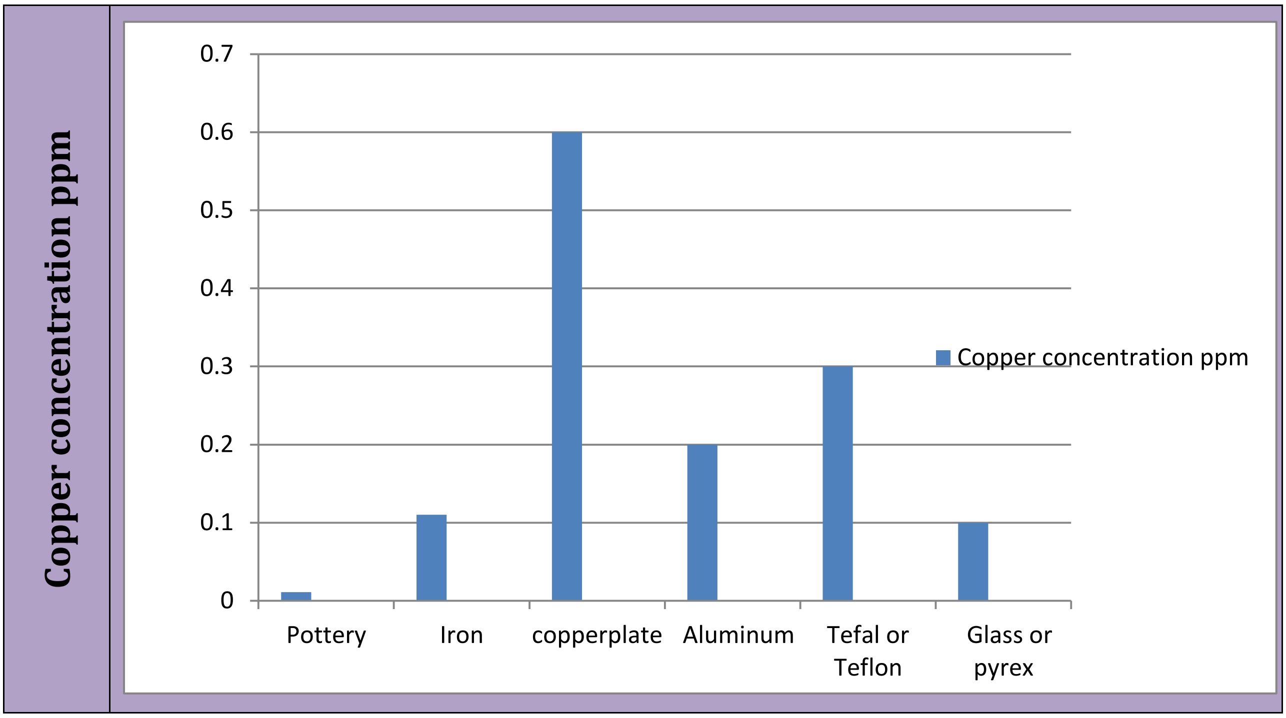

Fig. 3 *Average concentration of copper in meat cooked in different utensils*

4- Concentration of cadmium in meat cooked in different utensils

Figure 4 elucidates the concentration levels of the cadmium element in cooked meat across diverse cooking utensils, encompassing earthenware, ferrous, copper, aluminium, Teflon, and glass. The findings reveal a statistically significant increase in the concentration of this element in samples of cooked meat employing Teflon and aluminium utensils, registering 0.4 and 0.20 parts per million (Ppm), respectively. Conversely, concentrations were measured at 0.03, 0.005, 0.06, and 0.02 Ppm in samples cooked with utensils fashioned from earthenware, iron, copper, and glass, respectively.

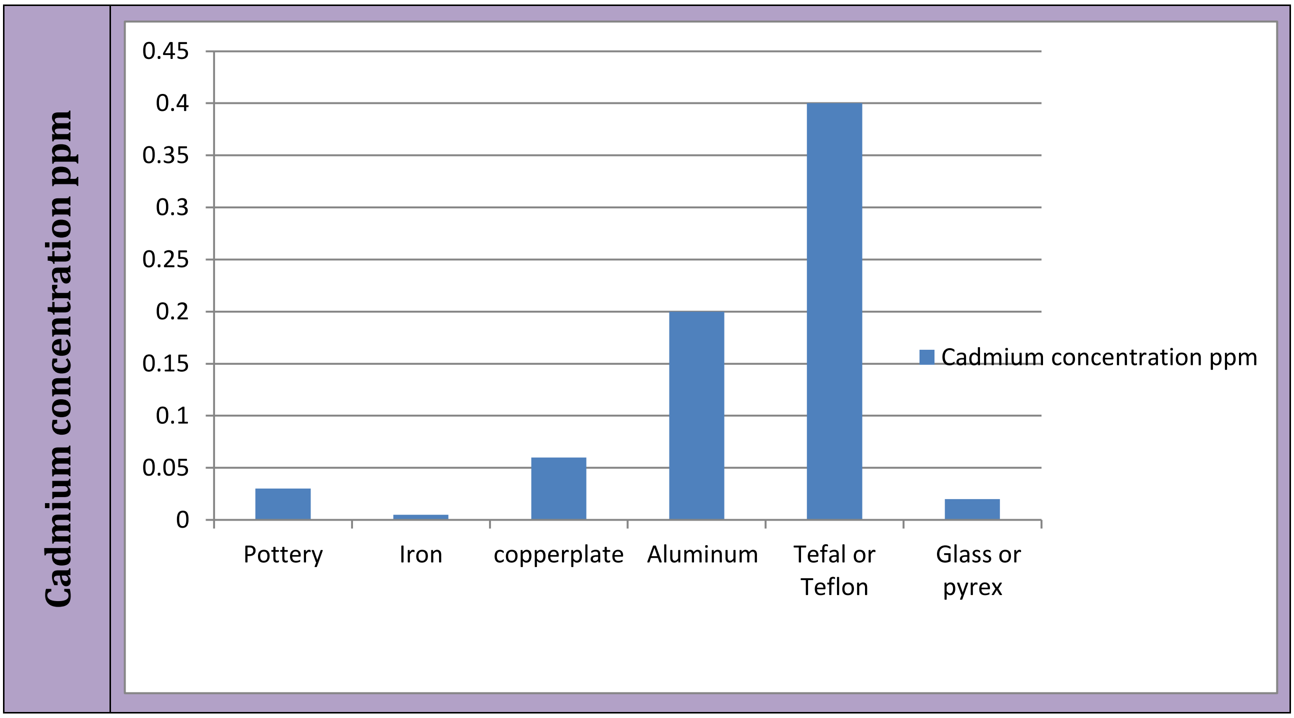

Fig. 4 *Average concentration of cadmium in meat cooked in different utensils.*

5- Concentration of lead in meat cooked in different utensils

The (5) figure delineates the concentration rate of the element lead in cooked meat utilizing diverse culinary vessels, encompassing earthenware, ferrous, copper, aluminium, Teflon, and glass. The outcomes manifest a significant elevation in the concentration of this element within meat samples subjected to utensils crafted from iron, glass, and copper, registering at 1.0, 0.90, and 0.70 ppm respectively, whereas it amounted to 0.60 ppm in samples cooked with utensils fabricated from aluminium.

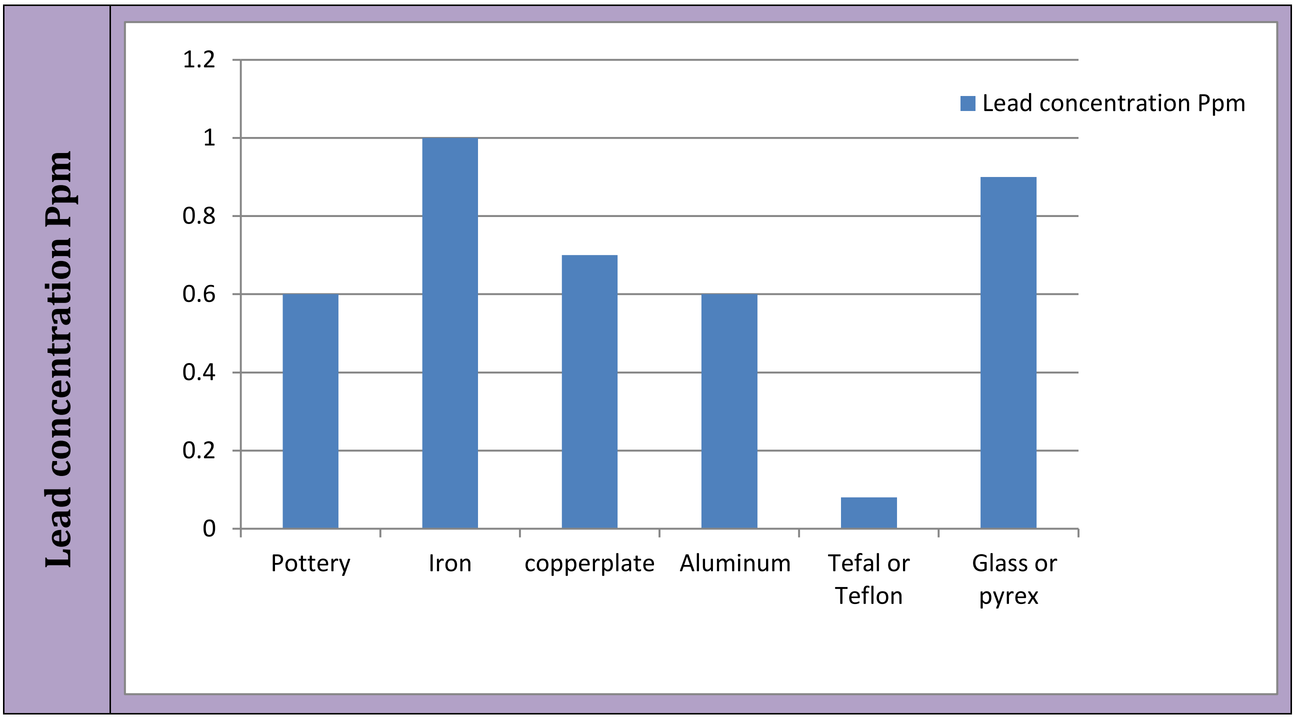

Fig. 5 *Average concentration of lead in meat cooked in different utensils.*

6- Concentration of aluminium in meat cooked in different utensils

The (6) figure illustrates the concentration of aluminium in cooked meat using various cooking utensils: earthenware, iron, copper, aluminium, Teflon, and glass. The results reveal a significant increase in the concentration of this element in samples of meat cooked using aluminium utensils, reaching 2.0 ppm, while it was 0.007, 0.09, 0.60, 0.30, and 0.40 ppm in samples cooked using earthenware, iron, copper, Teflon , and glass utensils, respectively.

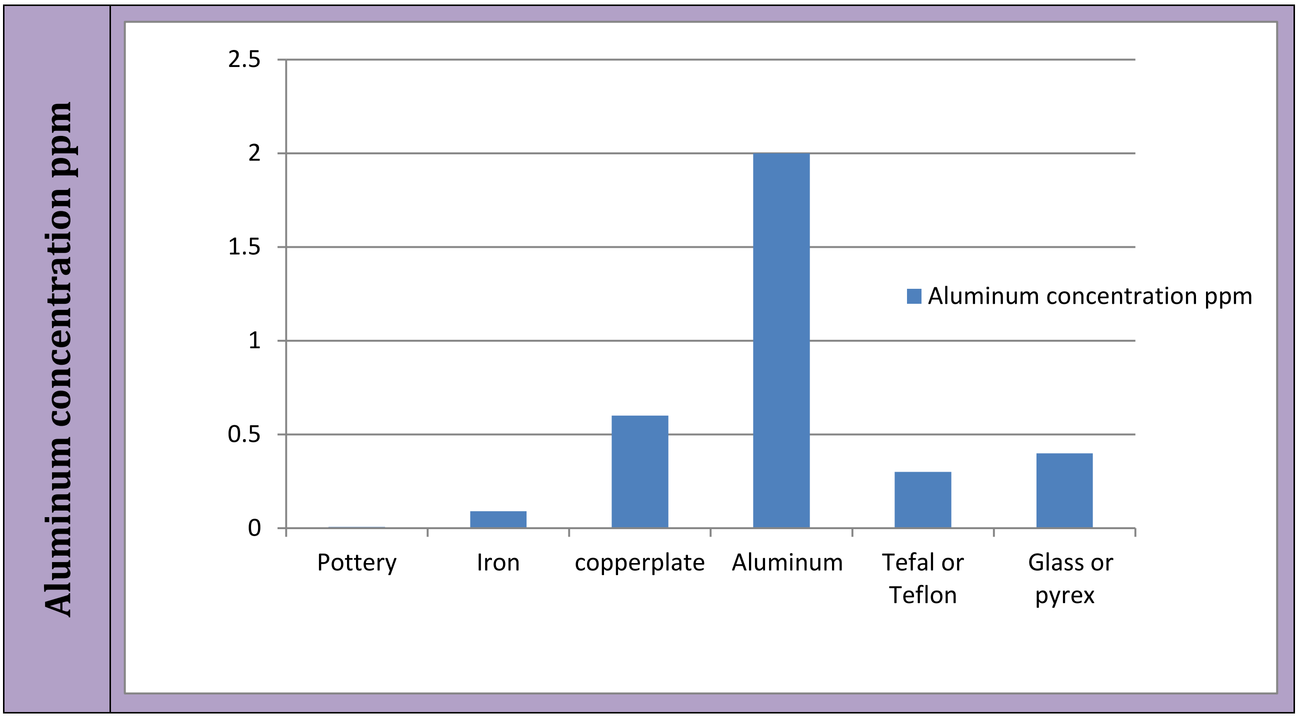

Fig. 6 *Average concentration of aluminium in meat cooked in different utensils.*

Iron is a fundamental element in the nutritional process, considered a natural component in all foods of both plant and animal origin. It is present in drinking water and found in red meats, poultry, and eggs. The average daily iron consumption is 17 milligrams for males and 9 to 12 milligrams for females. An increase in iron levels in the body leads to its deposition in the liver, pancreas, thyroid glands, and heart, causing liver fibrosis and cardiac and glandular insufficiencies [7].Despite this, iron contributes to growth, and iron deficiency results in anemia [8]. Zinc typically exists in mining and smelting areas, with human sources arising from the disposal of industrial emissions. It is also utilized in the production of sanitary drainage pipes. Over time, it dissolves in sewage water, transferring to the soil and later to plants. Exposure to high concentrations of zinc leads to immune deficiency, decreased levels of fatty proteins, anemia, and damage to the liver, pancreas, and kidneys [9].

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Samarra Journal of Pure and Applied Science

www.sjpas.com

p ISSN: 2663-7405
e ISSN: 2789-6838

الكشف عن العناصر الثقيلة في اللحم المطبوخ بأواني مختلفة

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معلومات البحث:

تأريخ الاستلام: 2024/03/25
تاريخ التعديل : 2023/04/20
تأريخ القبـــول: 2023/04/27
تاريخ الـنشر: 2024/10/01

الكلمات المفتاحية:

العناصر الثقيلة، اللحم، الاواني، الحديد، الزنك

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الخلاصة:

هدفت هذه الدراسة التي أجريت في مختبرات قسم علوم الأغذية كلية الزراعة – جامعة تكريت إلى تقدير وجود عناصر ثقيلة مختارة (الحديد والزنك والنحاس والكادميوم والرصاص والألمنيوم) في عينات اللحوم المطبوخة باستخدام - الأواني المختلفة، بما في ذلك الأواني الفخارية، والأواني الحديدية، والأواني النحاسية، والأواني المصنوعة من الألومنيوم، والأواني التيفال/التفلون، والأواني الزجاجية/البايركس. تم إجراء البحث في الفترة ما بين 15 فبراير و20 مارس 2023، أظهرت النتائج وجود اختلافات كبيرة في تراكيز المعادن بين عينات اللحوم المطبوخة. وأدى طهي اللحوم في أواني النحاس إلى زيادة ملحوظة في تركيز الحديد (0.7 جزء في المليون) مقارنة بأواني الألمنيوم (0.5 جزء في المليون). أظهر تركيز الزنك زيادة معنوية في اللحوم المطبوخة بالألومنيوم (0.26 جزء في المليون) والأواني النحاسية (0.18 جزء في المليون). علاوة على ذلك، أدى طهي اللحوم في أواني النحاس والتيفال إلى زيادة كبيرة في تركيز النحاس (0.60 جزء في المليون و0.30 جزء في المليون على التوالي). أظهر تركيز الكادميوم زيادة معنوية في اللحوم المطهية بإستخدام تيفال (0.4 جزء في المليون) وأواني الألمنيوم (0.20 جزء في المليون). وكان تركيز الرصاص أعلى في عينات اللحوم المطبوخة بأدوات حديدية، في حين أظهرت أواني الألومنيوم تركيزا أعلى من الألومنيوم، تسلط هذه النتائج الضوء على التأثير المحتمل لأدوات الطبخ المختلفة على وجود المعادن الثقيلة في اللحوم المطبوخة. هناك حاجة إلى مزيد من البحث والاعتبارات لتقييم آثار هذه النتائج على سلامة الأغذية وصحة الإنسان.