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## The Effect Of Partial Replacement Of Mung Beans Jerusalem Artichoke Powder On Some Microbial And Sensory Properties Of Chilled Chicken Burgers

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### ABSTRACT

#### KEY WORDS:

Burgers, mung beans,  
Jerusalem artichoke, cold  
storage.

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The study aimed to identify the relationship between the partial replacement of mung and Jerusalem artichoke powder in burgers made from chicken meat and 4,8,12 day of refrigerated storage and the effect of this on the total number of bacteria, coliforms, molds, and yeasts. Three different replacement ratios with the control treatment were proposed for a total of six treatments. In this study, two levels of replacement occurred mung powder 5% and 10%, and a treatment included replacing Jerusalem artichoke powder at 5% and 10%, when other treatment was replacing a mixture of 5% mung powder and 5% Jerusalem artichoke powder. The study also examined the extent to which substitution ratios affect the sensory evaluation and microbiological characteristics of the final product and consumer acceptance. Replacing mung beans with Jerusalem artichoke powder significantly enhanced the microbiological properties of burgers during refrigerated storage compared to control. The replacement Led to decreased the total number of bacteria and coliform activity, as well as a decrease in molds and yeasts number. The control group showed an increase in total bacteria, coliforms, and yeasts. The substitution ratios enhanced the sensory evaluation of the product, and this leading to increased customer acceptance of the burger with mung beans and Jerusalem artichoke powder compared to the control. The results indicated that the replacement negatively affected the total count of bacteria as well as coliform and also contributed to a decrease molds and yeasts growth. In contrast, the control showed an increase in total bacteria, coliforms, and yeasts. The substitution ratios enhanced the sensory properties of final product, resulting in increased customer acceptance of burgers with mung beans and Jerusalem artichoke powder compared to the control. The results indicated that the burger containing mung powder 10% was superior in terms of microbial characteristics, and general acceptance of the final product over the burger containing Jerusalem artichoke powder, while both were superior in terms of microbial quality and general acceptance of the control.

## تأثير الاستبدال الجزئي لمسحوق الماش ومسحوق تفاح الارض في بعض الخصائص الميكروبية والحسية لبيرجر الدجاج المبرد

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الخلاصة:

هدفت هذه الدراسة إلى التعرف على العلاقة بين الاستبدال الجزئي لحبوب الماش ومسحوق تفاح الأرض في البيرجر المصنوع من لحم الدجاج وعلاقة ذلك مع 4،8،12 يوم من التخزين المبردة وتأثير ذلك على العدد الكلي للبكتيريا القولونيات المعوية والأعفان والخمائر. تم اقتراح ثلاث نسب استبدال مختلفة مع معاملة السيطرة ليصبح المجموع ست معاملات. في هذه الدراسة، حدث مستويان من الاستبدال عند 5% و10% مسحوق ماش وتضمنت المعالجات استبدال مسحوق تفاح الأرض بنسبة 5% و10%، في حين كانت المعالجة الأخرى هي استبدال خليط مكون من مسحوق الماش 5% ومسحوق تفاح الأرض بنسبة 5%. كذلك تناولت هذه الدراسة مدى تأثير نسب الاستبدال المختلفة على التقييم الحسي والخصائص الميكروبية للمنتج النهائي وتقبل المستهلك. إن استبدال 10% من محتوى البيرجر من اللحم بحبوب الماش عزز بشكل كبير الخواص الميكروبية للبيرجر أثناء مدة الخزن المبرد ( 4،8،12 يوم ) مقارنة بمعاملة السيطرة، كما أدى إلى انخفاض نشاط القولونيات المعوية، فضلاً عن نمو الأعفان والخمائر، وعزز الخصائص الحسية للمنتج النهائي مما أدى إلى زيادة قبول المقيمين للبيرجر مع مقارنة مع معاملة السيطرة.

الكلمات المفتاحية: البيرجر، حبوب الماش، تفاح الأرض، الخزن المبرد

## INTRODUCTION

Burgers are among the most widely consumed rapid cuisines on an international scale. On a daily basis, particularly among young people, adolescents, and workers, hamburger sandwiches are consumed after or during the late hours of a lengthy workday. This is because such sandwiches are simple to prepare. It is readily available at retail locations dispersed throughout urban areas (Al-Azzami and Mohammed, 2023 & Fauzi et al., 2021). Manufacturers are accustomed to producing burgers using either beef, sheep, or pig meat, or a mixture of these types of meat. Sometimes, poultry meat can be relied upon in manufacturing according to combinations that vary according to the food, cultural, and religious customs of the society. The use of poultry meat in manufacturing has spread recently. Burgers are due to the high production rates of this meat, in addition to its cheap price and ease of obtaining it, as well as the ease of creating the mixture compared to beef and pork (Abdalla et al., 2023). To increase the acceptability of the product, manufacturers may sometimes add various types of food additives to the combinations when making burgers, such as fats and grease to add softness to the final product (Elkhateeb et al., 2024), and salt, spices, and garlic may be added to give their products a special flavor, which is considered one of the manufacturing secrets of each brand (Abdelqader et al., 2023 & Bassani et al., 2020). Sometimes, filler materials may be added to these mixtures to make them cheaper and healthier. For example, bean or chickpea flour is added to the mixture. These materials are considered sources of protein of plant origin (Sozua et al., 2023& De Souza et al., 2012). However, these materials must be added in limited proportions to the burger mixture, with emphasis. However, it does not affect the sensory and storage characteristics of the product in general, as these characteristics will always suffer from decline during periods of refrigerated or frozen storage (Olivra et al., 2013 & Zheng and Wang,2012). Also, manufacturers are always looking for new technologies or approved food additives to be added to their blends to increase their ability to store the final product and preserve its sensory and microbial characteristics from deterioration during the storage period, which may sometimes extend to weeks or months. Mung beans are a rich

source of protein and have antioxidant and antimicrobial capabilities. Accordingly, they have been used as a high-quality food in many countries around the world, such as India, the Arab region, and African countries. In addition, mung beans are considered a good source of vitamins, salts, and minerals (AL- Azzami *et al.*, 2021). Also, the tubers of the Jerusalem artichoke (*Helianthus tuberosus*), with its prebiotic content such as inulin, are considered a rich source of probiotics in the human digestive system (Wijaya *et al.*, 2015). Therefore, they have been used as additives in many modern foods with therapeutic properties that contribute to supporting and stimulating the consumer's intestinal flora. (Amponsah and Boye, 2014 & Abdulwahid *et al.*, 2022). In addition to its previously recorded role in supporting types of microorganisms that have the ability to inhibit pathogenic microbes and those that cause spoilage of manufactured foodstuffs during the storage period (Owaid *et al.*, 2018 & Shaman and Mohammedm,2023). Hence, this study came to determine the importance of partial replacement of mung flour and ground apple flour in burger formula made from chicken meat on the sensory characteristics, prolonging the storage period, and microbial characteristics during the refrigerated storage period.

## **MATERIALS AND METHODS**

### **Obtain Jerusalem artichoke and mung bean flour:**

Samples of mung beans and mature Jerusalem artichoke tubers were collected from local markets between November 1 and December 1, 2022, and washed well with water to thoroughly clean and remove dust. Samples were dried, thoroughly ground and placed in glass jars until use. Breast meat from healthy chickens Broiler (Ross 308 , by age42 day) from the same origin, fed the same feed, and not treated with antibiotics or sulfa compounds was minced one week before slaughter using an electric meat grinder equipped with an 8 mm diameter disc. The minced chicken meat was then mixed with the rest of the burger ingredients, such as fat, salt, and spices, in the quantities specified in accordance with the standard specifications issued by the Central Agency for Standardization and Quality Control ( Zaki, 2022). The coefficients were then divided as follows:

- 1- The control did not include any additions.
- 2- In the second and third treatments, mung powder was added in proportions of 5 and 10/100 w/w.
- 3- In the fourth and fifth treatments, Jerusalem Artichoke powder was added in proportions of 5 and 10/100 w/w.
- 4- The sixth treatment, a mixture of mung powder and adsorbent, 5 and 5 % w/w, respectively, was added.

The burgers were made with a weight of 100 grams and a diameter of 12 cm, then they were packaged and stored in the refrigerator for 4, 8 and 12 days.

### **Antimicrobial activity:**

Using the Pour-Plate Method protocol outlined by A.O.A.C., the total count of psychrophilic bacteria, yeasts, molds, and coliforms has been ascertained (Yaseen *et al.*, 2020). Using cultures on Nutrient Agar, the total count and psychrophilic bacteria were determined after 24 hours at 37°C and 7 days at 7°C, respectively. Coliform counts were determined using Mac-Conkey Agar cultures and a 24-hour incubation period at 37°C (A.O.A.C.,2005). On Potato Dextrose Agar, molds and yeasts were cultivated and incubated for five days at 22°C (A.P.H.A.,1992).

**Sensory evaluation:**

Sensory testing of the produced burgers was performed after preparation and cooking on a hot plate while stirring until fully fried. This includes ensuring the internal meat temperature of the food reaches 70 degrees Celsius and using a thermometer to measure the internal temperature of the food. Then, ten skilled evaluators used the appropriate forms to conduct the evaluations. (Yaseen *et al.*, 2020).

**RESULTS AND DISCUSSIONS**

Table (1) displays the impact of substituting mung seeds and Jerusalem artichoke powder on the overall microbe count in chicken meat burger during refrigerated storage. There were no significant differences in the total number of microbes at the start of manufacturing between all treatments and the control. However, a notable decrease in the total number of microbes during cold storage was observed in all treatments compared to the control. T3 had the lowest overall microbe count among other trades. The data indicates that mung bean powder effectively inhibited microbial growth compared to other treatments. The slow increase in the total number of microbes in burgers containing mung beans and Jerusalem artichoke powder may be due to the active compounds these plants contain that work to reduce the total number of bacteria (Jiang, 2024 & Yaseen *et al.*, 2020), as well as preventing the access of microorganisms into the samples by obstructing their penetration into the meat and not providing conditions suitable for the growth and activity of bacteria, thus reducing the total numbers, and from the results, we find that the best significant decrease was recorded in the T3 (adding 10g/100g of meat). This may be due to mung bean, which is one of the plants with effective antimicrobial activity, in addition to being a rich source of compounds that show effectiveness in restricting the growth of microbes, such as flavonoids, tannins, and phenolic compounds that possess antimicrobial properties (Meilgaard *et al.*, 1999). Numerous studies have shown that flavonoids, tannins, and polyphenols, which are found in large amounts in mung seeds, can kill bacteria and fungi by blocking enzymes that break down bacteria and mold (Sehrawa *et al.*, 2020).

Table (1) The effect of partial replacement of mung bean and Jerusalem artichoke powder on the total number of microbes in chicken meat burgers

Treatments	storage period			
	0 day	4 day	8 day	12 day
T1	3.645	5.499a	6.636a	8.030a
T2	3.665	4.775d	5.550c	6.746c
T3	3.629	4.517e	5.385d	6.509d
T4	3.646	4.897c	5.642b	6.844bc
T5	3.660	4.959b	5.638b	6.890b
T6	3.671	4.854c	5.555c	6.854b
<i>prob</i>	N.S.**	<.0001	<.0001	<.0001
<i>Total mean</i>	<b>3.652</b>	<b>4.917</b>	<b>5.734</b>	<b>6.979</b>
<i>sem</i>	<b>0.009</b>	<b>0.072</b>	<b>0.100</b>	<b>0.118</b>

Table (2) displays the impact of substituting mung bean and Jerusalem artichoke powder on coliform in burger chicken meat during refrigerated storage. There are no substantial disparities in production time between the treatments in comparison to the control (T1). The number of bacteria decreased significantly over time in treatments that involved partially replacing mung and Jerusalem artichoke powder. The results show that T3 (adding mung bean powder at a concentration of 10 g/100 g) had the most significant reduction in bacteria compared to the other treatments. This suggests that adding mung bean flour may help preserve refrigerated chicken burgers by reducing coliform bacteria counts. Mung beans are considered a rich source of protein, fiber and active ingredients, all of this will make the environment unsuitable for growth of bacteria, and this in turn will help regulate the bacterial balance in the digestive system. (Mirzan *et al.*, 2024). Based on these results, consuming mung bean may have a positive effect on colon health by reducing the growth of harmful colon bacteria and improving the balance of bacteria in the digestive system. (Jalal and Aziz,2023).

Table (2): The effect of partial replacement of mung bean and Jerusalem artichoke powder on the coliform number of chicken meat burgers

Treatments	storage period			
	0 day	4 day	8 day	12 day
T1	2.430	4.495	5.370	6.966
T2	2.419	3.866 a b	4.745 a c	5.864 a c
T3	2.417	3.488 c	4.434 d	5.551 d
T4	2.408	3.898 b	4.836 bc	5.933 bc
T5	2.423	3.940 b	4.911 b	5.966 b
T6	2.413	3.895 b	4.833 bc	5.868 c
<i>prob</i>	N.S.**	<.0001	<.0001	<.0001
<i>Total mean</i>	<b>2.418</b>	<b>3.930</b>	<b>4.855</b>	<b>6.025</b>
<i>sem</i>	<b>0.009</b>	<b>0.073</b>	<b>0.068</b>	<b>0.107</b>

While Table (3) shows the effect of partial replacement of mung beans and Jerusalem artichoke powder on molds and yeasts in fortified chicken burgers. The results showed that there were no significant differences either in the first storage period or after 4 days for all treatments. The results showed a significant decrease in all parameters after 8 days of treatment storage. After 12 days, T3 had the highest significant decrease compared to control. This is due to the fact that mung contains phenolic compounds that have inhibitory activity against microbes, and they play a role in reducing the growth of yeasts and molds (Naji and AL-Jabber,2024 & Tang et al., 2014).

Table (4) shows the effect of partial replacement of mung beans and Jerusalem artichoke powder on the sensory evaluation values of chicken burgers after the end of the cold storage, which took 12 days. It shows that there are significant differences ( $P \leq 0.05$ ) in all characteristics between the treatments when compared with the control without any sensory addition ratios. T3 showed significant superiority ( $P \leq 0.05$ ) over the rest of the parameters. Mung beans are considered an excellent source of high-quality protein and one of the cheapest and richest sources of vegetable

protein, which is commonly used in many foods and can improve sensory qualities (Mustafa and Harbourne, 2024 & Naji and Hussein,2023).

Table (3) The effect of partial replacement of mung bean and Jerusalem artichoke powder on molds and Yeasts in chicken meat burgers.

Treatments	storage period			
	0 day	4 day	8 day	12 day
T1	1.692	2.456	4.798	5.862
T2	1.634	2.447	3.591	4.615
T3	1.660	2.452	3.567	4.486
T4	1.666	2.446	3.589	4.731
T5	1.683	2.471	3.590	4.750
T6	1.634	2.470	3.601	4.649
<i>prob</i>	N.S.**	N.S.**	<.0001	<.0001
<b>Total mean</b>	<b>1.661</b>	<b>2.457</b>	<b>3.789</b>	<b>4.849</b>
<i>sem</i>	<b>0.018</b>	<b>0.005</b>	<b>0.110</b>	<b>0.112</b>

Table (4) The effect of partial replacement of mung bean and Jerusalem artichoke powder on the sensory evaluation of chicken meat burgers.

Treatments	storage period				
	Aroma	Taste	Color	Texture	Overall acceptability
T1	6.200	6.000	6.000	6.200	6.200
T2	7.400	7.600	7.600	7.000	7.400
T3	8.200	8.200	8.500	8.400	8.600
T4	7.200	7.200	7.400	6.600	7.000
T5	6.750	7.000	7.000	6.800	6.800
T6	7.400	7.200	7.500	7.500	7.600
<i>prob</i>	0.0003	<.0001	<.0001	0.0005	<.0001
<b>Total mean</b>	<b>7.2</b>	<b>7.2</b>	<b>7.333</b>	<b>7.05</b>	<b>7.266</b>
<i>sem</i>	<b>0.147</b>	<b>0.147</b>	<b>0.170</b>	<b>0.183</b>	<b>0.172</b>

## CONCLUSION

This study examined the effects of substituting mung beans and Jerusalem artichoke powder in chicken burger blends and refrigerated storage duration on bacteria, coliforms, molds, and yeasts. One treatment substituted 5% and 10% Jerusalem artichoke powder, while another substituted 5% and 10% mung powder. Alternatives to mung powder were 5% and 10%.

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## REFERENCES

- Al-Azzami, A. A , Th T Mohammed .( 2023) The Effect of Adding Lemongrass Leaf Powder (*Cymbopogon citratus*) to the Diet as a Natural Supplement on Some Productive Traits and Oxidation Indicators in Broiler (Ross 308). *IOP Conf Ser Earth Environ Sci*, 1252 (1), 12123. <https://doi.org/10.1088/1755-1315/1252/1/012123>.
- Fauzi ,N. F., Huda, N. & Adzitey, F. (2021). Effect of orifice size on quality characteristics of burger made from spent laying duck meat, *IOP Conf. Series: Earth and Environmental Science* 888 (2021), 012046.
- Abdalla, A. I. ., Rashid, R. M. ., Bayz, K. A. ., & Mohammedsalih, R. R. . (2023). The Impact of Hormonal, Non-Hormonal Supplement And Total Daily Energy Intake On Bodybuilders' Health During Off-Season Strength Training In Sulaymaniyah City-Iraq. *Journal of Life Science and Applied Research*, 4(2), 53–67. <https://doi.org/10.59807/jlsar.v4i2.85>.
- Elkhateeb, S. Z., Ebraheem, . M. O. ., & Ahmed, I. A. . (2024). The Impact Of Environmental Exposure Duration On Natural Detoxification And Physiological Health In Domestic Sheep Via Glucuronide Pathways. *Journal of Life Science and Applied Research*, 5(1), 27–33. <https://doi.org/10.59807/jlsar.v5i1.95>
- Abdelqader, A. ., Obeidat, M. D. ., Al-Rawashdeh, M. S. ., & Alhaj , A. A. . (2023). The Role Of Vitamin E As An Antioxidant And Preventing Damage Caused By Free Radicals. *Journal of Life Science and Applied Research*, 4(2), 88–95. <https://doi.org/10.59807/jlsar.v4i2.89>.
- Bassani, J. S. ., Grassi, T. L. ., Diniz, J. C. & Ponsano, E. H. (2020). Spices as natural additives for Beef Burger Production, *Food Science and Technology* (40), 4.
- Sozua, V. L. F , Sasaki, J. Y. ., Franco, M. L. R. ., Barbosa, M. J. & Cardozo, (2023) Processing, physicochemical, and sensory analyses of ostrich meat hamburger, *Food Science and Technology (Campinas)*, 32, (3):450-454.
- De Souza Oliveira, R. P., Perego, P., de Oliveira, M. N., & Converti, A. (2012). Effect of inulin on the growth and metabolism of a probiotic strain of *Lactobacillus rhamnosus* in co-culture with *Streptococcus thermophiles*, *LWT*, 47(2), 358-363.
- Olivra, D. F., Coelho, A. R., Burgardt, V. C., Hashimoto, E. H., Lunkes, A. M., Marchi, J. F. & Tonial, I. B. (2013) Alternatives for Healthier Meat Product: Areview, *Brazilian Journalof Food Techno*, (16), 3.
- Zheng, W. & Wang, S. Y. (2012) Antioxidant Activity and phenolic compounds in Selected herbs, *Journal of Agriculture Food Chemistry* , 49, 11: 5165-5170.



- AL- Azzami A.A. , Qasim M. A. and Yaseen A.A. (2021) Effect of Rhizome's Extracts of (*Alpinia officinarum*) in Oxidation Characteristics of Chicken Meat Stored in Cold, *IOP Conf. Series: Earth and Environmental Science*, (761), 012120.
- Wijaya, H. F.R., Zakaria, D., Syah & Prangdimutri, E.( 2015). Isolation of Mung Bean(*Vigna radiate* (L.)R.Wilczek Proteins To Create A Skin Prick Test Reagent To the Diagnosis of Mung Bean Allergy, *IOSR Journal of Pharmacy*,5 (1), January, 52-58
- Abdulateef SM, Majid AA, Al-Bayer MA, Shawkat SS, Tatar A, Mohammed TT, et al. Effect of aromatase inhibitors on sex differentiation and embryonic development in chicks. *Vet Med Sci*. 2021;7(6).
- Abdulwahid, A. S., Mohammed, A. B., & Al-Mjbel, A. A. (2022). Onion (*Allium cepa*) and sumac (*Rhus coriaria*) powder as dietary supplements for Japanese quail (*Coturnix japonica*): effect on egg production, blood parameters and antioxidant activity. <https://doi.org/10.17957/IJAB/15.1964>.
- Owaid, M.N., Al-Saeedi, S.S.S., Abed, I.A. (2018). Cultivation performance of pleurotus salmoneostramineus mushroom on wastes of date-palm trunk, phoenix dactylifera L., and woodworking sawdust. *Walailak Journal of Science and Technology*, 15 (12), pp. 831-839.
- Shaman, A. M. and Mohammed, T. T. ( 2023) Effect Using Feed Additives Instead of Imported Premixes Affects the Physiology of Broiler Chickens. *IOP Conf Ser Earth Environ Sci*, 1262 (7), 72080. <https://doi.org/10.1088/1755-1315/1262/7/072080>.
- Zaki, E. F. (2022). Effect of adding lemongrass (*Cymbopogon citratus*) extract on quality characteristics of chicken burger during frozen storage. *Journal of food quality and hazards control*.
- Yaseen, A. A. , Khashan, B. A., Hasan, A. N. and Abedalhammed, H. S., (2020), Effect of Addition of Jerusalem Artichoke (*Helianthus Tuberosus*) Tubers Powder, and Inulin on *Lactobacillus Reuteri* Activity and Recovery After Freezing Injury, *IOP Conf. Series: Earth and Environmental Science* 553 : 012012
- A.O.A.C. (2005) *Association of Official Analytical Chemists*. Official Methods on Analysis Microbiological food testing. Ch.12 & meat and meat products. Ch.39. U.S.A.
- A.P.H.A. (1992) *American Public Health Association Compendium of Methods for Food*.3th ed. Washington D.C., New York.
- Jiang, M. (2024). Progress in the Study of Active Ingredients and Pharmacological Actions of Mung Bean. *In BIO Web of Conferences* (Vol. 111, p. 02009). EDP Sciences
- Yaseen, A. A., Al-Azzami, A. A., & Qasim, M. A. (2021). Effect of treatment with rhizome extracts of *Alpinia officinarum* on some quality characteristics and acceptability of fresh chicken meat during the cold storage period. *Biochemical & Cellular Archives*, 21(1).
- Meilgaard, M. C., Carr, B. T., & Civille, G. V. (1999). *Sensory evaluation techniques*. CRC press.
- Sehrawat, N., Yadav, M., Kumar, S., Upadhyay, S. K., Singh, M., & Sharma, A. K. (2020). Review on health promoting biological activities of mungbean: A potent functional food of medicinal importance. *PLANT ARCHIVES*, 20(2), 2969-2975.
- Mirzan, N. A. , Khudhair, M. Y. , & Rashid, R. M. (2024). Chemical And Oxidative Stability Of Lamb And Turkey Kaurma With Beeswax As A Fat Replacer During Cold Storage In Kurdistan-Iraq. *Journal of Life Science and Applied Research*, 5(1), 1–7. <https://doi.org/10.59807/jlsar.v5i1.92>.
- Jalal, R. A., & E. Aziz, K. (2023). Usage Of Antimicrobial Activity Against E. Coli O157:H7 Isolated From Local Meat And Vegetables In Erbil City. *Anbar Journal Of Agricultural Sciences*, 21(1), 114-123. doi: 10.32649/ajas.2023.179721.



- Naji, H. F. . ., & AL-Jabber , M. A. . (2024). Genetic Diversity and Antibiotic Resistance Patterns of *Pseudomonas aeruginosa* Isolates from Iraqi Hospitals. *Journal of Life Science and Applied Research*, 5(1), 8–15. <https://doi.org/10.59807/jlsar.v5i1.93>
- Tang, D., Dong, Y., Ren, H., Li, L., & He, C. (2014). A review of phytochemistry, metabolite changes, and medicinal uses of the common food mung bean and its sprouts (*Vigna radiata*). *Chemistry Central Journal*, 8(1), 1-9.
- Mustafa, R. D., & Harbourne, N. (2024). Effects Of Storage Temperature And Ph On The Phenolic Content, Antioxidant Activity, Turbidity And Colour Of Chamomile Enriched Beverages . *Journal of Life Science and Applied Research*, 5(1), 16–26. <https://doi.org/10.59807/jlsar.v5i1.94>
- Naji, S. H., & F. Hussein, F. (2023). Health Effect Of Using Alkaline Diet In The Prevention And Treatment Of Diabetic Ketoacidosis And Disruption Of Serum Electrolytes Of Experiment Rats. *Anbar Journal of Agricultural Sciences*, 21(1), 188-204. doi: 10.32649/ajas.2023.17972.