American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)

ISSN (Print) 2313-4410, ISSN (Online) 2313-4402

http://asrjetsjournal.org/

Bacterial Contamination of Imported and Local Corn Kernel (Used as Animal Feed) in Iraq

Musaddak D. Ali[a], Muhsin L. Al-Musawi[b], Siham B. Hussein[c]*, Ra'afat S. Abid[d], Shireen S. Ferman[e]

[a,b,c,d,e]*Iraqi Agriculture Ministry - Directorate of Animal Resources - Department of Quality Control on Feed, Baghdad, Iraq*

[c]*Email: sehama106@gmail.com*

Abstract

This study was carried out to determine bacterial contamination of imported and local corn kernel (used as animal feed) in Iraq, which causes diseases and great economic losses. A total of 163 samples were collected (100 samples of the imported corn kernel from border points and 63 samples of the local corn kernel from the provinces) and cultured then Isolates were identified according to morphological Characteristics, biochemical tests and Agglutination test. The results indicated a total Gram-negative bacteria in 94 samples of the total samples (163) at (58%), includes: 57 Isolates from the imported corn kernel at (57%), which includes :*Salmonella* spp. in 14 samples at (14%), *Escherichia coli* in 21 samples at (21%), *Klebsiella* spp. in 13 samples at (13%), *Proteus* spp. in 9 samples at (9%) but absence of *Serratia* spp. and *Enterobacter* spp. . Addition to 37 Isolates from the local corn kernel at (60%),which includes: *Salmonella* spp. in 10 samples at (16%), *Escherichia coli* in 15 samples at (24%), *Proteus* spp. in 6 samples at (10%), *Serratia* spp. in 3 samples at (5%), *Enterobacter* spp. in 3 samples at (5%) but absence of *Klebsiella* spp. This study concluded that must be evaluated the microbial quality of imported and local corn kernel (used as animal feed) by manufacturers and health authorities to ensure safety and quality of corn to prevent diseases and great economic losses.

Keywords: *Escherichia coli* ; *Enterobacter* spp. ; *Proteus* spp. ; *Salmonella* spp. ; *Serratia* spp.

---

* Corresponding author.

1. Introduction

Corn is a grain plant first domesticated in Mexico about 10,000 years ago [20]. Corn types are: dent , flint , pod , popcorn, sweet , and flour corn [15].

Corn contains starch, protein, and fat about (72%), (10%), (4%) respectively, providing an energy (365 Kcal/100 g). corn supplies B vitamins and essential minerals along with fiber, but lacks some nutrients (vitamin B12 and vitamin C), and is a poor source of calcium, folate, and iron. Corn uses as food, industrial uses, and feed so it is a main component of feedstuff [18].

Corn production in Iraq saw a decline between the years of 2006 and 2011 because of lack of adequate water supply that discouraged farmers to adopt “thirsty” summer crops.

Currently, Iraq requires about (300,000) metric tons of corn per year to meet the feed consumption of its growing poultry sector. In 2010, Iraq produced about (150,000) metric tons of corn, but imported about (150,000) metric tons to meet the feed consumption requirement [3].

The safety and quality of corn is an important subject for the feed industry, that safety of feed is a fundamental requirement for all animals.

In the field, Corn exposed to insect and microorganisms during its growth, also, in the soil, there are many microorganisms blown by the wind, and some of these bacteria come in contact with the growing plant, also, during harvest, it is mechanically damaged and exposed to additional dust and microorganisms[19], Contamination of feed ingredients during storage and transportation can occur through wild animals (rodents, birds) and these infections agents can be transmitted to animals through feed contamination [22] therefore, to ensure safety and quality of corn must have low microbial contamination and must be free of health hazards [19] because of unsafe feed may cause great economic losses in case of destroying a flock of birds [17]. Briefly, this study was designed to identify the pathogenic bacteria contamination in imported and local corn kernel (used as animal feed) in Iraq which it causes animal diseases. Therefore, the aims of this study were (1) pathogenic bacteria diagnosis in imported and local corn kernel, (2) preventing of diseases via the microbial quality evaluation for imported and local corn kernel (used as animal feed) to ensure safety and quality of corn. The research will focus on the diagnosis of bacterial contamination of imported and local corn kernel (used as animal feed) in Iraq, thus it used imported and local corn kernel for microbial quality evaluation, and we noted the solution is more attention to growth, harvest and storage conditions for corn, addition to microbial quality evaluation of corn before the consumption.

2. Materials and Methods

2.1 Samples Collection

This study had conducted in the Directorate of Animal Resources / Department of Quality Control on Feed in Baghdad, Iraq.The samples collected for two types; Imported and local corn kernel. (100) samples of imported

corn kernel collected from border points about (3) Kg a sample, as it is shown in (Table 1):

Table 1: NO. of samples and Name of border points

	NO. of samples	Name of border point
1	50	Western border points
2	50	South border points
Total	100	

While (63) samples of local corn kernel collected from the provinces about (3) Kg for each sample, as it shown in (Table 2):

Table 2: NO. of samples and Name of province

	NO. of samples	Name of province
1	15	Babylon
2	20	Diayla
3	20	Kurkuk
4	18	Karbala
Total	63	

2.2 Preparation of media used

The media were prepared depending on the manufacturer's instructions on the labels of the media and autoclaved at 121°C for 15 min.

2.3 Isolation

For *Salmonella* isolation, (25) g of corn kernel sample was pre-enriched in (225) ml peptone water, mix and incubated, (1) ml from pervious mixture was transferred to (9) ml of Selenite Cystine Broth and incubated at 37°C for 24 hours. Then three differential media used Xylose Desoxycholate agar, Hiktone Enteric agar and *Salmonella-Shigella* agar, were streaked and incubated at 37°C for 24 hours. *Salmonella* suspect colonies were picked up for biochemical tests (triple sugar iron (TSI) and urease)[7], agglutination test (O&H antiserum for *salmonella*)[10] and isolates stained with gram stain to know Microscopical Characteristics of isolates [7].

Conformation of isolates conducted in the Health Public Central Laboratory (HPCL).

For isolation of *Escherichia coli* and other bacteria uses EosineMethlyen Blue agar (EMB agar), Nutrient agar

and macconkey agar.

3. Results

A total of (163) samples was collected;(100) sample of the imported corn kernel and (63) samples of the local corn kernel. Isolates Identification depends on the following tests: biochemical tests, morphological and microscopical Characteristics as compared with identification scheme described by [7].

The results were total Gram-negative bacteria in 94 samples of the total samples (163) at (58%), includes 57 Isolates for the imported corn kernel at (57%) and 37 Isolates for the local corn kernel at (60%), most isolated Gram-negative bacteria were *Escherichia coli* isolates in 36 samples at (22%) of total samples of imported and local corn kernel in 21 samples at (21%), 15 samples at (24%) respectively.

Followed by *Salmonella* spp. isolates in 24 samples at (15%) of total samples of imported and local corn kernel in 14 samples at (14%), 10 samples at (16%) respectively.

Then *Klebsiella* spp. isolates in 13 samples at (8%) of total samples of imported corn kernel in 13 samples at (13%) but absent in the local corn kernel.

Then *Proteus* spp. isolates in 15 samples at (9%) of total samples of imported and local corn kernel in 9 samples at (9%), 6 samples at (10%) respectively.

Then *Serratia* spp. isolates in 3 samples at (2%) of total samples of local corn kernel in 3 samples at (5%) but absent in the imported corn kernel.

Then *Enterobacter* spp. isolates in 3 samples at (2%) of total samples of local corn kernel in 3 samples at (5%) but absent in the imported corn kernel. as it is shown in (Table 3)

Table 3: Number and percentage of each bacterial isolate.

Bacterial isolates	No. bacterial isolates in imported corn	Percentage of specific Isolation (1)	No. bacterial isolates in local corn	Percentage of specific Isolation (2)	Total No. bacterial isolates	Percentage of Total Isolation (3)
Salmonella spp.	14	14%	10	16%	24	15%
Escherichia coli	21	21%	15	24%	36	22%
*Klebsiella*spp.	13	13%	-	-	13	8%
Proteus spp.	9	9%	6	10%	15	9%
Serratia spp.	-	-	3	5%	3	2%
Enterobacter spp.	-	-	3	5%	3	2%
Total	57	57%	37	60%	94	58%

(1) Total NO. of samples (100)

(2) Total NO. of samples (63)

(3) Total Isolation (163) samples.

4. Discussion

Safe animal nutrition is an essential requirement of Animal Health Organization (OIE) to ensure animal health because of bacterial contamination of animal feed causing diseases and death. Corn is a grain that is used as animal feed therefore corn must be free of health hazards such as pathogenic bacteria to ensure its safety and quality.

From results in a (Table 3), we note bacterial contamination in both imported and local corn kernels with a various percentages as it is shown in a (Figure 1)

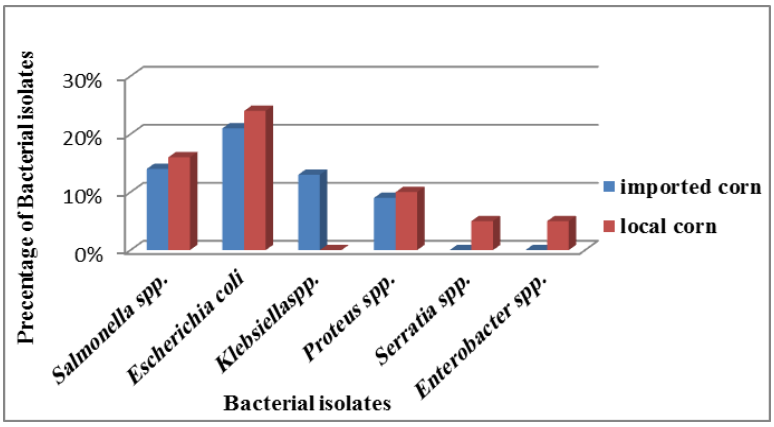

Figure 1: percentage of bacterial isolates in imported and local corn kernel

From Figure 1 which shown the percentage of bacterial isolates in imported and local corn, we note the percentage of *Salmonella* spp. isolates in imported and local corn kernel was (14%) and (16%) respectively, the reference [13] shown that feed ingredients can be a source of *Salmonella* contamination in feed mills. the reference [21] shown *Salmonella* contamination of 15 maize samples was (27%) and the reference [17] noted *Salmonella* causes salmonellosis for poultry and human via consumption animal products.

Percentage of *Escherichia coli* isolates in imported and local corn kernel was (21%) and (24%) respectively, the reference [16] noted the percentage of *Escherichia coli* in 9 feed samples was (5.7%). the reference [17] shown pathogenicity of *Escherichia coli*for poultry and human, and this organism transfer via feces and causes infection.

Percentage of *Proteus* spp. isolates in imported and local corn kernel was (9%) and (10%) respectively, the reference [11] suggested that inoculation of corn plants with *Proteus mirabilis* during an earlier growth period

could be related to its plant growth promoting activities and avoidance of cumulative damage upon exposure to zinc, the reference [6, 2] shown pathogenicity of *Proteus* spp. for animal and human.

Percentage of *Klebsiella* spp. isolates was (13%) in imported corn kernel, but absent in the local corn kernel, the reference [16] shown corn plants in the field could serve as a reservoir for *Klebsiella pneumonia* which might infect plants, animals and probably humans.

Percentage of *Serratia* spp. isolates was (5%) in the local corn kernel, but absent in imported corn kernel, the reference [5] shown *Serratia* spp. in corn roots as an entophytic bacteria which is a promoting growth organism and the reference [4] shown *Serratia* spp. is a pathogenic bacteria for human, animal (such as chick, cows, foals, goats and horse) and plant.

Percentage of *Enterobacter* spp. isolates was (5%) in the local corn kernel, but absent in imported corn kernel, the results of the reference [12] noted *Enterobacter* spp. a promoting growth organism in roots of corn, the reference [8, 1, 14] shown pathogenicity of *Enterobacter cloacae* for human, animal (buffalo calves) and plant (corn).

From the obtained results can conclude that the presence of *salmonella* and *Escherichia coli* are pathogenic bacteria for human and animal by contamination via the feces of animals (infected rodents), presence of *Klebsiella*(*Klebsiella pneumonia*) is a pathogenic bacteria for plant, animal and human, Presence of *Proteus* spp., *Serratia* spp. and *Enterobacter* spp.in the soil as promoting growth organisms, but by the wind or during harvest these bacteria transfer to become in contact with the growing plant then causes the infection via consumption.

5. Conclusions

It is highly recommended to take more an attention to growth, harvest and storage conditions for corn and must assess the microbial quality of corn by manufacturers and health authorities to ensure animal health then human health via safe animal product consumption.

References

[1] Abdul-kareem Salman Al-Yassari, Study the pathogenicity of Enterobacter cloacae in rats that isolated from diarrheatic buffalos calves in Babylon province, AL-Qadisiya Journal of Vet. Med. Sci. Vol. 14 No. 1, pp. 44-48, 2015.

[2] Faisal Islam, TahiraYasmeen, Muhammad Riaz, Muhammad Saleem Arif, Shafaqat Ali, Syed Hammad Raza, Proteus mirabilis alleviates zinc toxicity by preventing oxidative stress in maize (Zea mays) plants, Ecotoxicology and Environmental Safety, Volume 110, pp. 143–152, 2014.

[3] Field Corn Production in Iraq", review by the United States Agency for International Development. It was prepared by USAID-InmaAgribusiness team for a consortium led by The Louis Berger Group, Inc. pp.

1-66,2011, General information: info@inma-iraq.com ,Website: www.inma-iraq.com.

[4] Francine Grimont and Patrick A. D. Grimont, The Genus Serratia, Chapter 3.3.11, Prokaryotes 6: 2006,pp. 219–244

[5] Gao Z, Zhuang, Chen , Liu , Tang ., Population of entophytic bacteria in maize roots and its dynamic analysis, Ying Yong Sheng Tai XueBao.,15(8):pp. 1344-8, 2004.

[6] Hadya E. Ahmed and El Amin, E. D, M, Pathogenicity of Proteus mirabilis with reference to Bumble-foot in chickens, The Sudan J. Vet. Res. 23: pp. 91-95, 2008.

[7] Holt, J.G., N.R. Krieg, P.H.A. Sneath, J.T. Staley, and S.T. Williams. 1994, Bergy's manual of determinative bacteriology. 9th ed. Williams and Wilkins, Baltimore, USA.

[8] Hopley, Lara, Schalkwyk, Jo van.2001, "Enterobacter." 29 Sept 2001. http://www.anaesthetist.com/icu/infect/bacteria/gramneg/Findex.htm#enterobacter.htm

[9] HUANG Min, LIN Li, WU Yi-xin , Honhing Ho , HE Peng-fei , LI Guo-zhi , HE Peng-bo , XIONG Guo-ru , YUAN Yuan , HE Yue-qiu , Pathogenicity of Klebsiella pneumonia (KpC4) infecting maize and Mice, Journal of Integrative Agriculture,15(7): pp. 1510–1520, 2016.

[10] ISO/TR 6579-3, Microbiology of food and animal feed – Horizontal method for the detection, enumeration and serotyping of Salmonella – Part 3 Guidelines for serotyping of Salmonella spp. v4.2 111212, pp. 1 of 31.

[11] JIM MANOS AND ROBERT BELAS, The Genera Proteus, Providencia, and Morganella , CHAPTER 3.3.12 , Prokaryotes 6:2006, pp. 245–269

[12] John A. McInroy and Joseph W. Kloepper, Survey of indigenous bacterial endophytes from cotton and sweet corn, Plant and Soil, Volume 173, Issue 2, pp. 337–342, 1995.

[13] Jones,F.T. and Richardson, K.E,Salmonella in commercially manufactured feeds. Poult. Sci. 83, pp. 384-391,2004.

[14] K. A. Nishijima, M. M. Wall, and M. S. Siderhurst, Demonstrating Pathogenicity of Enterobacter cloacae on Macadamia and Identifying Associated Volatiles of Gray Kernel of Macadamia in Hawaii, Plant Disease, Vol. 91, No. 10, pp. 1221-1228, 2007.

[15] Linda Campbell Franklin, "Corn" in Andrew F. Smith (ed.), the Oxford Encyclopedia of Food and Drink in America. 2nd ed. Oxford: Oxford University Press,2013, (pp. 551–558), pp. 553.

[16] Maung S. Myint, Yvette J. Johnson, Joseph C. Paige and Daniel A. Bautista , A cross-sectional study of bacterial contamination in plant-protein feed from feed stores in Northern Virginia and Maryland,

Animal Feed Science and Technology 133, pp. 137–148, 2007.

[17] Nahid Taha Hanafi Ahmed, 2002, Bacterial Contamination in Poultry Feed in Khartoum State, master theses, Omdurman Islamic University,

[18] Peter Ranum, Juan Pablo Pe˜na-Rosas, and Maria Nieves Garcia-Casal, Global maize production, utilization, and consumption, Ann. N.Y. Acad. Sci. ISSN 0077-8923,1312, pp. 105–112, 2014.

[19] R.J. Bothast , R.F. Rogers , and C.W. Hessel Tine. Microbiology of corn and dry milled corn products, American Association of cereal chemists, vol.51, pp. 830-838, 1974.

[20] "The Evolution of Corn". University of Utah HEALTH SCIENCES.Retrieved 2 January 2016.

[21] Veldman, A., Vahl, H.A., Borggreve, G.J. and Fuller, D.C.,A survey of the incidence of Salmonella species and Enterobacteriaceae in poultry feeds and feed components. Vet. Rec. 136, pp. 169-172, 1995.

[22] Wilson, J. E..AvianSalmonellosis.Vet.Rec. 60, pp. 615-629, 1948.