**A research comparison of antibiotics and hormone-like anabolic agents’ residuals in chicken meat and their offal under two different country legislation**

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**Abstract**

Antibiotics and hormone-like anabolic agents use in order to intensify the production of chicken farms. These may reflect on formation the harmful chemical residues in their meat and offal. The purpose of the current study was to analyze some chemical hazards in local and imported chicken meat and their edible offal including: Quantitative assessment of ciprofloxacin and sulfonamide and growth promoters’ 17β-Estradiol. A total of 214 fresh and imported chicken carcasses were purchased from different commercial chicken markets at Ismailia governorate, Egypt and Bahrain. 10 grams of meat sample was blended, centrifuged, homogenized, extracted and analyzed by HPLC to estimate the concentration levels of ciprofloxacin and 17β-Estradiol residues. Spectrophotometer used to detection of sulfonamide residues. The mean concentrations ciprofloxacin values for Egyptian and Bahrainis chicken meat were; 0.339 ± 0.026 and 0.126 ± 0.031 µg/g respectively. While, the mean concentrations ciprofloxacin values for Egyptian and Bahrainis chicken offal were; 0.65 ± 0.075 and 0.545 ± 0.045 µg/g respectively. The mean concentrations Sulfadiazine values were; 0.020 ± 0.003 and 0.006 ± 0.002 µg/g respectively while, in chicken offal were 0.045 ± 0.020 and 0.025 ± 0.015 µg/g respectively. The mean concentrations 17β-Estradiol values for chicken meat were; 1.626 ± 0.076 and 1.593 ± 0.069 µg/g respectively. While, in chicken offal were 2.60 ± 0.089 and 2.95 ± 0.075 µg/g respectively. Results of this study observed that the Egyptian chicken meat under investigation contained several chemical residues than Bahrain samples which may represent a sever public health hazards for consumers if increase their daily intake level of chicken meat. In addition to, such chemical residues were more concentrated in the chicken offal than chicken meat. More attention from the concerned authority must be considered in controlling antibiotics and hormone-like anabolic agents at chicken farms.

**Key Words:** ciprofloxacin, sulfadiazine, 17β-Estradiol, local, imported, residues.

**1. Introduction**

The first consumer right is to consume a meat of good quality and does not constitute any health hazards. To completely explore trials to control of some chemical and biological hazards in chicken meat, a variability of food bacteriological and chemical analyses is necessary. Chicken meat can be contaminated by different biological, chemical or physical hazards during farming and final processing, chemical residues as antibiotics and veterinary medications, insecticides and growth promoters are an example for important chicken meat residues **(Ahmed & Shimamoto, 2014)**.

In order to intensify the production of chicken farms. Antibiotics, chemotherapeutics, ionophores, hormones and hormone-like anabolic agents were used for this purpose. Poultry growers use disease preventive medications, growth promoter and antimicrobials for quicker development of chickens in the shortest probable period to enhance the rate of feed conversion and to minimize the occurrence of deaths caused by a pathogen attack. Antibiotics are consumed by the poultry farmers and poultry veterinarians to enhance growth, feed conversion and reduce disease. While these uses benefit the farmers and the veterinarians, unlikely, consumer awareness are that edible tissues are polluted with harmful concentrations of antibiotic residues in the comestible tissues and by-products of the treated birds **(Donoghue, 2003 and Ibrahim, 2009)**.

The usage of antimicrobial agents during the food series assigned to the development of resistant bacteria that could be passed directly to human being. The occurrence and transmission of resistant bacterial strains from poultry meat and its products to individuals put humans at danger for the strains of bacteria that resist antibiotic treatment **(Apata, 2009)**.

Hormones play a tremendously important role in upholding the normal living functions of the body. This hormone balance is essential to attain maturation, sexual development, regeneration, and the replacement of many physiological functions. Any disturbance of hormone balance can result in malfunctioning of many organs or disorders that affect the whole body. The consumption of meat and meat products resulting from hormone-applied animals can outcome in consumers to be exposed to various levels of hormone residues. There is a worry that hormones, which are very important for the human body, can be a reason of many health hazards if they are consumed, even in little quantities found in foods of animal origin. The quantity of exposure to hormone residues differs individually depending on the consumer's eating habits **(Getabalew *et. al.* 2020)**.

17β-Estradiol affects body weight by enhancing secretion of growth hormone, but it results in a great suppression in LH values **(Hemmat *et. al.* 2018)**.

Therefore, the main purpose of the present study was to analyze some chemical hazards in chcicken meat and their edible offal collected from two different Arab countries to evaluate the potential of control trials on these chemical hazards as follows: Quantitative assessment of Ciprofloxacin & Sulfates Antibiotic residues and Quantitative assessment of Steroidal Growth promoters’ evaluation.

**2. Materials and Methods**

**Study Area:**

Ismailia governorate is one of [Egypt](http://en.wikipedia.org/wiki/Egypt) [governorates](http://en.wikipedia.org/wiki/Governorates_of_Egypt), which situated on the west side of the [Suez Canal](http://en.wikipedia.org/wiki/Suez_Canal). The governorate's total area covers 5066.97 km2, it encompasses 7 offices, 3 districts, 33 rural local units annexed by 33 villages, and 592 hamlets.

[Bahrain](https://www.worldatlas.com/as/bh/where-is-bahrain.html) is a secret gem tucked within the gulf region. It is connected by the 25 kilometers (16mi) King Fahd’s Causeway. The kingdom of Bahrain consists of Bahrain Island and 33 of the Bahrain islands, lying in the Arabian Gulf.

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| **Image (1): Ismailia governorate map.** | **Image (2): Bahrain Province map.** |

**Sample Size:**

Sample size calculated statistically by “Raosoft” sample size calculator program (figure, 1). The calculation based on the number of 480 broiler farms in Ismailia governorate which served by 11 slaughterhouses under the supervision of the General Organization for Veterinary Services with a production capacity up to 4.17675 million broiler chickens slaughtered annually. Kingdom of Bahrain has 19 broiler farms. According to [**Raosoft**](http://www.raosoft.com/) **(2004)** sample size calculated as 214 samples from Ismailia and 19 from Bahrain.

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| **Image (3): Raosoft sample size calculator website (Ismailia).** | **Image (4): Raosoft sample size calculator website (Bahrain).** |

**Samples Collection:**

A total of 233fresh chicken carcasses and their offal (liver and kidney) were collected from November 2018 to November 2019. The carcasses (1050 to 1350g dressed weight) were purchased from different commercial Ismailia governorate, on the day of slaughter, (800 to 1100g dressed weight) were purchased from different [Bahrain](https://www.worldatlas.com/as/bh/where-is-bahrain.html) poultry marketed. The samples were individually placed in sterile coolers and immediately transported to Food Hygiene Lab., Faculty of Veterinary Medicine, Suez Canal University.

**Determination of Antibiotic residues:**

**Application of HPLC technique for Ciprofloxacin:**

Accurately, 5gm of each sample and 10 gm of anhydrous sodium sulfate were blended with 20 ml of ethyl acetate and then centrifuged. Dried evaporate supernatant was dissolved in 5ml of ethy1 acetate-n-hexane. The surveyed antimicrobial residues were eluted from the cartridge with 5ml acetonitrile (20%) and 0.05 M ammonium format. The preparation was injected into HPLC system (model LC – 10A series equipped with constant flow pump and variable wavelength U/V detection, Kyoto, Japan.

Operating conditions for analysis of amoxicillin were; eluant at 35°C, flow rate 1 ml/min., injection volume, 10ul; detection wavelength 216/ nm. While, the operating conditions for analysis of sulphaquinoxaline were; eluant at 30°C, flow rate 1 ml/min., injection volume, 20/ul; detection wavelength 272nm **(Pieckova & Van Peteghem, 2001 and Oka *et al.,* 2003)**.

**Preparation and Extraction of Meat Samples:**

Meat samples (50 g) were blended at 20000 rpm in a tissue blender (IKA, M 20, Germany) for 2 minutes. Ten grams of blended meat tissue and 10 ml of deionized water were taken in 50 ml polypropylene centrifuge tube. The mixture was homogenized for 1.5 minutes using Ultra-Turrax T25 tissue homogenizer (IKA, Ultra-Turrax, T25 basic, Germany).

Extraction method similar in principle to method described by **Biswas *et al.,* (2007)**the solid phase extraction (SPE) apparatus (Lichrolut) was set up and Bond-Elute C18 cartridge. A 28 ml of universal bottles were placed under the column for receiving waste then supernatant fluids passed through a Bond-Elute C18 cartridge column (3 ml Varian, USA) at a flow rate of 1 ml/min preconditioned with 5 ml of HPLC water followed by vacuum drying. The residue was dissolved with 500 μL of an acetonitrile/water mixture (1:1) and filtered through a disposable syringe filter (Mini Sart RC4, 0.45 μm, Sartorius AG, Germany) into HPLC autosampler vials for HPLC analysis.

**HPLC Determination:**

Analysis of the sulfonamide standards and extracted samples were conducted using a HPLC system equipped with HPLC column oven L-7300, detector L-7400, auto sampler L-7200, pump L-7100, vacuum degasser L-76610, interface module D-7000 and HSM software (Hitachi D-7000 series, Japan). The samples were filtered through disposable syringe filter (Mini Sart RC4, 0.45 μm, Sartorius AG, Germany); the filtrates were directly collected into HPLC sample vials then placed in HPLC auto sampler vial rack. A Teknokroma Mediterranea C 18 (5 µm 25 cm×0.46) column was used for the separation of the 5 sulfonamides using 0.01 M potassium di-hydrogen phosphate buffer and methanol at 70:30, v/v as the mobile phase. The flow rate was fixed at 1.0 ml/min and analysis was performed at 35 ºC. The injection volume was 15 μL and ultraviolet detector wavelength of 265 nm was applied.

**The optimal wavelength of detection:**

Spectrophotometer used for detection of sulfonamides residues in poultry meat and offal with maximum absorption at 250-275 nm, UV at 265 nm. A standard calibration curve for sulfonamides was obtained (in triplicate) on HPLC and then plotting peak areas against concentrations (µg/g). Linearity was evaluated through the correlation coefficient. The best fit of data was determined by linear regression using the following equation:

Y= mx +b

Where: Y = Peak area m = Slope x = Concentration b = Intercept

**Limit of Detection (LOD):** The present method provided the limit of detection of sulfonamides residues in meat samples at 0.02 μg/g and 0.025 µg/ml, respectively which were below the MRL (0.1 μg/g).

**Detection of 17 β-Estradiol residues:**

**Preparation of samples**

Ten grams of samples homogenized with 10 mL of 67mM PBS buffer by mixer for 5minutes.Then2 gm of homogenized sample were mixed with 5mL of tertiary butyl methyl ether (TBME) in a centrifugal and shaken vigorously by shaker for 30-60min. After that, re-centrifuged at 3000 rpm/10 min. Then dried extract and dissolved in 1mL of 40% methanol for MT and 80% methanol for TBA.

The methanolic solution was diluted with 2mL of 20mM PBS-buffer and applied to a RIDA C18 column (Art. No. R2002); flow rate: 1 drop / sec.-Column was rinsed by flowing of 3mL methanol (100%).Column was rinsed by injection of 2mL methanol(40%).Column was dried by pressing nitrogen through it for 3min.Sample was eluted, injection of 1mL methanol (80 %) then diluted with water, 20μL per well of resulting solution was used in the test.

**Test procedures:** The test procedures were done according to the chart enclosed in the kits of RIDAR and RIDS screen. R is register trademarks of R-Biopharm AG, Darmstadt, Germany. R-Biopharm AG is ISO certified.

**The results were calculated by this equation:**% absorbance = (OD sample/ OD standard) x 100, results were calculated as ppt. In order to obtain the 17β-Estradiol concentration in ppt contained in the samples. The concentration was read from the calibration standard curve.

**Assessment of health risk**

Health risk estimates for different chemical residues in chicken meat and offal was computed using two basic standard indices: Estimated Average Daily Intake (EADI) and the acceptable daily intake (ADI). Degree of risk associated within the consumption of each chemicals detected (present in chicken meat and offal) was monitored by evaluating the results of chemical residues detected in samples. Health risk index (HRI) was calculated by using estimated daily intake (EDI) and acceptable daily intake (ADI). The value of acceptable daily intake for ciprofloxacin and Sulfadiazine is 0.01 ppm.The EDI was calculated by multiplying average consumption of a person per day (kg/day) and residual concentration of antibiotics (mg/kg) and dividing by average weight of an Asian (60 kg) **(Abubakar *et al.,* 2015; Hossain *et al.,* 2013 and Balkhair & Ashraf, 2016)**. The average consumption of chicken meat and offal was considered 0.0425 person/day. Health risk to consumers was assessed by calculating health risk index using formulas as given in the following Equations **(Mahmood & Malik, 2014)**

**Estimated Daily Intake** = Residual antibiotics concentration X Food consumption rate (kg / day)

Body Weight for an adult 60 Kg

**Health risk index**= Estimated Daily Intake

Acceptable Daily Intake

**3. Results and Discussion**

**Part I: Antibiotics Residues in Chicken meat**

**A. Ciprofloxacin**

The mean concentrations level for ciprofloxacin residues in chicken meat samples were presented in table (1) as following; the mean concentrations ciprofloxacin values for Egyptian and Bahrain chicken meat were; 0.339 ± 0.026 and 0.126 ± 0.031 µg/g respectively. The minimum and maximum values ranged were; 0.21 – 0.45 and 0.00 – 0.28 µg/g for local and imported chicken meat respectively. The mean concentrations ciprofloxacin values for Egyptian and Bahrain chicken offal were; 0.65 ± 0.075 and 0.545 ± 0.045 µg/g respectively. The minimum and maximum values ranged were; 0.20 – 0.87 and 0.41 – 0.65 µg/g for local and imported chicken meat respectively.

The mean ciprofloxacin residues levels compared to International and Egyptian standards (0.1 µg/g) in Egyptian and Bahrain chicken meat and offal were analyzed in table (2) in 100% of samples the concentrations of ciprofloxacin were as following; 10% of the local chicken meat and offal were exceeding international and Egyptian permissible limits while about 80% of the Bahrainis chicken meat and offal samples were within the both standards for ciprofloxacin (0.50 µg/kg for chicken offal) which recommended by **(E.O.S., no. 7136, 2010)**.

The maximum residue level (MRL) for fluroquinolone, such as; ciprofloxacin, legally permitted in food under European Union regulation of 30µg/kg of muscle, liver and kidney and not more than 75µg/kg for quinolones according to Egyptian Organization Standardization**(E.O.S. no. 7136, 2010)**. All samples examined are lower than Egyptian permissible limits and fit for human consumption.

The highest concentration of ciprofloxacin was found in Bahrain is chicken meat samples. The same results were reported in organs of different slaughtered food animals by (**Javadi *et. al.,* 2011)**. On the contrary, other authors had reported higher ciprofloxacin concentration levels **(Cinquina, *et. al. ,*2003 and Amjad *et. al.,* 2006)**.

The ciprofloxacin is a member of the fluoroquinolone antibiotics which is broad-spectrum antibiotic. It can result in adverse side effects. In most cases, such as tendinitis and tendon rupture, central nervous system toxicity, cardiovascular toxicity, renal failure, seizures. Ciprofloxacin is known to rapidly penetrate body tissues and fluid and has been detected in animals but presence of antibacterial agents in food animals induces pathogen resistance in humans such as; resistant *S. typhi*, *Neisseria gonorrhoea*, *Escherichia coli* **(Cinquina *et. al.*, 2003 and Lolo *et. al.*, 2006)**.

**B. Sulfadiazine**

The mean concentrations level for Sulfadiazine residues in chicken meat and offal samples were presented in table and figure (1) as following; the mean concentrations Sulfadiazine values for Egyptian and Bahrein chicken meat were; 0.020 ± 0.003 and 0.006 ± 0.002 µg/g respectively. The minimum and maximum values ranged were 0.01 – 0.038 and 0.00 – 0.016 µg/g for Egyptian and Bahrain chicken meat respectively. While, in chicken edible offal samples the mean concentrations Sulfadiazine values for Egyptian and Bahrain chicken offal were; 0.045 ± 0.020 and 0.025 ± 0.015 µg/g respectively. The minimum and maximum values ranged were 0.03 – 0.058 and 0.019 – 0.38 µg/g for Egyptian and Bahrain chicken offal respectively.

The mean Sulfadiazine residues levels compared to International and Egyptian standards (0.1 µg/g) in Egyptian and Bahrain chicken meat and offal were analyzed in table (2) in 100% of samples the concentrations of Sulfadiazine were as following; about 10% of tested local chicken meat samples exceeding within the International and Egyptian permissible limits while about 80% of Bahrain chicken meat and offal were within the both standards for Sulfadiazine (0.50 µg/kg for chicken offal) which recommended by **(E.O.S., no. 7136, 2010)**.

Nearly similar results were reported in chicken meat and offal in Malesia by **Cheong, *et. al.,* (2010)** whom reported about 0.005 and 0.008 μg g-1 from chicken meat and offal respectively and the authors added that these values were still within the criteria of the Codex for residue analysis. Different samples recorded by **Zhenga *et al.,* (2007)** they had been rendered as the major cause in approximately 95% of all violations involving sulfonamides in tissues.

Sulfonamides detected in chicken samples in Malaysia is considered low. For instance, in USA, the contamination rates of sulfonamides were reported to over 4%, while in Italy it was lower (less than 1% violation). Samples of poultry meat surveyed in Italy showed contamination of sulfadiazine at 0.64 - 21.0 μg/kg and sulfaquinoxaline at 0.98- 116.0 μg/kg **(Weiss *et al.,* 2007)**. Positive samples detected for sulfonamides in their study were always in the liver. Study on the occurrence of veterinary drug residues, including sulfonamides, in poultry products in Nigeria showed contamination of 1% in eggs and 33.1% in broilers, 23.6% in slaughter and 4.8% in local chickens **(Kabir *et al.,* 2004)**.

Sulfonamides are a group of synthetic antibiotics with broad spectrum effects against most Gram positive, Gram negative bacteria and protozoa **(Mor *et. al.,* 2012)**. They are frequently used in the poultry industry for therapeutic, prophylactic, or growth-promoting purposes **(Doyle, 2006).** Sulfonamides are also used to treat various types of infections in digestive and respiratory tracts **(Furusawa and Hanabusa, 2002)**. The widespread use of sulfonamides as a result of their availability and low cost has resulted in considerable increase in resistant bacteria strains for these compounds **(Van den Bogaard*et al.,* 2001)**. It is well established that consumption of animal products containing sulphonamide residues poses potential human health risks which include hypersensitivity or anaphylactic shock, cancer **(Goetting *et al.,* 2011)** and induction of bacterial resistance to the antimicrobials **(Mor *et al.,* 2012)**. Therefore, to safeguard public health against threats posed by antimicrobial residues, the MRL for sulfonamides in poultry products have been established at 100 μg/kg by Codex Alimentarius commission and the EU (**Sasanya *et. al.,* 2005 and Malik *et. al.,* 2013)**. In developed countries, such as the USA, Japan and EU, regulations and strict monitoring measures on the use of antimicrobials have been established (**Salehzadeh *et al.,* 2006; Passantino & Russo, 2008 and Reig &Toldrá, 2008)**. In Tanzania, legislations regarding antibiotic drug application in food producing animals as well as monitoring and control of their residues are not adequately enforced **(Nonga *et al.,* 2009)**. Poor enforcement of these regulations may explain the reported high prevalence of antimicrobial residues in poultry products **(Nonga *et al.,* 2009 and Nonga *et al.,* 2010)**. However, all the latter studies employed qualitative assays which indicate presence of antimicrobials but could not establish whether the residues exceed the MRL.

The sulfonamide residues of meat samples ranged from 0.02 to 0.8 μg/g. Out of total 11poultry meat samples collected from Islamabad, 5 (45%) had detectable concentrations of sulfonamides, of 5 positive samples2exceeded recommended MRL Meat samples collected from Islamabad hadsulfonamideresiduesbetween0.02 to 0.6 μg/g. In total 30 poultry meat samples were analyzed for sulfonamide residues, out of which 43% (13 Nos) samples had detectable levels (0.02-2.0 μg/g) of sulfonamide residues. Out of 13 positive samples,7(23.3%) exceeded recommended MRL(0.12-0.8 μg/g) and found to be unfit for human consumption.

Sulfonamides (SAs) are synthetic antibiotics with a wide spectrum against most gram-positive and many gram-negative organisms. They are regularly used by veterinarians in chickens for therapeutic, prophylactic, or growth-promoting purposes and halt the growth of bacteria in animal production. They are also used to treat many kinds of infections caused by bacteria and certain other microorganisms such as infectious diseases of digestive and respiratory tracts **(Hela *et al.,* 2003).** The extensive use of SAs as a result of their low cost has resulted in the increase of many sulfonamide-resistant strains of bacteria**(Shao *et al.,* 2005)**. Therefore, to ensure the safety of the food to the consumers, SAs are set at 0.1 μg g-1 of food producing animals for the maximum residue limit (MRL) The aim of this study is to determine level of four SAs, Sulfadiazine (SDZ), Sulfamethazine (SMZ), Sulfamethoxazole (SMX) and Sulfaquinoxaline (SQX,) in chicken muscle and liver samples marketed in Malaysia.

However, there is no Allowed Daily Intake (ADI) recommended by regulatory agencies for exposure to sulfonamides. Furthermore, there is no previous study on sulfonamides exposure from other countries to be compared with. The residue of sulfonamides detected in chicken liver was higher than breast meat samples.

**Part II: Hormonal Residues in Chicken meat**

**C. 17β-Estradiol**

The mean concentrations level for 17β-Estradiol residues in chicken meat and offal samples were presented in table (1) as following; the mean concentrations 17β-Estradiol values for Egyptian and Bahrain chicken meat were; 1.626 ± 0.076 and 1.593 ± 0.069 µg/g respectively. The minimum and maximum values ranged were 1.22 – 1.96 and 1.20 – 1.90 µg/g for Egyptian and Bahrein chicken meat respectively. While, in case of chicken offal were; 2.60 ± 0.089 and 2.95 ± 0.075 µg/g respectively. The minimum and maximum values ranged were; 2.19 – 4.00 and 2.30 – 3.90 µg/g for Egyptian and Bahrain chicken offal respectively.

The mean 17β-Estradiol residues levels compared to Egyptian and Gulf standards (2 µg/g) in local and imported chicken meat and offal were analyzed in table (2) in 100% of samples the concentrations of 17β-Estradiol were as following; 100% of the tested local and imported chicken meat samples were within the International and Egyptian permissible limits for 17β-Estradiol (2.0 µg/kg for chicken offal) which recommended by **E.O.S., no. 7136, (2010)**.

Nearly similar results reported by **Ibrahim, (2009)** whom recorded about; 0.782±0.07 and 2.077±0.08 μg/ kg from chicken meat and offal for 17β-Estradiol. Lower findings were obtained by **Doyle (2000)** who found 17β-estradiol in chicken meat was ranged from < 0.03-0.02 ppb. While higher findings were obtained by **Sadek *et al.,* (1998)** whofound17β-estradiol in chicken meat and offal were 0.865, 4.216 ppb respectively.

The acceptability of samples according to permissible limit (>2ppb) stipulated by the Egyptian Organization for standardization and quality control 100% and 29% in chicken muscle and offal respectively. No samples were exceeding the permissible limit stated by **Gracey (1998)**.

17β-Estradiol affects body weight by enhancing secretion of growth hormone, but it results in a great suppression in LH values. Generally, withdrawal of estradiol greatly influenced by the level of lipid content of different tissues. The consumption of meat containing estrogenic material resulted in fluctuation in estrogenic hormones and significant disorder in gonadotrophins of lactating mother **(Ayat 1987)**.

17β-Estradiol hormone has great side effect on human who consume meat contain this hormone which made hepatocellular carcinoma and consider hepato tumorigenic agent also, it effects on gonadotrophins of lactating mother. The administration of health-risk related substances such as growth promoting agents and hormones is a recurring problem in animal production where these compounds. The withdrawal time of hormone from the body of chicks need more time so it is forbidden to give hormones as growth promoters to chickens to avoid exposure to hormonal residues in poultry meat and its public health hazard **(Platter *et al.,* 2003)**.

**Part III: Health Risk Index of ciprofloxacin, Sulfadiazine and 17β-Estradiol Residues in Chicken meat and offal**

The level of the risk imparted towards health due to these antibiotics present was further assessed by calculating the health risk index (HRI). Health risk calculations **(Carmen *et al.,* 2008)** showed that health risk index exceeded 1 (the cut off value) for ciprofloxacin in samples while for Sulfadiazine and 17β-Estradiol value did not exceed 1 for any sample (Table 3). Results indicate that there is the possibility of potential health risk associated with exposure to ciprofloxacin, Sulfadiazine and 17β-Estradiol through chicken meat and offal to human beings utilizing them especially because of presence of those residues as HRI for Sulfadiazine was the highest in most of samples followed by 17β-Estradiol. Regular monitoring of the use of common ciprofloxacin, Sulfadiazine and 17β-Estradiol especially in developing countries should also be undertaken for regular monitoring of residual ciprofloxacin, Sulfadiazine and 17β-Estradiol levels that may pose potential health hazard. Adaptation of best agricultural practices in the surrounding area and best management practices in the chicken meat and offal may help to avoid or reduces the chances of contamination.

**4. Conclusion**

The results of this study observed that the local chicken meat was more contaminated by several residues than imported samples. In addition to that the contaminants were more precipitated in chicken offal than chicken meat the study concluded that local and imported chicken meat and offal samples were contaminated with a variety residue such as; antibiotics (ciprofloxacin and sulfadiazine) and hormone (17β-Estradiol) at different levels.

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**Table (1): Mean antibiotic and 17β-Estradiol (μg/g) values for Egyptian and Bahrainis chicken meat and offal**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Chicken Samples** | **Antibiotics** | | | | | | | | **17β-Estradiol** | | | |
| **Ciprofloxacin** | | | | **Sulfadiazine** | | | |
| **chicken meat** | | **chicken offal** | | **chicken meat** | | **chicken offal** | | **chicken meat** | | **chicken offal** | |
| **Local** | **Imported** | **Local** | **Imported** | **Local** | **Imported** | **Local** | **Imported** | **Local** | **Imported** | **Local** | **Imported** |
| **Minimum** | 0.210 | 0.000 | 0.200 | 0.410 | 0.010 | 0.000 | 0.030 | 0.019 | 1.220 | 1.200 | 2.190 | 2.300 |
| **Maximum** | 0.450 | 0.280 | 0.870 | 0.650 | 0.038 | 0.016 | 0.058 | 0.038 | 1.960 | 1.900 | 4.000 | 3.900 |
| **Mean** | 0.339 | 0.126 | 0.650 | 0.545 | 0.020 | 0.006 | 0.045 | 0.025 | 1.626 | 1.593 | 2.600 | 2.950 |
| **± SE** | 0.026 | 0.031 | 0.075 | 0.045 | 0.003 | 0.002 | 0.020 | 0.015 | 0.076 | 0.069 | 0.089 | 0.075 |

**Table (2): Mean antibiotics concentration levels compared to the WHO Standards Egyptian and Bahrainis chicken meat and offal**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Chicken Samples** | **Ciprofloxacin** | | | | **Sulfadiazine** | | | | **17β-Estradiol** | | | |
| **chicken meat**  **(0.1 µg/g)** | | **chicken offal**  **(0.5 µg/g)** | | **chicken meat**  **(0.1 µg/g)** | | **chicken offal**  **(0.5 µg/g)** | | **chicken meat**  **(2.0 µg/g)** | | **chicken offal**  **(2.0 µg/g)** | |
| **Egyptian** | **Bahrainis** | **Egyptian** | **Bahrainis** | **Egyptian** | **Bahrainis** | **Egyptian** | **Bahrainis** | **Egyptian** | **Bahrainis** | **Egyptian** | **Bahrainis** |
| **Within the International Standards** | 90% | 80% | 90% | 80% | 90% | 80% | 90% | 80% | 100% | 100% | 100% | 100% |
| **Exceed the International Standards** | 10% | 20% | 10% | 20% | 10% | 20% | 10% | 20% | 00% | 00% | 00% | 00% |
| **Within the Egyptian Standard** | 90% | 80% | 90% | 80% | 90% | 80% | 90% | 80% | 100% | 100% | 100% | 100% |
| **Exceed the Egyptian Standard** | 10% | 20% | 10% | 20% | 10% | 20% | 10% | 20% | 00% | 00% | 00% | 00% |
| **Total** | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

**Table (3): Health Risk Index of Antibiotics and 17β-Estradiol concentration detected levels in Egyptian and Bahrainis chicken meat and offal**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Chicken Samples** | | | **Health Risk Index** | **Health Risk** |
| **Ciprofloxacin** | **chicken meat** | **Egyptian** | 0.002 | Yes |
| **Bahrainis** | 0.775 | Yes |
| **chicken offal** | **Egyptian** | 0.140 | Yes |
| **Bahrainis** | 0.873 | Yes |
| **Sulfadiazine** | **chicken meat** | **Egyptian** | 1.720 | Yes |
| **Bahrainis** | 9.360 | Yes |
| **chicken offal** | **Egyptian** | 3.770 | Yes |
| **Bahrainis** | 12.24 | No |
| **17β-Estradiol** | **chicken meat** | **Egyptian** | 1.590 | Yes |
| **Bahrainis** | 3.100 | Yes |
| **chicken offal** | **Egyptian** | 2.300 | Yes |
| **Bahrainis** | 3.500 | Yes |