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Chemical and bacteriological evaluation of broiler's meat after adding garlic powder to poultry ration

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ABSTRACT:

This study was conducted on 75 chicks starting from the age of one day (Cobb strain) in the laboratory animal's home in the College of Veterinary Medicine, University of Sadat City to find out the changes that garlic powder has made on the meat quality of these broilers. Chicks were weighed upon arrival and randomly allocated into3 experimental groups with apparently healthy chicks and adding of garlic powder (3% and 5%) in its feed from the first day. After 42 days, meat samples taken from breast and thigh after slaughtering then made chemical examination (pH, Thiobarbituric acid values "TBA"and Total volatile base nitrogen values "TVN") and bacteriological examination (Aerobic Plate Count "APC", Coliform count, Staphylococci count as well as isolation and identification of Salmonella, *Escherichia coli* and *Staphylococcus aureus*). Garlic powder (3%) revealed the best results in pH, TBA and TVN. Bacteriologically, garlic powder (5%) achieved the best results for Coliforms count and Staphylococci count. Generally; garlic additives revealed that salmonella, *E. coli* or *S.aureus* failed to be isolated.

Key words: Garlic powder as additives, meat quality, bacteriological and chemical evaluation.

INTRODUCTION:

Poultry meat and its products are very popular food throughout the countries and no surprise because it's scrumptious, nutritious and considered as a good and low cost source of protein characterized by good flavor and simply digestible. Poultry meat has about 20 to 23% protein (Smith, 2001).

All over the world, garlic (Allium sativum L.) is used not only as a spice, but as a herbal medicine for the prevention and treatment of many diseases, starting with infections and heart disease (JAVANDEL *et al*. 2008). Moreover, Garlic has a positive effect on digestion and respiration in birds because it contains aromatic oils and also has substances that make it work as an antioxidant (Gardzielewska *et al.* 2003).

The pH value is an indication of the quality of chicken meat as it determines the shelf life and quality of products (Hathout-Amal and Aly – Soher, 2010).

Total Volatile Nitrogen (TVN) is a reliable guideline for the quality of meat, meat products and various foodstuffs. In general, TVN increases in meat products with increasing storage period as the growth of microbes and proteolytic enzymes break down protein (ammonia) (Alina and Ovidiu, 2007).

Theobarbituric Acid (TBA) test is widely used to measure oxidative rancidity in foods that contain fat. It is a sensitive test to determine

the decomposition of highly unsaturated fatty acid products (Melton, 1983).

Degradation of chicken meat due to chemical and/or physical factors can occur depending on the microbiological conditions of poultry carcasses which are directly affected by slaughter, processing and storage conditions (Balamatsia *et al.* 2006).

The Aerobic Plate Count is considered as an index of quality, which gives an idea about the hygienic measures during processing and help in assessing the keeping quality (Aberle *et al.* 2001). Also, the coliform group of bacteria is a reliable indicator of fecal contamination, improper handling and storage of meat and meat products (Aberle *et al.* 2001).

Salmonella is a major public health hazard because it is one of the most pathogenic microorganisms of bacterial food poisoning. In poultry meat, handling of raw poultry carcasses and products as well as consumption of undercooked poultry meat causes Salmonella infection (Panisello *et al.* 2000).

E. coli is one of the most important natural populations in the intestinal tract of humans and warm-blooded animals. Its danger is that it acquires antimicrobial resistance faster than other conventional bacteria (Miranda *et al.* 2008). *E. coli* has been isolated from poultry meat all over the world (Canton *et al.* 2008 and Adesiji *et al.* 2011).

Poor personal hygiene, poor handling and temperature control are powerful Guides in which we guess the presence of Staphylococcus microorganism especially *S.aureus* (Rindhe *et al.* 2008).

S. aureus is the third largest cause of food poisoning outbreaks in the world (Aydin *et al.* 2011, Sasidharan *et al.* 2011 and Achi and Madubuike, 2007). The production of enterotoxin is the dangerous weapon of this pathogen. Its food poisoning is commonly related to fresh and processed foods particularly meat products (Aydin *et al.* 2011).

So, the objective of the experiment is to study the effect of feeding garlic powder (3% and 5%) on broiler's meat quality.

MATERIAL AND METHODS:

This study was conducted on 75 chicks ranging from the age of one day (strain Cobb) and raised for 42 days within the laboratory animal's home in the college of Veterinary Medicine, University of Sadat City. The chicks were allotted in 3 experimental groups with tw enty five apparently healthy chicks per every. Chicks were allocated underneath similar conditions of management. They fed on balanced formulated basic rations (starter ration from one day old till 20 days old and grower finisher ration from 20 days old till the end of the experiment) *ad-libitum* feeding and free water intake. The garlic powder was added to the basal rations. Birds were vaccinated against Avian Influenza (AI), Newcastle Disease (ND) and "Gamboro" Infectious Bursal Disease (IBD).

Groups were: Control (eat ration without any addition), Garlic powder (3% of the ration) and Garlic powder (5% of the ration).

1-Sampling:

Meat samples were taken randomly from five birds of each group (thigh and breast). Fifty grams of thigh and breast meat of each carcass were minced, mixed together and represented as one sample. Homogeneous meat samples were placed in sterile polyethylene bags and then transported to the laboratory in an ice box under complete sterile conditions without delay in time, then subjected to the following examinations:

2-Chemical indices:

2-1-Determination of pH

pH was determined according to Pearson and Tauber (1984).

2-2-Determination of Thiobarbituric acid (TBA)

TBA was determined according to Harold *et al*. (1987).

2-3-Determination of total volatile bases (TVN)

TVN was determined according to according to Pearson (1976).

3-Bacterial indices:

Preparation of Samples for bacteriological examination according to APHA (2001) recommended method.

Aerobic plate count was done according to APHA (2001). Coliforms count, isolation and identification of *E. coli* were done according to ISO (2004). Staphylococci count was done

according to ICMSF (1996b). Isolation and Identification of *S.aureus* and salmonella were done according to MacFaddin (2000).

RESULTS:

1-pH:

It is indicated in table (1) that the mean value of pH of the examined chicken meat that fed on ration contain garlic powder (3%) was 5.68±0.05 and 5.74±0.03 for broilers that fed on ration contain garlic powder (5%), while the control group was 5.91±0.03**.**The previous results revealed that the group of garlic powder (3%) had less pH value compared to the other two groups.

2-Thiobarbituric acid (TBA):

Results achieved in table (2) revealed thatmean value of TBA of the examined broilers that fed on ration contain garlic powder (3%) varied was 0.268±0.048 and 0.53±0.049 for broilers that fed on ration contain garlic powder (5%), while the control group was0.724±0.041. So, the above mentioned results cleared that the group of garlic powder (3%) had lessTBA value compared to the other two groups.

3-Total volatile base nitrogen (TVN):

Table (3) indicated that the mean value of TVN of the examined broilers that fed on ration contain garlic powder (3%) was 2.11±0.01 and 2.29±0.007 for broilers that fed on ration contain garlic powder(5%), while the control group was 2.80±0.028**.** The previous results proved that the group of garlic powder (3%) had less TVN value compared to the other two groups.

4-Bacteriological results:

Results in table (4) showed that the mean value of aerobic plate count of the examined broiler's samples fed on ration containing garlic powder (3%) was $6.3\times 10^7\pm5.0\times 10^7$cfu/g and $6.1\times 10^7\pm4.7\times 10^7$cfu/g for broiler's samples that fed on ration contain garlic powder (5%), while the control group mean value was$1.7\times 10^8\pm1.5\times 10^8$cfu/g. The above mentioned results revealed that the group of garlic powder (5%) had less APC value compared to the other two groups.

Concerning the mean value of Staphylococcal count was $2.4\times 10^5\pm2.1\times 10^6$cfu/g for chicken meat fed on garlic powder(3%) and $2.3\times 10^5\pm1.9\times 10^6$cfu/g for chicken meat fed on garlic powder (5%), while the control group was$3.7\times 10^5\pm3.0\times 10^6$cfu/g. The previous results cleared that garlic powder (5%) had less count for Staphylococci compared to the other groups.

Furthermore, the mean value of total coliform count for chicken meat fed on garlic powder (3%)was$2.5\times 10^6\pm1.7\times 10^6$cfu/g and 4.4×10^6cfu/g for chicken meat fed on garlic powder (5%), while the control group was$3.7\times 10^6\pm2.7\times 10^6$cfu/g. The author revealed that chicken meat fed on garlic powder (5%) had less total coliform count compared to the other two groups.

Meat samples from both groups of garlic powder (3% and 5%) showed no evidence of *E. coli* infection, while the control group showed 80% of examined samples containing *E. coli*. So it was clear that addition of garlic powder to broiler's ration inhibit infection of meat with *E. coli*.

In addition, the meat samples taken from both groups of garlic powder showed no evidence of salmonella infection, while the control group showed 40% of examined samples containing salmonella. So it was cleared that addition of garlic powder to broiler's ration inhibit infection of meat with salmonella.

Moreover, *S. aureus* failed to be isolated from meat samples taken from both groups of garlic powder (3% and 5%), while the control group showed 80% of examined samples containing *S. aureus*. So it was cleared that addition of garlic powder to broiler's ration inhibit growth of *S. aureus* in meat samples.

Table (1) Statistical analytical results of pH of untreated (control) and treated broiler chicken meat samples (n=15)

Test	Min	Max	Mean± s.d*
Control	5.88	5.95	5.91±0.03
Garlic powder (3%)	5.59	5.72	5.68±0.05
Garlic powder (5%)	5.70	5.77	5.74±0.03

Table (2) Statistical analytical results of TBA of untreated (control) and treated broiler chicken meat samples (n=15)

Test	Min	Max	Mean± s.d*
control	0.66	0.76	0.724±0.041
Garlic powder (3%)	0.2	0.33	0.268±0.048
Garlic powder (5%)	0.48	0.59	0.53±0.049

The permissible limit of TBA is 0.9 mg malondialdehyde/ kg according to **(Egyptian standards, 2006)**

Table (3) Statistical analytical results of TVN of untreated (control) and treated broiler chicken meat samples (n=15)

Test	Min	Max	Mean± s.d*
control	2.52	3.08	2.80±0.28
Garlic powder (3%)	1.96	2.24	2.11±0.01
Garlic powder (5%)	2.24	2.42	2.29±0.07

The permissible limit of TVN is 20 mg / 100gm according to **(Egyptian standards, 2006)**

Table (4): Statistical analytical results for examined chicken meat samples bacteriologically (n=15)

Groups / parameters		Control	Garlic (3%)	Garlic (5%)
Aerobic plate count (cfu/g)	**Min**	4.6×10^7	28×10^6	21×10^6
	Max	3.6×10^8	15×10^7	14×10^7
	Mean± S.D	$1.7\times 10^8\pm 1.5\times 10^8$	$6.3\times 10^7\pm 5.0\times 10^7$	$6.1\times 10^7\pm 4.7\times 10^7$
Total coliform count (cfu/g)	**Min**	8.4×10^5	6.2×10^5	5.7×10^5
	Max	6.7×10^6	4.6×10^6	4.4×10^6
	Mean± S.D	$3.7\times 10^6\pm 2.7\times 10^6$	$2.5\times 10^6\pm 1.7\times 10^6$	$2.2\times 10^6\pm 1.6\times 10^6$
Staphylococci count (cfu/g)	**Min**	5.3×10^4	3.3×10^4	2.8×10^4
	Max	7.2×10^5	5.2×10^5	4.7×10^5
	Mean± S.D	$3.7\times 10^5\pm 3.0\times 10^6$	$2.4\times 10^5\pm 2.1\times 10^6$	$2.3\times 10^5\pm 1.9\times 10^6$
***S. aureus* isolation**		80%	Not detected	Not detected
Salmonella isolation		40%	Not detected	Not detected
***E. coli* isolation**		80%	Not detected	Not detected

DISCUSSION:

This study proved that garlic has an effective effect on increasing the quality of meat from the chemical and bacteriological aspects. So, increase the shelf life of such meat and maintaining its safety.

In table (1) the results cleared that garlic powder (3%) is the best additive in pH because the lower pH revealed better quality of the meat. Also acidity increases the shelf life and palatability of the meat. These results agreed with that recorded by Kim *et al.* (2009) who showed that increasing the ratio of nutritional garlic leads to a linear decrease in the pH of poultry meat compared to the poultry meat of the control group.

Concerning, the results in table (2) recorded that garlic powder (3%) in ration of poultry increases the shelf life of meat because the process of lipid oxidation is delayed and does not occur rapidly. These results agreed with

these of Kim *et al*. (2009) who reported that value of TBA decreased in broiler's muscles which fed on ration containing garlic compared to broiler's muscles fed with garlic-free ration. Also, Yin and Cheng. (1998) said that the decrease in the value of TBA is due to a strong garlic inhibitory effect on fat oxidation. The addition of garlic to the ration resulted in increased oxidative stability in refrigerated broiler's meat (Onibi *et al.* 2009).

Furthermore, table (3) cleared that addition of garlic powder (3%) to poultry ration delay protein deterioration and increases the shelf life of meat. Unfortunately, the authors haven't find any literature dealing with the effect of garlic powder on TVN, but the decrease in TVN in this study may be due to antioxidant activity of garlic.

The results of the bacteriological examination were collected in table 4 and revealed that garlic is a powerful antibiotic against most bacteria and is cleared that garlic powder (5%) is the best when addedto poultry's ration which increase the shelf life of the meat because the garlic act as antibiotic against bacteria by decreasing its count.These results agreed with that recorded by Fayed *et al*. (2011) who reported that there is a marked decreases in the APC counts in muscles of broilers due to dietary garlic.

Concerning the total coliform count, It is noticed that garlic powder (5%) is the lowest value and these results confirmed that garlic act as antibiotic and these results recorded by Fayed *et al*. (2011) who reported that there are observable decrease in coliforms count in broiler's muscles that fed on ration containing garlic.

The next examinations are Staphylococci count, *S. aureus, E. coli* and salmonella isolation. It is cleared that the mean values of Staphylococci count results proved that garlic is a strong antibiotic and increases the quality of meat as it reduces or inhibit the infection of meat with bacteria, which increases its shelf life and delays its deterioration. These results agree with those obtained by Ramiah *et al*. (2014) who showed that a significant reduction in the number of *E. coli* occurred as a result of dietary supplementation of garlic powder (0.5%) also appearance of antibacterial effect on *S. aureus*. Moreover, Ibrahim *et al*. (2016) reported that *S. aureus* is considered to be sensitive to garlic, as it has reduced and even completely prevented, when garlic concentration increased. Meanwhile, Noori Al-Waili *et al*. (2007) reported that *E. coli* and *S. aureus* were sensitive to garlic juice. Furthermore, Helander *et al*. (1998) and Hammer *et al*. (1999) reported that addition of garlic powder to ration lead to decrease microflora population in the birds thus it has antimicrobial activity against intestinal microorganisms such as *Salmonella typhimurium* and *E. coli*, while El-Khatib and Abdel Rahman. (1987) reported that garlic can be effective against the growth of *S. typhimurium*.

5-Conclusion:

In this study we found that the best results achieved in pH is the garlic powder (3%) also the best results achieved in TBA is due the use of also the garlic powder (3%).Also, the best results achieved in TVN when use garlic powder (3%). The authors noticed that garlic powder (3%) achieved the best results for chemical evaluation of meat. While APC count revealed best results when used the garlic powder (5%).Meanwhile, total coliforms count and staphylococci count cleared best results with garlic powder (5%). Isolation of *E.coli*, Salmonella and *S. aureus* revealed that both garlic groups (3% and 5%) were effective for these microbes.

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