

## CONSEQUENCES OF SLAUGHTER METHODS ON THE HYGIENIC QUALITY OF MEAT

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### ABSTRACT

The aim of the present study was to evaluate the impact of slaughter methods frequently used in Algeria on the stress of slaughter and its consequences on the quality of meat. Two groups of chickens of the same strain were chosen. The first group was slaughtered by the true Islamic technique and the second one without pronunciation of ritual "takbeer". The results of this study showed for the first time, the importance of "takbeer" in the reduction of stress of animal slaughtering. Significant differences of the parameters of stress, the quality of meat and meat offal were recorded between the two groups. A significant relationship between biological parameters was observed.

**Key words:** Slaughter; ritual phrase; stress; slaughterhouse; chickens.

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### I. INTRODUCTION

Quality of carcasses and meat can be improved by a better mastery of breeding conditions, transport and especially the animal slaughters.

According to Pouillaude [1], methods of dizziness during slaughter (electric or pistol) are more traumatic than ritual slaughter (Islamic and Jewish) by direct bleeding. On the other side, Andrey [2] has indicated that the method of Islamic slaughter was better compared to the direct bloodletting. In a Syrian study of Chikhou [3] compared between meat of animals



slaughtered by and without "takbeer" and reported that "takbeer" in the Islamic bloodletting had a positive effect in improving the microbiological quality of meat from different animal species for slaughter.

In Algeria, the Islamic slaughter technic had changed after the introduction of industrialized slaughter where the ritual of "takbeer" had been eliminated at all the abattoirs. The present study had been undertaken, to determine, the biological difference between the meat of poultry, from both slaughter techniques and the response generated with or without "Takbeer" on the stress of chicken during slaughter. By analysing of some biological parameters that will make it possible to judge the quality of meat and answer to the famous question: "Why "takbeer" at the time of the Islamic slaughter is a prerequisite for legal and good quality meat?"

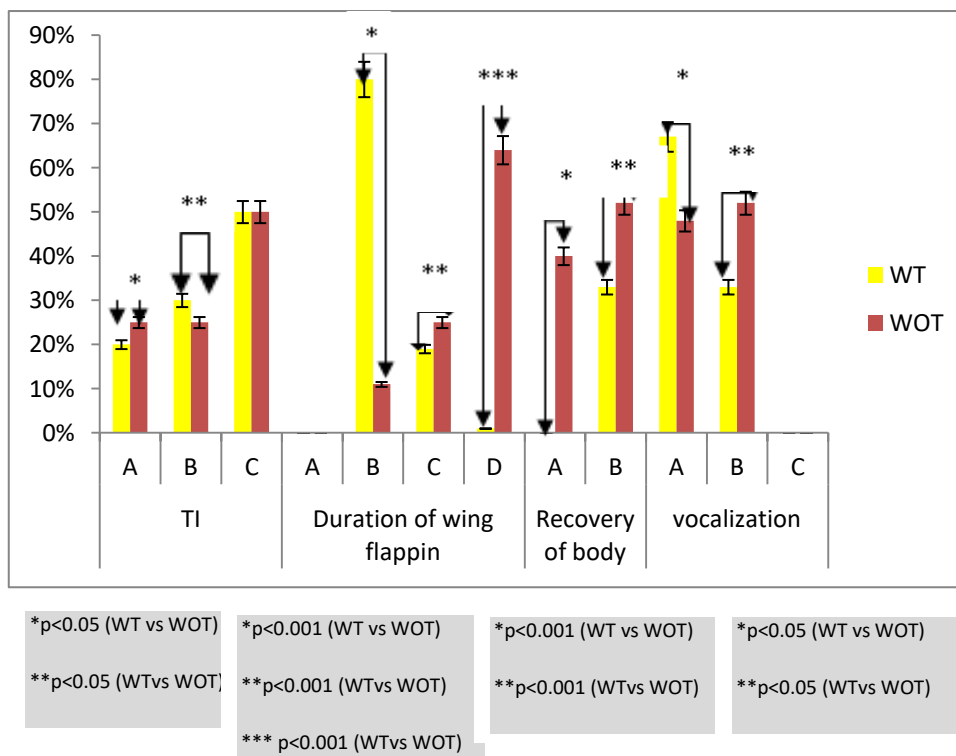
## 2. MATERIALS AND METHODS

40 chickens, of the same strain (Loamann), age and sex (male) were studied. The distribution of the groups was done in order to establish traceability for a better identification after the slaughter using bracelets on the legs of the animal. One week before transport to the abattoir, a behavioral measure was carried out by immobility tonic test (IT) to estimate the level of fear of each chicken in different groups (n=10). At the abattoir, a secondary inspection was carried out looking for possible injuries. Chickens of the two groups were slaughtered by manual bleeding: 5 chickens of the first group (WT), were slaughtered with the pronunciation of the ritual phrase "takbeer", the second group without "takbeer" (WOT). 5ml of the blood of each chicken were collected in a sterile tube. The carcasses were then plucked, cleaned and stored at 4°C. 15mn after of slaughter, the first evaluation of pH was carried out by the insertion of the electrode of pH-meter in a cavity set aside in the thigh. Once in the laboratory, the blood collected was used for the determination of glucose by a referenced kit. Viscera were used later for biochemical analysis, microbiological and histological studies. 24h after the second assessment of pH was performed. The results were expressed in mean  $\pm$  standard deviation, the Act Normal for microbiology. A difference of 1 log between two analyzes was considered significant. The Fisher test was applied for the frequencies expressed in % and a  $P \leq 0.05$  was considered significant.

## 3. RESULTS

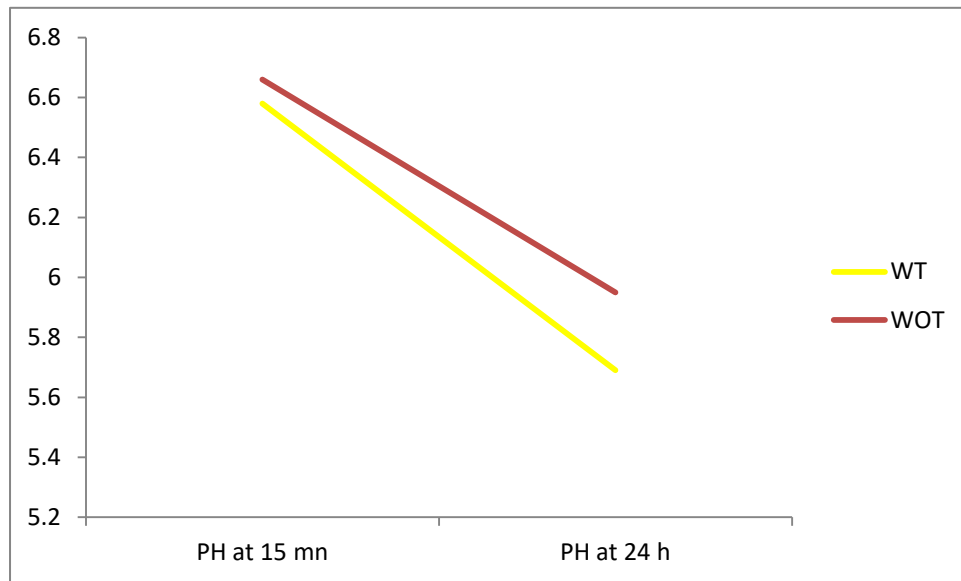
The behavior of the animal in the slaughter chain can guide us previously to its response to the stress of slaughter. The results of this study had confirmed the importance of "takbeer"

during slaughter by a significant decrease of stress expressed by a total duration of wing flapping short (9s) compared to the control group (WOT) 19s ( $p < 0.001$ ). The other criteria of behavior: the recovery of body of chicken was more common (71.60%) among individuals of group slaughtered without «takbeer» (WOT) ( $p < 0.001$ ): While the group slaughtered with "takbeer" (WT), the frequency was 40% (Figure 1). The vocalization by a cry longer and more observable in the group slaughtered (WOT): 52% than in the group (WT) with a short and low vocalization 67% ( $p < 0.05$ ).



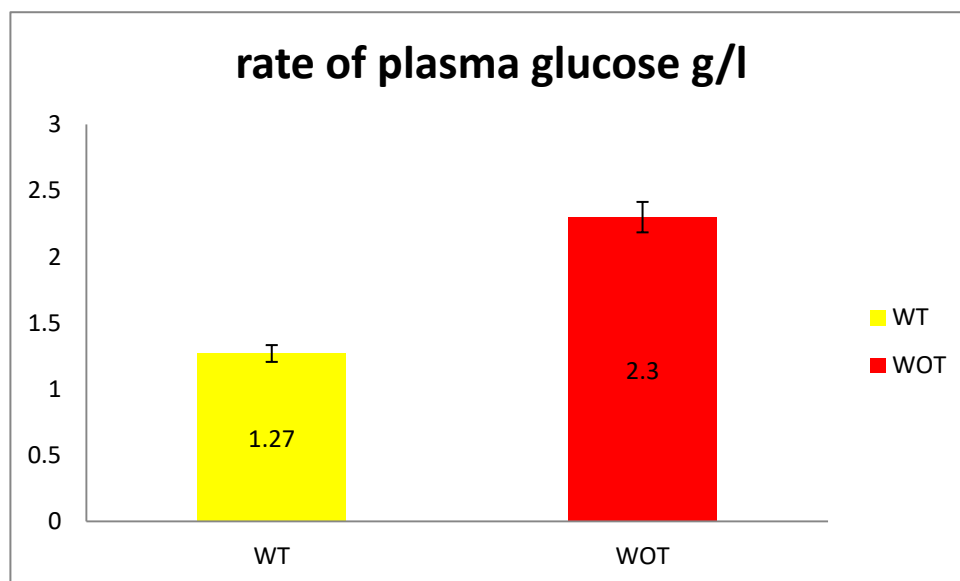
**Fig.1.** results on behavioral study in the chain of slaughter

15mn than 24h after of slaughter, pH decreased toward the acidity in the two groups of chickens. However, it was noted that meat of group (WT) had a low pH of 5.69; compared to the group (WOT) pH (6), (Figure 2).



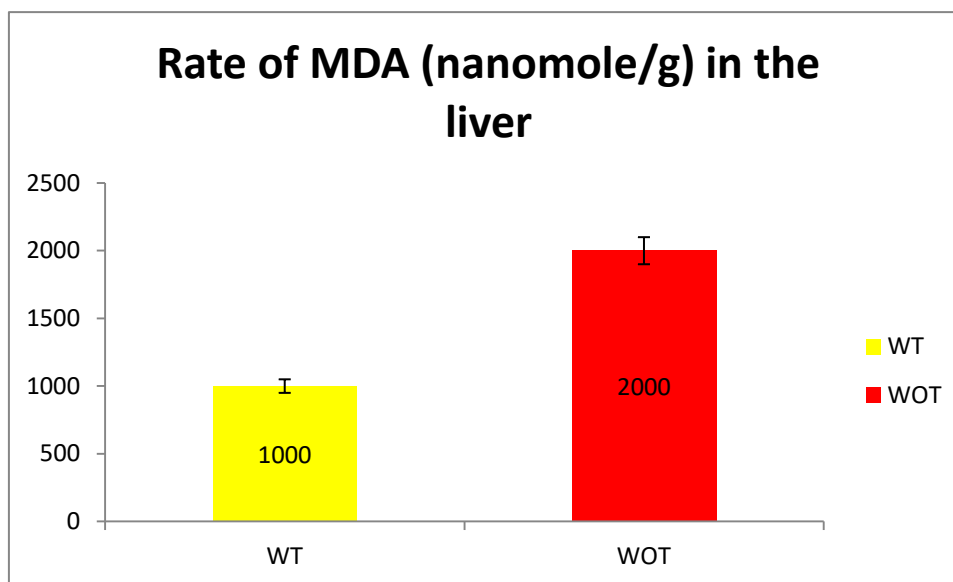
**Fig.2.** Kinetics of meat pH in the two groups of chickens

Blood glucose was 1.27 g/l in the group (WT), while the group (WOT) presented a hyperglycemia 2.3 g/l ( $p < 0.05$ ), (Figure 3).



**Fig.3.** Rate of plasma glucose in the two groups of animals

The MDA rate in the group of chickens slaughtered (WOT) was significantly higher (2000 nanomolar/g) than that the group of chickens slaughtered (WT) (1000 nanomolar/g) ( $p < 0.001$ ) (Figure 4).

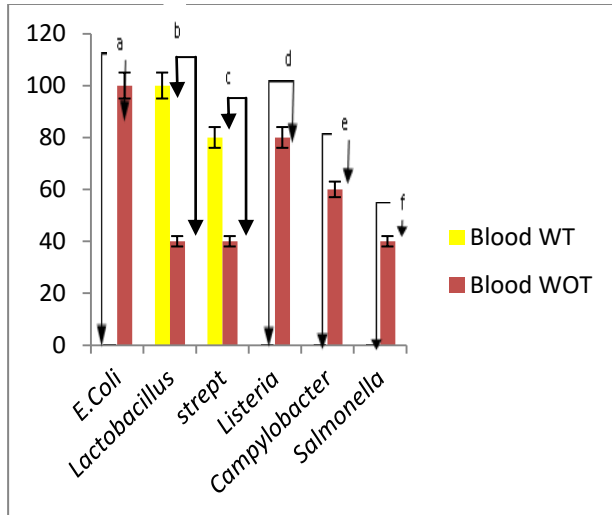


**Fig.4.** MDA rate in the liver in the two groups of chickens

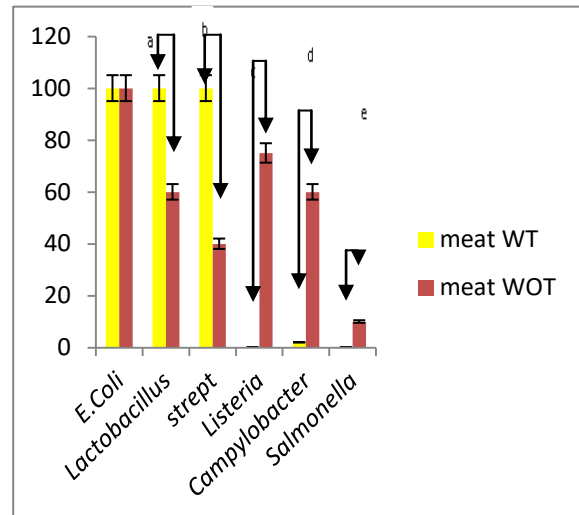
24h after slaughter, the chickens slaughtered (WT) appear whitish, without bad smell, tender, while the group (WOT) pinkish, without smell more in less rigid.

The microbiological study showed the intestines of chickens in the two groups contained the same bacteria species. However, *Lactobacillus sp* rate tract was significantly high ( $p < 0.01$ ) in chickens slaughtered (WT), than that of the chickens slaughtered (WOT). On the other hand, intestines of chickens (WOT) were significantly more contaminated by *E.coli*; *campylobacter jejuni*; *Listeria innocua*; *Salmonella sp* by elsewhere, the sulfite reducers bacteria, *Staphylococcus sp*, *Pseudomonas sp* and *Streptococci β-hemolytic* had never been isolated in intestines and internal organs of the two groups of chickens. The search and enumeration of intestinal bacteria in viceria, meat and the blood were undertaken to detect any a bacterial translocation (BT) following a stress of slaughter. Bacterial translocation was important among the group (WOT). Blood in the group (WT) was contaminated primarily by the intestinal bacteria non-pathogenic. *Lactobacillus sp* was the highest number between them. While the blood of chickens in the group (WOT) was contaminated by bacteria resident in intestine such as *E.coli*, *Streptococcus sp* and a lesser number of *Lactocacillus sp*.

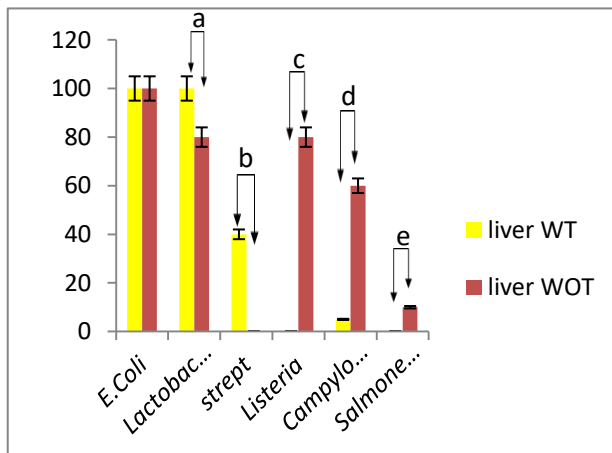
Translocation of these intestinal bacterial pathogens was absent in the group (WT), Viscera in this group was contaminated primarily by the resident bacteria of the intestine not pathogen, while the group (WOT) was contaminated by the intestinal bacteria non-pathogenic, and pathogens (*Campylobacter jejuni*, *Listeria innocua*, *Salmonella sp.* (Figure 5).



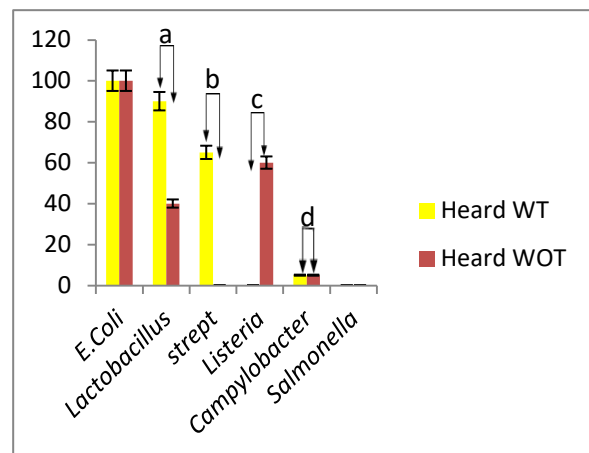
A :p<0.05 (WT vs WOT), b :p<0.05 (WT vs WOT), c :p<0.05 (WT vs WOT), d :p<0.05 (WT vs WOT), e :p<0.05 (WT vs WOT), f :p<0.05 (WT vs WOT).



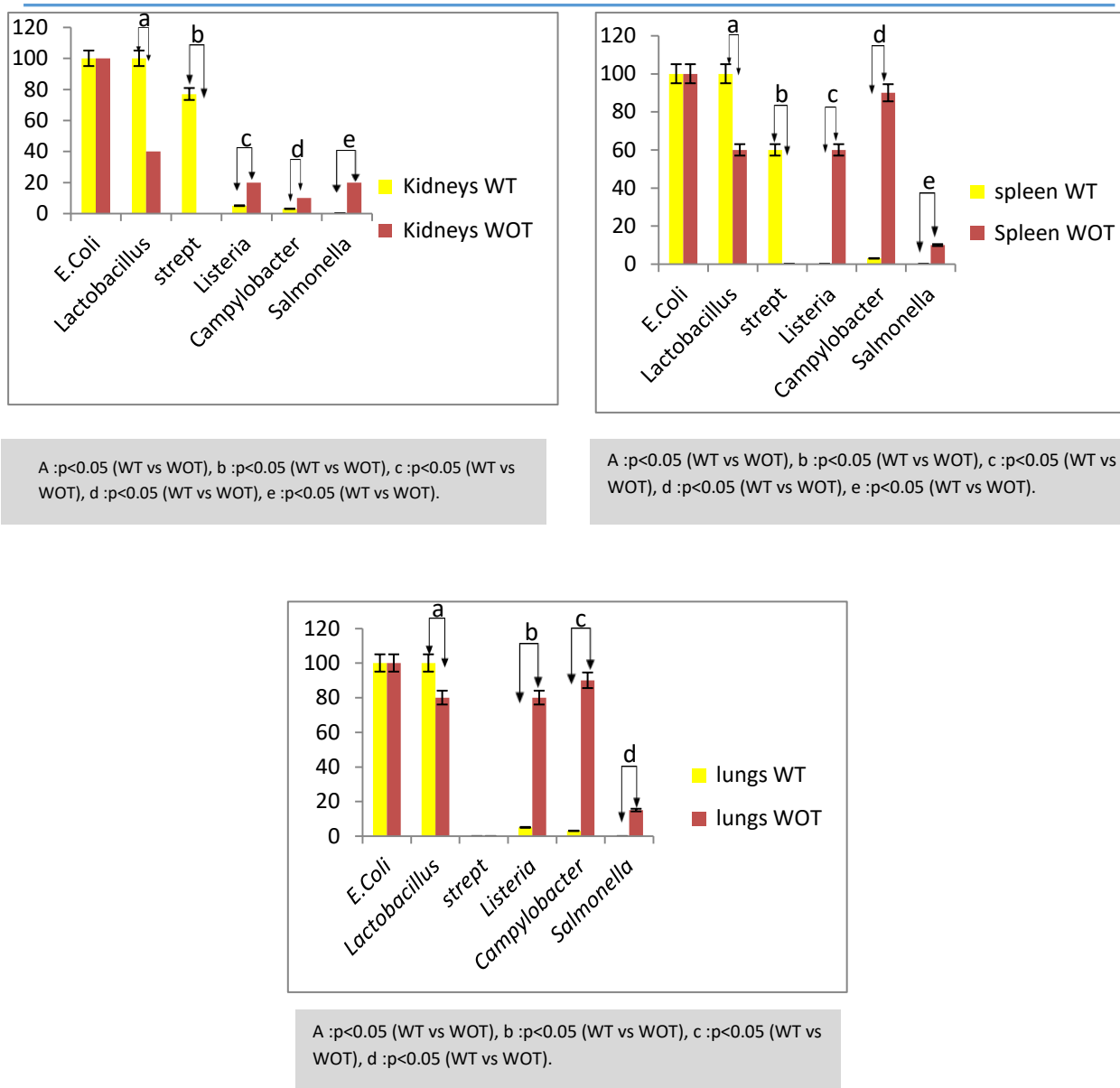
A :p<0.05 (WT vs WOT), b :p<0.05 (WT vs WOT), c :p<0.05 (WT vs WOT), d :p<0.05 (WT vs WOT), e :p<0.05 (WT vs WOT).



A :p<0.05 (WT vs WOT), b :p<0.05 (WT vs WOT), c :p<0.05 (WT vs WOT), d :p<0.05 (WT vs WOT), e :p<0.05 (WT vs WOT).



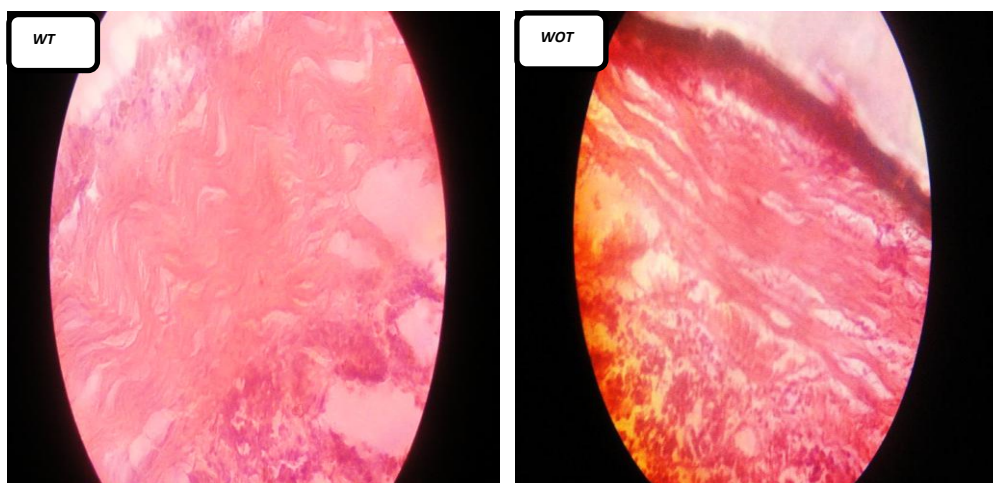
A :p<0.05 (WT vs WOT), b :p<0.05 (WT vs WOT), c :p<0.05 (WT vs WOT), d :p<0.05 (WT vs WOT).



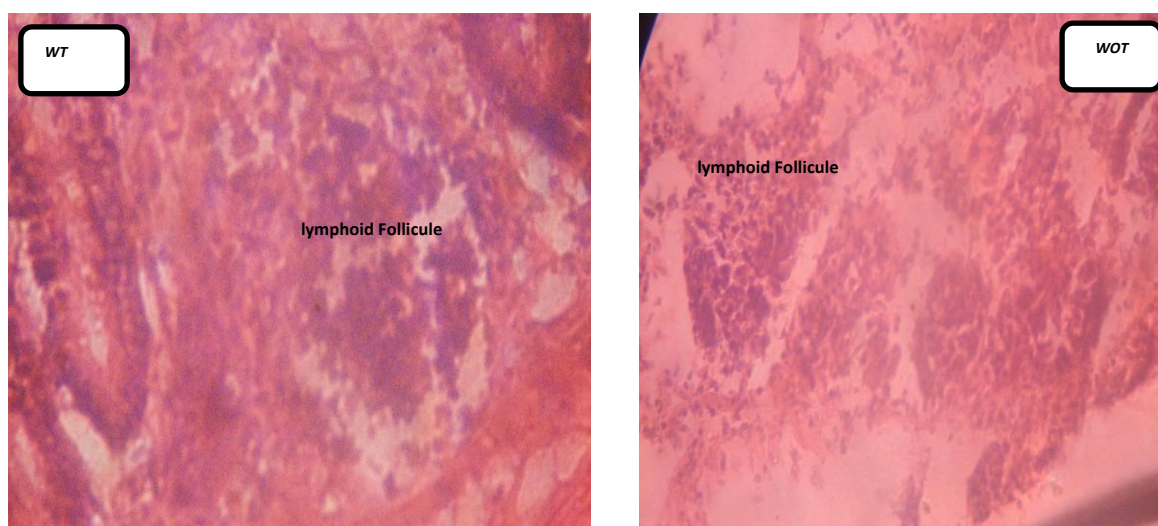
**Fig.5.** incidence of contamination of viceria in the two groups of chickens

The histological study revealed a massive cell destruction among the group slaughtered (WOT) with a deformation of muscle cells. Hyperplasia was observed in intestinal glands in the group of chickens slaughtered (WOT) and lymphoid follicles in the group of chickens slaughtered (WOT), with a very high number of Immune Cells (macrophages), (Figure 7).

It was also noted that the fibers of the muscle layer of intestinal group (WT) presented a wavy form and a very strong association between them. While the fibers of the muscle layer in the group (WOT), had a form more dropped with a malformed aspect (Figure 6).



**Fig.6.** Meat Fibers forming the muscular tunic in the two groups studied



**Fig.7.** Lymphoid follicles in ileum in the two groups of chickens

#### 4. DISCUSSION

According to "tonic immobility" test, for an extremely fearful animal is expressed by a long duration of tonic immobility- (>2mn) and the longer of duration of flapping wings is on the chain of slaughter [6]. According to the test, chickens slaughtered by "takbeer" had presented a short total duration of wing flapping which revealed a decrease in the level of stress in the group (WT).

Bendall [7] has written the balance sheet of the biochemical reactions of degradation and synthesis of ATP that occur in the muscle cell immediately after the death. It distinguishes



between two phases: the phase of latency and the installation phase of the rigor. The latency phase is characterized by the fall of the concentrations in phosphocreatine and glycogen. The ATP degraded by many ATP muscle ACSO is resynthesized by the degradation of phosphocreatine and by glycolysis. The second phase or phase of installation of the rigor is characterized by the disappearance of the ATP. In this second phase, there is no more of phosphocreatine. The whole of these reactions occurring in the muscle cell post-mortem following the liberation in the sarcoplasm of calcium ions which stimulate the activity of ATPase of the actomyosin complex, resulting in the release of inorganic phosphate, led to the accumulation of lactic acid and to the liberation of protons (H) in proportion substantially equivalent. These phenomena cause a gradual acidification of the muscle and therefore a fall of the muscle pH post-mortem which continues up to the judgment of the biochemical reactions (or glycolysis anaerobic) [8], [9]. The diminution of the pH post-mortem is characterized by its speed and its amplitude. The speed of the drop is determined primarily by the ATPase activity, then that the amplitude of the fall of the pH post-mortem depends mainly of the reserves of the muscle glycogen at the time of slaughter [7]. Indeed, depending on the level of stress which are exposed the chickens in the period of pre-slaughter can cause excessive consumption of glycolytic reserves of the muscle. Under the effect of intense stress, the mobilization of energy reserves of the muscle is more important [10], [11]. A low rate of muscle glycogen after the slaughter is reflected by an insufficient acidification of the Muscle [7]. As in the case of chickens slaughtered without "takbeer". The meat to a high pH are dark in color and therefore little attractive to the consumer. In addition, the high pH levels favor the development of microorganisms responsible for the alteration of the meat which affectst to its conservation badly [12].

The stress, in its different modalities (physical or psychological) affects the quantities of CRF released in the different organs [13] conducted by receptors to this hormone (reproductive tissue digestive, immune cells, skeletal muscle...) [14] but also in the central nervous system of the animal. The glucocorticoids represent the final product of the activation of the corticotropic axis and are the effector molecules of primary of this neuroendocrine system. These hormones present a broad spectrum of activity characterized mainly by:

- A stimulation of the neo-glycogenese which translates by an increase in blood glucose levels.
- A modulatory action on the immune system

According to our results, the chickens slaughtered without "takbeer" and which have presented a behavior stressful, and hyperglycaemia during the slaughter, confirms that chickens in this group have been intensively stressed. These results are identical to those obtained by Yamada et al. [15] on the impact of stress on the blood sugar in several animal species such as: rats, dogs, chickens...

Meat and offal (viceria) of Chickens are enriched in lipid primarily polyunsaturated fatty acids (PUFAS) during the period of the finishing. However, these inputs can foster lipoperoxidation by the oxidative stress in the meat and offal produced [16]. The process of lipoperoxidation generate not only of the metabolites terminals deteriorating the organoleptic qualities (by rancidity) and nutritional (by loss of PUFA) of meat and offal, but also of the metabolites potentially toxic to the consumer such as aldehydes or the products of oxidation of cholesterol (hydroxystérol, epoxides, kétocholestérol). The consumption of these substances has been associated with the initiation of severe pathologies, including atherosclerosis, demonstrated on models of animals [17]. This content in (MDA) in the Liver of chickens slaughtered without "takbeer," indicates the intensity of oxidative stress which has undergone the animal at the time of slaughter.

The alterations of the permeability of the intestinal epithelium promote the translocation of bacteria in the intestinal lumen to the lymph nodes mesophilic (LNM), the peritoneum, liver, spleen, the general circulation. The modalities of crossing of the intestinal epithelium by bacteria are not fully elucidated. However, there is a study which has highlighted the role of membranous enterocytes ("M cells") [18]. These specialized cells of the epithelium that covers the Peyer's patches and other lymphoid follicles of the mucosa of the absorb of bacteria in the intestinal lumen and put them in contact with macrophages and lymphocytes (T, B) follicular intra, thus introducing the immune response. This phenomenon seems well relate to a great diversity of bacterial pathogens and non-pathogens are normally present in the intestinal lumen. These bacteria are beyond the destruction by macrophages by mechanisms incompletely elucidated. They then have the opportunity to win the lymph node and the general circulation. [18]. There are mechanisms for the translocation other than the cells M, such as:

- transcellular Passages: by the alterations of the permeability of the intestinal epithelium
- intercellular Passages: by the loss of tight junctions by anomaly of proteins (their oxidation by reactive oxygen species). [19]

- most dominant bacteria in the Bacterial contamination of meat and offal of chickens slaughtered without "takbeer" is *Listeria innocua*. It is non-pathogenic for the consumer [20] but, there are previous studies which showed that the toxins of *listeria innocua* were implicated in the colorectal cancer humans [21]. These results are confirmed by the study of Khayat [22], that the blood of the meat contains substances highly carcinogenic (other than iron) that we do not know their virulence as bacterial toxins of the intestinal tract.

A survey of the European Food Safety Agency (European Food Safety Authority, EFSA), showed that 76% of the chickens tested in the European slaughterhouses in 2008 were contaminated by the *Campylobacter jejuni*, and 16% by *salmonella*. The survey was conducted in 2008 on 561 poultry slaughterhouses of the European Union (except in Greece, but also in Norway and Switzerland). 100132 inspections have been made, from the arrival of the chickens at the slaughterhouse, the output of the carcasses after slaughter. And the results are enlightening. On average, *Campylobacter* was present in the digestive tract of 71% of the chickens to their entry, and more than 10% to the output of the Slaughterhouse "Suggesting a contamination during the slaughter", indicates the report of the EFSA. 2008.

Hyperplasia of the lymphoid follicles in the small intestine (ileum) of chickens slaughtered (WOT) is due to the presence of a very large number of immune cells participating in the immune system of digestive tract (T lymphocyte, B, macrophages) [23]. The intensity of this immune participation is considered as a response to the stress of slaughter. [24]. The influence of stress on the activity of the immune system involves the sympathetic system and hypothalamo-hypophyso surrenalian involved in the response to stress. More generally, the stress aggravates inflammatory mechanisms where the immune cells recognize and respond to the hormones and neuropeptides involved in the response to stress [24]. These results are in agreement with the work of Cuvelier [25] which confirm the presence of the hyperplasia of the lymphoid follicles at the level of the small intestine of the stressed animals by the shock of hemorrhage

## 5. CONCLUSION

The present study showed, for the first time, that the ritual "takbeer» in the Islamic slaughter "takbeer" reduces the stress of slaughter and therefore generates good quality of meat.

## 6. ACKNOWLEDGEMENTS

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