EFFECT OF LASER BEAM EXPOSURE ON THE QUALITY OF CATTLE MEAT DURING COLD STORAGE

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ABSTRACT

The aim of this research is to study effect of laser exposure on the fresh cattle meat quality during cold storage with respect to survival and growth of bacteria, shelf-life and physiochemical properties. Fresh cattle meat samples were exposed to three doses (9, 18 and 27 $W.s/cm^2$) of laser beam with wavelength 450 nm. The obtained results were indicated that: 1) the total account of microorganisms of samples weren't changed at 0 (control) and 9 $W.S/cm^2$ of laser exposure dose for 5 days of cold storage period. Meanwhile, it was decreased 8.1 $x10^6$ and 8.3 $x10^6$ CFU/g. of 18 and 27 $W.s/cm^2$ laser exposure dose of meat sample, respectively, at extended shelf life of 10 and 15 days of cold storage period, comparing in control sample which was 3.6 $x10^6$ CFU/g. at 5 days of cold storage period. Also, the physiochemical properties of samples were taken the same trend, 2) the samples were rejected of 0 (control), 9, 18 and 27 $W.s/cm^2$ of laser exposure dose at 10, 15, and 20 days of cold storage period, because of the total account of microorganisms of meat was higher than within the acceptable limits. 3) the total account of microorganisms and physiochemical properties of sample at 18 and 27 $W.s/cm^2$ laser dose were within the acceptable limits, and these results lead to increase the beef meat shelf life about 10 and 15 days, comparing with control sample at 5 days of cold storage period., and 4) laser beam exposure can be used to increase shelf life and inspection of meat quality.

Key words: *laser exposure, cattle meat quality, cold storage and physiochemical properties.*

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1.INTRODUCTION:

Meat can be define as the whole or part of the carcass of any buffalo, camel, cattle, deer, goat, hare, sheep and poultry, or rabbit, slaughtered, but dose not include eggs, or fetuses (**Williams, 2007**). The hot and humid climate of Egypt is quite favorable for the growth of numerous insects and microorganisms that destroy stored food and cause spoilage of it. Spoilage can also occur due to chemical and physiological changes during storage of foods especially beef. The fresh meat and meat products are commonly marketed at refrigerated temperatures (2–5°C). However, many undesirable changes of the products can occur during refrigeration due to microbial growth and lipid oxidation, which give rise to quality reduction, meat spoilage, and economic loss. (**U.S. Department of Agriculture and foreign agriculture service, 2013**). Recently, a world has been looking for development in technology. LASER is one of these technologies, and there are many applications at several fields such as agriculture, communication and medicine (**Du and Sun, 2005**).

Cozzolino and Murray (2004) showed that applied VIS/NIR 400–2500 nm spectra for classifying the meat from beef, lamb, pork, and chicken achieved accuracy was over 80%.

Adams and Moss (2008) concluded that contamination of the meat of slaughtered animals by processing equipments, knives and workers however, less important than contamination from the animals themselves.

Perez-Marin et al. (2009) mentioned that applied NIR for all stages of pigs: the live animal, carcass in slaughterhouse, subcutaneous fat sample with skin, skin-free subcutaneous fat sample, and transverse section.

Aleksić et al. (2011) stated that factors affecting the quality of meat can be divided into ante-mortem (genetic background, housing, nutrition, disease and etc.) and post-mortem (slaughtering procedure, storage and cooling of meat).

Ameral et al. (2013) concluded that the optical methods have the greatest potential since they are fast, nondestructive, and generally low cost. Potential application of laser bio-speckle technique and its methods of image processing can be used to assess and quantify biological phenomena related to beef aging and evaluating quality of meat color.

Gap-Don et al. (2013) referred to the most quality traits such as drip loss, cooking loss, tenderness, lightness, redness, and moisture content were affected by freeze-thawing. Exudates were positively correlated with total protein content and total plate count but negatively correlated with pH and cooking loss.

Marcos et al. (2013) said that the surface enhanced laser desorption/ionization time of flight mass spectrometry (SELDI-TOF-MS) considered useful tool to obtain the soluble protein profiles of Longissimus Thoracis (LT) muscles of fresh pork.

Schmidt et al. (2013) approved that the prototype handheld Raman system can be used as a rapid non-invasive optical device to measure raw sheep meat to estimate cooked meat tenderness and cooking loss. The results showed the potential usefulness of Raman spectra which can be recorded during meat processing for the prediction of quality traits such as tenderness and cooking loss.

Wang and Li (2013) referred to the coherent laser has been considered as one of the standard light sources for measuring the optical properties of living tissues.

The objective of the study was to determine the laser exposure effect upon the chemical, physical and color changes in beef meat during cold storage period and to evaluate microbiological quality of laser exposure beef samples during cold storage period.

2. MATERIALS AND METHODS:

Sample preparation:

The fresh cattle samples were obtained from local slaughter house. It was taken from a single male cattle carcass of Egyptian native cattle (Baladi Bullocks), under Egyptian conditions. With (approximately 22 months of age and 430 kg live weight). The cattle samples were taken from the right carcass side (top round) and were brought to laboratory in cold iced foam box within (24-h post-mortem). Samples were divided into portions about 200 g weights (2 cm thickness) and packed in tightly sealed polyethylene pouches (15 cm L x10 cm W) under atmospheric condition and stored at $1\pm4°$ C for 5, 10, 15 and 20 days of cold storage, which carried out through-2014.

Laser setup:

The experimental setup was developed and assembled in the Laboratory of Laser Application in Agriculture Engineering at National Institute of Laser Enhanced Science (NILES), Cairo University, Egypt. It consists of laser source, beam expander and holders as shown in Fig.(1). Diode laser in the blue visible light with continuous wavelength 450 nm was used, the output power 5000 mW. The diode laser used gives high intensity to cover the entire cattle meat samples surface area, including the boundaries by using the beam expander.
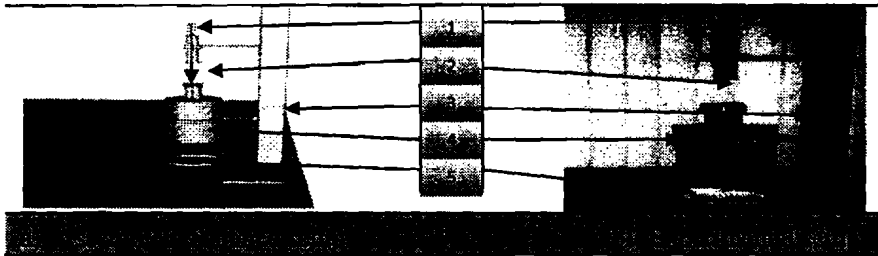
1- Laser source, 2- Laser beam, 3- Copper holder, 4-Beam expander and 5- Cattle sample

Fig. (1): The assembled designed and the experimental setup of laser exposure for cattle samples.

Laser exposure treatment:

Cattle samples were subjected to different doses of laser beam. The power intensity was determined prior to laser exposure treatment, according to (**Al-Watban et al., 2007**) by measuring the laser power (W) and the laser spot size (cm^2) and it was calculated from the following equations (1).

$$P_I = \frac{W}{A} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: P_I: Power intensity in W/cm^2; **W**: Laser power 5000mW and **A**: Laser spot size 10 cm^2

The exposure dose of laser beam was determined from the power intensity and the exposure time of laser beam with the cattle meat surface, according to (**Al-Watban et al., 2007**) and it was calculated from the following equation (2)

$$I = P_i\ (T) \dots\dots\dots\dots\dots\dots (2)$$

Where: **I**: Laser exposure dose in $W.sec/cm^2$; P_i: Power intensity in $W/cm2$ and **T**: exposure time (180, 360 and 540 seconds).

Variable exposure times were employed to provide different laser doses of 9, 18 and 27 $W.s\ /cm^2$ to be applied to the surface of the beef meat samples.

Cattle samples were treated on each side, therefore a total laser dose of first treatment $(9W.s/cm^2) = 2 \times 4.5W.s/cm^2$ according to **(Sommers et al., 2010) and (Escalona et al., 2010).**

Storage process:
Treated and non-treated cattle meat samples were immediately refrigerated stored at $4\pm1°C$ and subjected to the periodical analysis at 0, 5, 10, and 20 days intervals.
Chemical analysis:

Chemical analyses include of moistures content, protein, collagen, fat, pH value and thiobarbituric acid value (TBA), were measured as the following:

Moisture content, protein, fat and collagen percentages:

Sample chemical analysis was performed using Food Scan™ Pro meat analyzer (Foss Analytical- A/S, Model 78810, and Denmark).

pH measurement, it was measured after 24hr post-chilling using 5g of meat according to the following methodology described by **(Abdel-Aziz, 2006).** The pH of the obtained suspension was measured by Micro-processor pH meter (pH211, Hanna instruments, Italy).

Thiobarbituric acid test, it was used to determine the extent of lipid oxidation in chilled beef samples, and the average values were reported as (mg malonaldehyde per kg beef sample). The method for analysis was described by **(Vyncke, 1970).**

Physical characteristics:

Water holding capacity percentage, it was measured according to (Sami, 2001). Water holding capacity (%) can be calculated by the following equation (3):

$$\text{Water holding capacity, } \% = \frac{W1 - W2}{W1} \times 100 \quad \ldots\ldots (3)$$

Where: **W1**= Weight of meat sample before measuring, g and **W2**= Weight of meat sample after measuring, g.

Cooking loss percentage, it was determined using two cubes of beef about 100 g, (W3). After boiled process, then beef cooked samples were left to be cool at room temperature. Samples were re-weighed (W4) according to the method described by (**Sami, 2001**). The Cooking loss (%) content can be calculated by the following equation (4):

$$\text{Cooking loss, } (\%) = \frac{W3 - W4}{W3} \times 100 \quad \ldots\ldots (4)$$

Where: **W3**= Weight of meat sample before measuring, g and **W4**= Weight of meat sample after measuring, g.

Shear force, after measuring cooking loss, the cooked samples were used for determining the shear force (kgf) by using Instron Universal Testing Machine (Model 2519-105, USA) according to the procedure outlined by (**Shackelford et al., 2004**).

Color properties:

Meat color was measured using Croma meter (Konica Minolta, model CR 410, Japan). Color was expressed using the CIE L, a, and b color system (**CIE, 1976**). a values measure redness (positive a value indicates a reddish color, while negative value measures greenish); and b values measure yellowness (positive b value indicates a more yellowish color, while negative value measures blueish).

Color measurements:

Light intensity value, a total of three spectral readings were taken for each sample on different locations of the muscle. L (lightness) values

measure (higher L value indicates a white color, while lower L value indicates a black color);

Hue degree (φ), defined as the angle between the hypotenuse and 0˙ on the (blue-green / red-yellow) axis, according to **(Balkeniues et al., 2003).** Hue angle degree can be computed from the following equation (5):

$$\varphi = \tan^{-1}(b/a) \dots\dots\dots\dots (5)$$

Where: **a,** (red-green) axis, values and **b:** (yellow-blue) axis, values.
Saturation (σ) was referred to color saturation according to **(Balkenius et al., 2003).**
This can be calculated from the following equation (6)

$$\sigma = \sqrt{(a)^2 + (b)^2} \dots\dots\dots\dots (6)$$

Microbiological analysis:
The standard method and suitable culture media were used for the microbiological analysis, the counting of microbial colonies was carried out after 48 h incubation and results were expressed as log values and reported before exceeding acceptable limits, **(ISO 4833, 2003).**

3. RESULTS AND DISCUSSION:

Fig.(2) shows that effect of laser exposure dose on chemical composition of meat during cold storage.

The moisture content percentage of control samples decreased from 77.63, 77.23 and 75.68% and sample of 9 W.s/cm^2 dose, it was 77.61, 77.2 and 75.66% for 0, 5th, 10th days respectively. For 18 W.s/cm^2 dose, it was 77.51, 76.98, 75.41, and 75.24% for 0, 5th, 10th and 15th days, respectively. For 27 W.s/cm^2 dose, it was 77.39, 76.61, 75.3, 75.22 and 74.92% for 0, 5th, 10th, 15th and 20th days of cold storage period, respectively.

The protein percentages of meat samples were slightly affected by laser exposure dose. Where, the protein percentage of control meat sample decreased from 21.31, 20.62 and 19.99 % and sample of 9 W.s/cm^2 dose, it was 21.29, 20.58 and 19.99 % for 0, 5th and 10th days, respectively. For

18 W.s/cm^2 dose it was 21.27, 20.51, 19.96 and 19.35% for 0, 5th, 10$^{th \, and}$ 15th days, respectively. For 27 W.s/cm^2 dose, it was 21.25, 20.49, 19.65, 19.32 and 19.07 % for 0, 5th, 10th, ^{15th} and 20th day of cold storage period respectively.

The moisture content/protein (MC/P) ratio proportionally was changed by the applied laser exposure doses and cold storage time; the MC/P ratio of control meat sample increased from 3.64, 3.74 and 3.78 and sample of 9 W.s/cm^2 dose, it was 3.64, 3.75 and 3.78 for 0, 5th and 10th days, respectively. For 18 W.s/cm^2 dose, it was 3.64, 3.75, 33.78 and 3.89 for 0, 5th, 10th and 15th days, respectively. For 27 W.s/cm^2 dose, it was 3.64, 3.74, 3.83, 3.89 and 3.93 for 0, 5th, 10th, 15th and 20th day of cold storage, respectively.

The collagen percentages slightly decreased as increased of laser exposure dose and cold storage period for meat samples. The collagen percentage of control samples decreased from 2.29, 1.87 and 1.79 % and sample of 9 W.s/cm^2 dose; it was 2.22, 1.8 and 1.75% for 0, 5th and 10th days, respectively. For 18 W.s/cm^2 dose, it was 2.15, 1.84, 1.74 and 1.68% for 0, 5th, 10th and 15th days, respectively. For 27 W.s/cm^2 dose, it was 2.1, 1.81, 1.72, 1.67 and 1.65% for 0, 5th, 10th, 15th and 20th days, respectively.

From the above results, it was found that the higher laser exposure dose lead to the lower rate of moisture content, collagen and protein percentage and the higher (Mc/P) ratio of treated meat samples.

Fig.(3) shows that the effects of laser exposure dose on chemical compositions (fat content, pH and TBA values) of meat during cold storage.

The fat content under the laser exposure doses and cold storage conditions was decreased, where the fat percentage of control meat samples decreased from 2.87, 2.76 and 2.42% and sample of 9 W.s/cm^2 dose, it was 2.85, 2.75 and 2.41% for 0, 5th and 10th days, respectively. For 18 W.s/cm^2 dose, it was 2.82, 2.71, 2.6 and 2.51% for 0, 5th, 10th and 15th days, respectively. Whereas, for 27 W.s/cm^2 dose, it was 2.78, 2.69, 2.57, 2.49 and 2.44 % for 0, 5th, 10th, 15th and 20th days of cold storage, respectively.
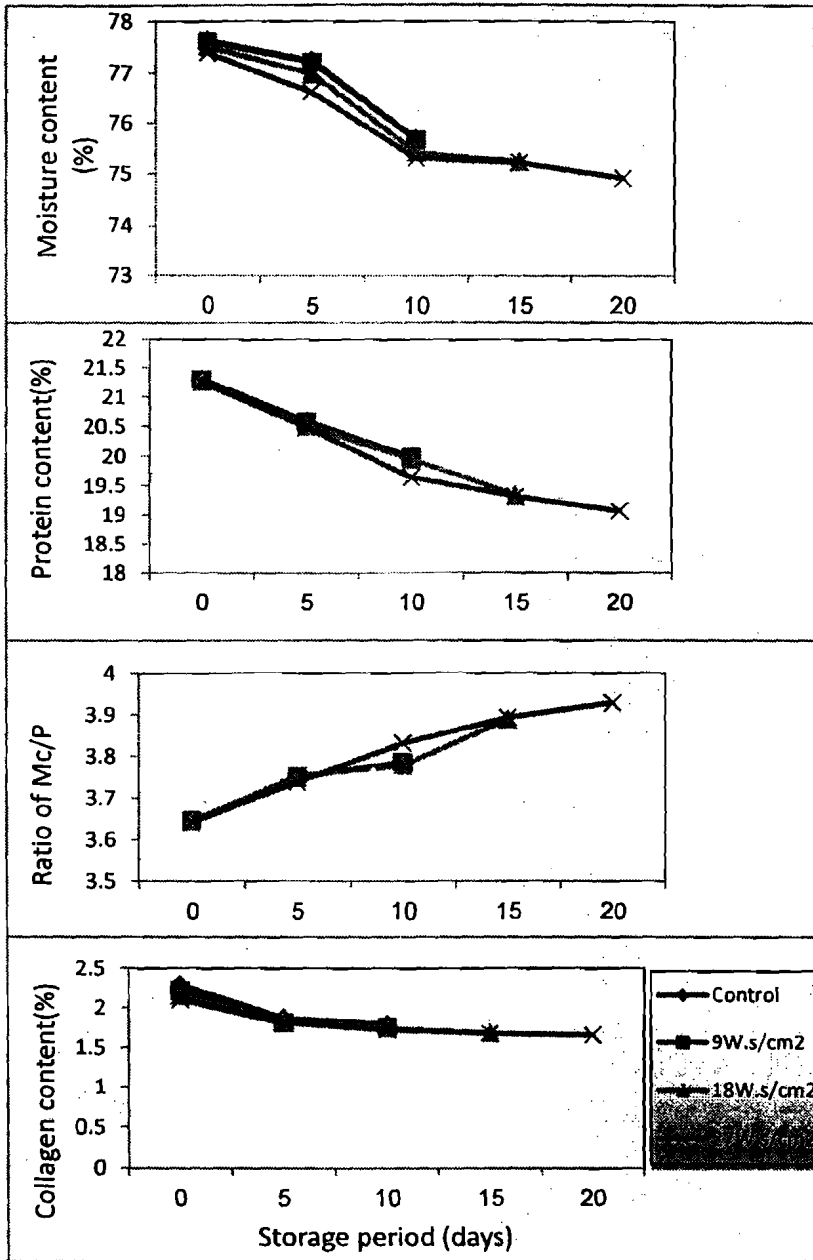
Fig.(2): Effect of laser exposure on moisture content, protein, collagen and Mc/p ratio of cattle meat during cold storage.
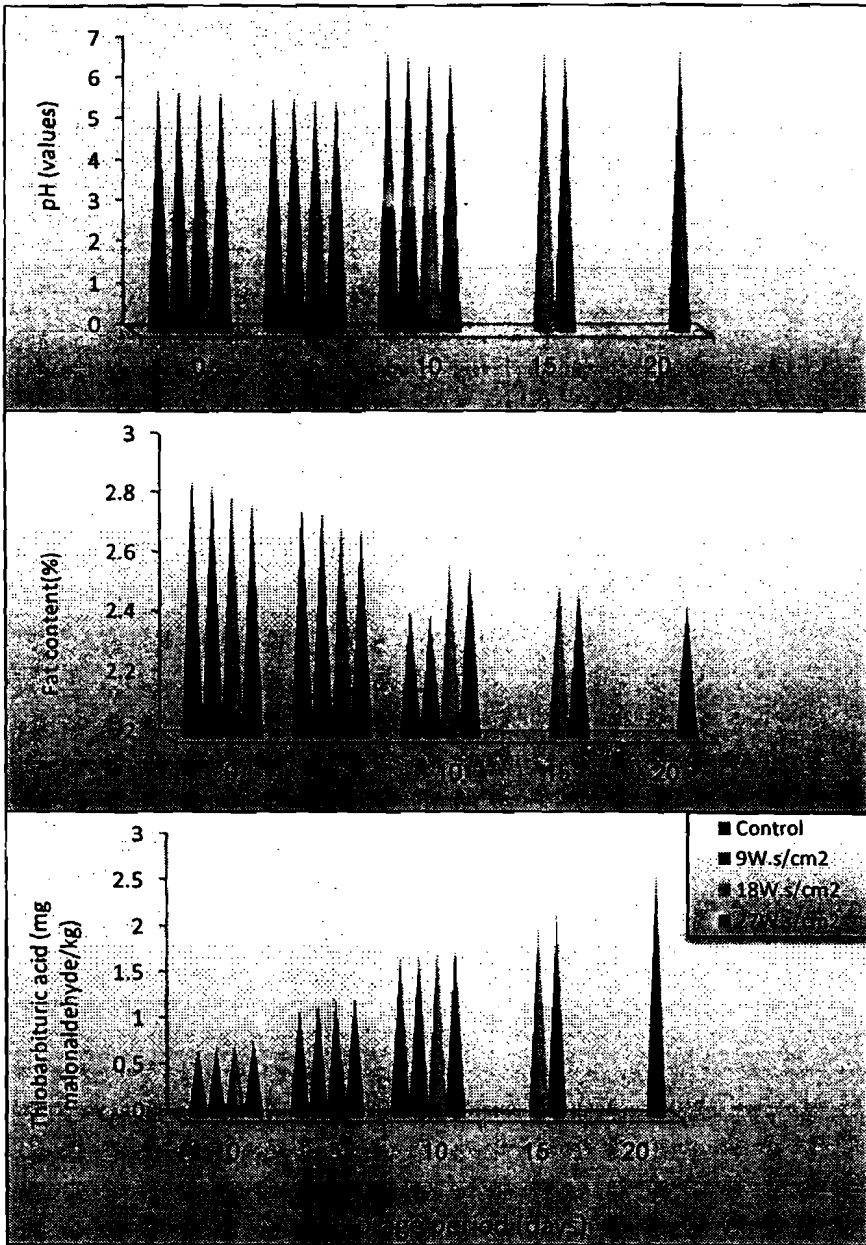
Fig.(3): Effect of laser exposure doses on pH, fat and thiobarbituric acid of cattle meat during cod storage.

The pH values of treated samples by laser were lower than the untreated ones and increasing by storage time. The pH value of control cattle sample increased from 5.86, 5.67 and 6.74 and sample of 9 $W.s/cm^2$ dose, it was 5.85, 5.66 and 6.75 for 0, 5th and 10th days, respectively. For 18 $W.s/cm^2$ dose, it was 5.83, 5.63, 6.68 and 6.73 for 0, 5th, 10th and 15th days, respectively. For 27 W.s/cm2 dose, it was 5.82, 5.61, 6.65, 6.7 and 6.79 for 0, 5th, 10th, 15th and 20th days of cold storage, respectively.

The behavior of the thiobarbituric acid values (TBA) of laser exposure meat sample showed progressively increased associated with the higher laser exposure dose; the TBA value of control sample was increased from 0.73, 1.13 and 1.81mg malonaldehyde/kg and sample of 9 $W.s/cm^2$ dose, it was 0.76, 1.19 and 1.74 mg malonaldehyde/kg for 0, 5th and 10th days, respectively. For 18 $W.s/cm^2$ dose, it was 0.79, 1.23, 1.78 and 2.01 mg malonaldehyde/kg for 0, 5th, 10th and 15th days, respectively. For 27$W.s/cm^2$ dose, it was 0.82, 1.29, 1.82, 2.19 and 2.61mg malonaldehyde/kg for 0, 5th, 10th, 15th and 20th days of cold storage, respectively.

From the above results it was found that, during subsequent cold storage at $4\pm1°C$ the fat content and pH values of cattle meat samples decreased with an inverse relationship to the applied laser exposure doses; while, the TBA values increased progressively associated with the higher laser exposure doses.

Fig.(4) shows that the effect of laser exposure doses on the physical characteristics (cooking loss, water holding capacity and shear force) of meat samples.

The cooking loss percentage of control meat sample decreased from 46.44, 45.21 and 36.41% and sample of 9 $W.s/cm^2$ dose, it was 46.43, 45.19 and 36.39% for 0, 5th and 10th days, respectively. For 18 $W.s/cm^2$ dose, it was 46.41, 45.1, 36.13 and 36.02% for 0, 5th, 10th and 15th days, respectively. For 27 $W.s/cm^2$ dose, it was 46.37, 44.95, 36.06, 35.94 and 35.73% for 0, 5th, 10th, 15th and 20th days of cold storage, respectively.

The water holding capacity (WHC) of treated samples during cold storage, were lower than the untreated. The WHC percentage of control samples decreased form 77.69, 72.66 and 73.47% and sample of 9 $W.s/cm^2$ dose, it was 77.67, 72.59 and 73.46% for 0, 5th and 10th days
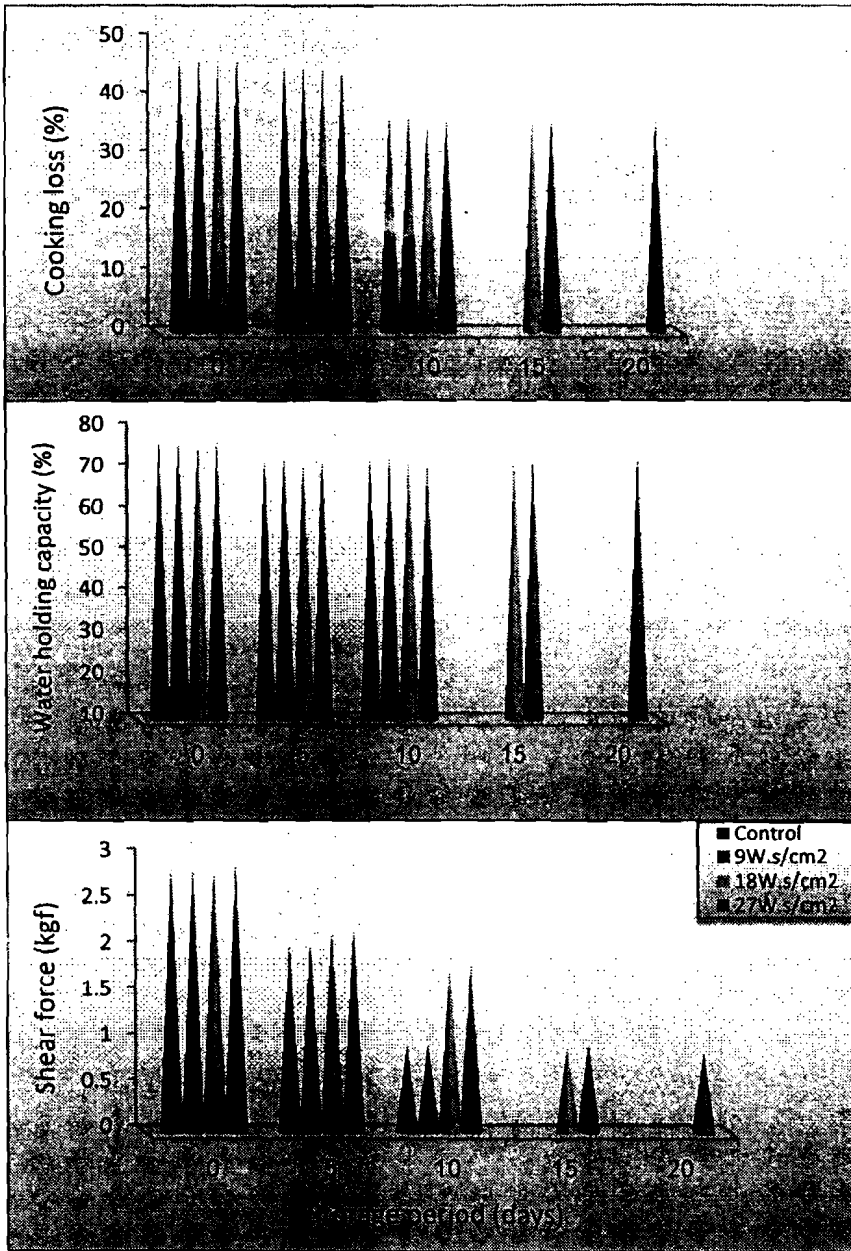
Fig.(4) :Effect of laser exposure doses on cooking loss, water holding capacity and shear force of meat during cold stotage.

respectively; at 18 $W.s/cm^2$ dose achieved values form 77.57, 71.89, 72.35 and 72.82% for 0, 5th, 10th and 15th days of cold storage, respectively. For 27 $W.s/cm^2$ dose, it was 77.49, 71.83, 72.31, 72.78 and 73.31% for 0, 5th, 10th, 15th and 20th days of cold storage respectively.

The shear force value of control sample decreased from 2.86, 2.03 and 0.94 kgf and sample of 9 $W.s/cm^2$ dose, it was 2.87, 2.05 and 0.95 kgf for 0, 5th and 10th days respectively. For 18 W.s/cm2 dose, it was 2.89, 2.16, 1.77 and 0.93 kgf for 0, 5th, 10th and 15th days, respectively; whereas at 27 W.s/cm2 dose, it was 2.91, 2.18, 1.81, 0.96 and 0.87 kgf for 0, 5th, 10th, 15th and 20th days of cold storage respectively.

Form the above data it is noticeably that, the higher laser exposure doses lead to the lower WHC and cooking loss percentages and the higher shear force values of treated beef meat samples

comparison in control sample.

Fig.(5) illustrates that the color attributes of meat as affected by laser exposure doses during cold storage.

The light intensity values of meat sample has been effected by laser exposure doses upon cold storage time; The light intensity value of control sample decreased from 37.21, 29.72 and 29.03value and sample of 9 $W.s/cm^2$ dose, it was 37.2, 29.71 and 29.05 value for 0, 5th and 10th days, respectively. For 18 $W.s/cm^2$ dose, it was 36.95, 35.1, 32.25 and 31.02 value for 0, 5th, 10th and 15th days, respectively. By applied of 27 $W.s/cm^2$ dose, it was 36.89, 34.94, 32.22, 30.88 and 29.61 value for 0, 5th, 10th, 15th and 20th days of cold storage, respectively.

The results show also that, the saturation values of meat sample were increased by the laser exposure doses and decreased during cold storage period, the saturation value of control samples was decreased from 31.05, 22.05 and 19.72 value and for sample of 9 $W.s/cm^2$ dose, it was 31.07, 22.01 and 19.73 value for 0, 5th and 10th days, respectively. For 18 $W.s/cm^2$ dose, it was 31.8, 23.72, 22.68 and 19.75value for 0, 5th, 10th and 15th days, respectively. For 27 $W.s/cm^2$ dose, it was 31.95, 23.68, 22.79, 22.06 and 19.76value for 0, 5th, 10th, 15th and 20th days of cold storage, respectively.

The Hue degrees of meat sample were slightly increased by the laser exposure doses during cold storage period. The Hue degree of control sample increased from 25.04, 27.01 and 29.31degree and sample of 9 $W.s/cm^2$ dose, it was 25.05, 27.02 and 29.32 for 0, 5th and 10th days, respectively. For 18 $W.s/cm^2$ dose, it was 25.31, 27.31, 28.95 and 29.42 degree for 0, 5th, 10th and 15th days, respectively. For 27 $W.s/cm^2$ dose, it was 25.36, 27.39, 29.1, 29.17 and 29.55 degree for 0, 5th, 10th, 15th and 20th days of cold storage, respectively.

From the above results, it was found the higher laser exposure dose lead to the lower light intensity and higher saturation values and hue degrees of treated beef meat samples.

Fig.(5) shows the relationship of total bacterial counts(TBC) in fresh meat at laser exposure doses during cold storage.

The total bacterial count (TBC) of treated and untreated meat samples were gradually increased during cold storage at $4+1^{o}C$ according to the borderline of **(Seydim et al., 2006)** the maximum values allowed in ground ostrich meat is 10^7 to 10^8 CFU/g which associated with an off-odor and possible slime development, the total bacterial count of control meat sample increased from $4.2x10^5$, $3.6x10^6$ and $3.1x10^7$ CFU/g and sample of 9 $W.s/cm^2$ dose, it was $1.2x10^5$, $2.4x10^6$ and $.9x10^7$ CFU/g for 0, 5th, 10th days, respectively. For 18 $W.s/cm^2$ dose, it was $7.1x10^4$, $6.9x10^5$, $8.1x10^6$ and $2.6x10^7$ CFU/g for 0, 5th, 10th and 15th days, respectively. For 2 $W.s/cm^2$ dose, it was $1.5x10^4$, $7.4x10^4$, $9.7x10^5$, $8.3x10^6$ and $2.6x10^8$ CFU/g for 0, 5th, 10th, 15th and 20th days of cold storage, respectively.

From the above results; it was clearing that, the higher laser exposure dose had obvious effect to extend shelf lives and lower TBC rate of treated meat sample, where the extend shelf lives were did not change (5 days) for control and sample of 9 $W.s/cm^2$ dose. While, shelf lives were 10 and 15 of $18W.s/cm^2$ and 27 $W.s/cm^2$, respectively. But, the meat sample of control, 9, 18 and 27 $W.s/cm^2$ were rejected at 10, 10, 15 and 20 day, respectively.
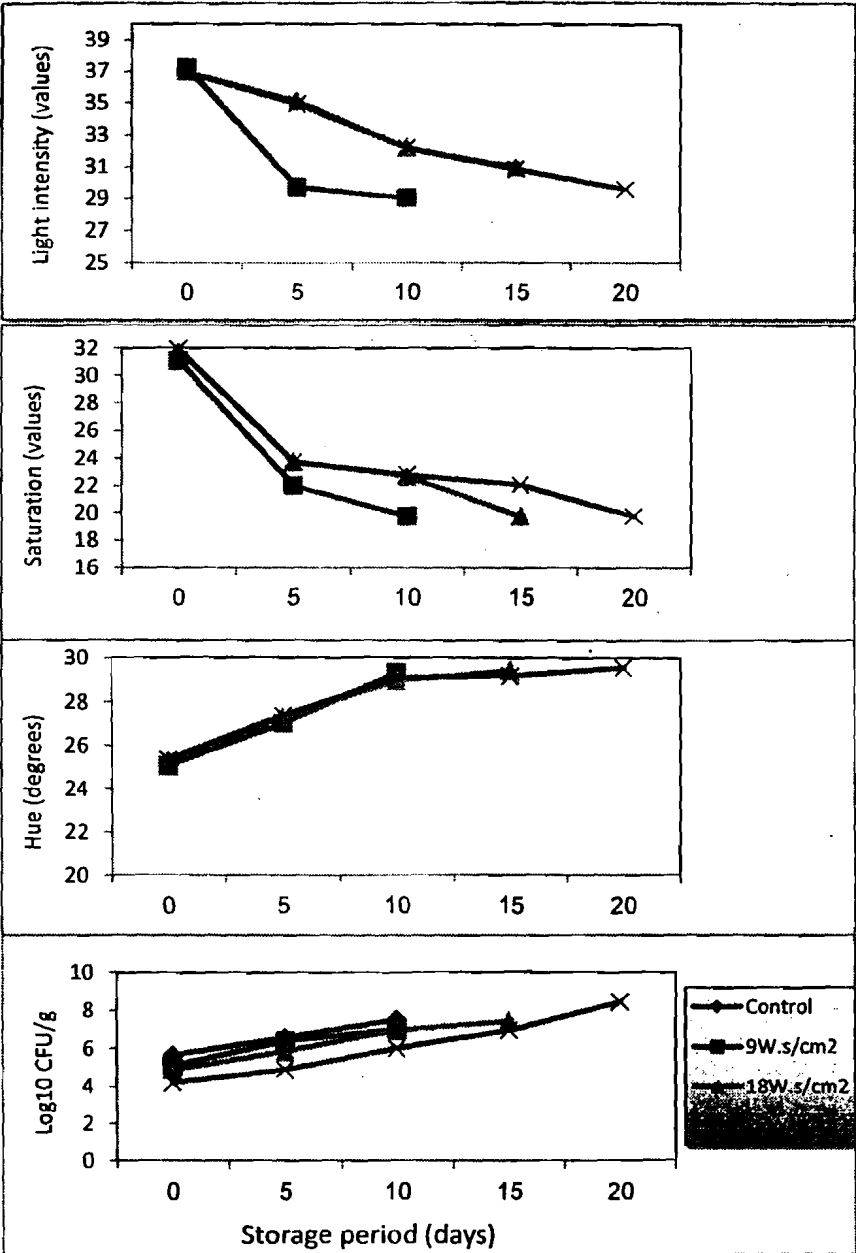
Fig.(5): Effect of laser exposure doses on color attributes (light intensity, saturation values and Hue degree) and total bacterial count of cattle meat during cold storage.

4. CONCLUSIONS:

The results of the present study can be summarized as follows:

1) Laser beam was leaded to reduce the total account of microorganisms 1.2×10^5, 7.1×10^4 and 1.5×10^4 CFU/g for 9, 18 and 27 W.s/cm^2, respectively. Meanwhile, shelf lives were did not change (5 days) for control and sample of 9 W.s/cm^2 dose. While, shelf lives were 10 and 15 of 18 W.s/cm^2 and 27 W.s/cm^2, respectively.

2) For the chemical properties the moisture content decreasing from 77.63 to 77.61, 77.51 and 77.39%; protein content from 21.31 to 21.29, 21.27 and 21.25%; collagen content from 2.29 to 2.22, 2.15 and 2.1% and fat content form 2.87 to 2.85, 2.82 and 2.78%; pH values from 5.86 to 5.85, 5.83 and 5.82. Meanwhile, there were increasing at TBA values from 0.73 to 0.76, 0.79 and 0.82 mg malonaldehyde/1kg by laser exposure during cold storage period days for control and laser exposure doses 9, 18 and 27 W.s/cm^2 respectively.

3) The physical parameters like cooking loss were slightly decreasing from 46.44 to 46.43, 46.41 and 46.37%; water holding capacity was from 77.69 to 77.67, 77.57 and 77.49%. Meanwhile, the share force was increased form 2.86 to 2.87, 2.89 and 2.91 kgf for control and laser exposure doses 9, 18 and 27 W.s/cm^2 of treated beef samples during cold storage respectively.

4) For color properties laser irradiated samples had higher Hue degree from 25.04, 25.05, 25.31 and 25.36 degree and saturation values from 31.05 to 31.07, 31.8 and 31.95. Meanwhile, lightness values decreased from 37.21 to 37.2, 36.95 and 36.89 for control and laser exposure doses 9, 18 and 27 W.s/cm^2 respectively.

5) It was concluded that laser beam had obvious impacts on microbial quality, extend shelf-life, chemical and physical parameters and color attributes of fresh cattle meat during cold storage.

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<u>الملخص العربى</u>

تأثير التعرض لشعاع الليزر على جودة لحم البقر الطازج خلال التخزين المبرد

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الهدف من هذا البحث دراسة تأثير أشعة الليزر على جودة لحوم البقر الطازجة المخزنة على (٤±١ درجة مئوية) وتأثيرها على النمو البكتيري، ومدة الصلاحية للأستهلاك والمحتوى الكيميائي و الفيزيائى. تم إجراء التحليل الطبيعى والكيميائى والبكتريولوجى للعينات بمجمع المعامل البحثية، كلية الزراعة ، جامعة القاهرة ،تم تعريض عينات الحم البقرى الطازجة لثلاثة جرعات (٢٧،١٨،٩ وات ثانية/سم[٢]) من أشعة الليزر ذو الطول الموجى ٤٥٠ نانوميتر تمت بالمعهد القومى لعلوم الليزر ، جامعة القاهرة ، مصر ، خلال ٢٠١٤... أظهرت النتائج المتحصل عليها الاتى:

١) لم يحدث تغير فى العدد الكلى للكائنات الحية الدقيقة في عينات اللحم البقرى الغير معاملة والمعاملة بجرعة أشعة الليزر ٩ وات ثانية/سم[٢] لمدة ٥ أيام خلال التخزين المبرد .. بينما إنخفض العدد الكلى للكائنات الحية الدقيقة في عينات لحم البقر الى ٨,١ x ١٠[٦] ، و ٨,٣ x ١٠[٦] وات ثانية/سم[٢] فى العينات المعاملة بجرعات أشعة الليزر ١٨، و٢٧ وات ثانية/سم[٢] على الترتيب عند فترة نصف العمر ١٠ و ١٥ يوم خلال التخزين المبرد ، مقارنة بعينة الكنترول والتى كانت ٣,٦ x ١٠[٦] وات ثانية/سم[٢] لمدة ٥ أيام خلال التخزين المبرد كما أخذت الخصائص الفيزوكيميائية نفس الأتجاة.

١. أستاذ الهندسة الزراعية ـ المعهد القومى لعلوم الليزر ـ جامعة القاهرة ـ مصر.

٢. أستاذ الهندسة الزراعية ـ معهد بحوث الهندسة الزراعية ـ مركز البحوث الزراعية ـ مصر.

٣. أستاذ العلوم البيولوجية ـ المركز القومى لبحوث و تكنولوجيا الاشعاع ـ هيئة الطاقة الذرية ـ القاهرة ـ مصر.

٤. أستاذ مساعد البيوتكنولوجى ـ المعهد القومى لعلوم الليزر ـ جامعة القاهرة ـ مصر.

٥. طالب دراسات عليا (دكتوراة) ـ قسم تطبيقات الليزر فى القياسات والكيمياء الضوئية والزراعة ـ المعهد القومى لعلوم الليزر ـ جامعة القاهرة ـ مصر.

تم رفض العينات المعاملة بجرعات أشعة الليزر ٠، ٩، ١٨، و٢٧وات.ثانية/سم² عند تخزينها ١٠، ١٥، و ٢٠ يوم خلال التخزين المبرد على الترتيب.. بسبب ان العدد الكلى للكائنات الحية الدقيقة في هذه عينات كان أعلى من الحدود المقبولة.

٢) وجد أن العدد الكلى للكائنات الحية الدقيقة والخصائص الفيزوكيميائية في عينات اللحم البقرى المعاملة بجرعات أشعة الليزر١٨، و٢٧وات.ثانية/سم² كانت فى الحدود المقبولة .. وأدت هذه النتائج الى زيادة فترة نصف العمر مدة الصلاحية) الى ١٠ و ١٥ يوم خلال التخزين المبرد، مقارنة بعينة الكنترول والتى كانت ٥ أيام خلال التخزين المبرد.

٣) نستنتج أن أشعة الليزر ذات تأثير واضح على خفض المحتوى البكتيري واطالة عمر اللحم البقرى (فترة الصلاحية للأستهلاك) ، وعدم حدوث تغيير ملحوظ فى الخصائص الفيزوكيميانيةفى اللحم البقرى الطازج والمخزن بالتبريد.. ولذلك يوصى باستخدام أشعة الليزر كطريقة غير تقليدية فى تحسين ومراقبة جودة اللحم البقرى .