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Comparison between characteristics of mixer and bowel chopper meat batter

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Abstract

Luncheon sausage is one of the most popular sausage product consumed by Egyptian populations, and is basically produced from beef. Paddle mixer was the main machinery used for production of such type of sausage but it needs a long time (hours) to produce a single batch. Recently, massive production of emulsion type products in Egypt forced the meat processors to update the machinery used. Most meat processers prefer bowel cutters for production of emulsion sausage as it reduces the time required for production to few minutes. The main objective of the current study was to compare the physicochemical and sensory characteristics as well as emulsion stability of beef and chicken meat batters and cooked sausages produced by paddle mixer and bowl cutters. Sensory evaluation showed significant differences ($P<0.05$) in luncheon color, tenderness and juiciness while flavor and taste scores revealed non- significant change among different machines. Shear force was significantly ($P<0.05$) higher in emulsion produced by bowel cutter in comparison with those produced by paddle mixer. Total fluid release and fat release were higher in emulsion produced by bowel cutter. Significantly ($P<0.05$) higher total soluble and myofibrillar protein were obtained for emulsion produced by bowel cutter.

(**Key words:** Processing, Emulsion stability, Shear force, Emulsion sausages, Luncheon sausage)

Introduction

Emulsion-type sausages are made from a mixture of finely chopped meat, fatty tissue, ice and additives e.g. salt, nitrate, phosphate, seasoning and flavorings (Hernández-Hernández and Guerrero-Legarreta, 2010; Ugalde-Benítez, 2012). Formation of a balanced meat emulsion is of great importance for product quality where failure to form stable meat batter results in loss of water and fat as well as production of a mushy and mealy texture (Foegeding et al., 1991). Moreover, emulsion breakdown can be very costly especially in high volume processing lines because finely comminuted meat products represent a large segment of the processed meat market.

During chopping processor cannot detect any warning signs indicating a later fat separation during cooking. Therefore, understanding of the relationship between meat batter stability and processing equipment will enable the processor to select the best chopping/emulsifying equipment as well as least-cost-formulation for production of effective product of high quality (Barbut, 1995).

Machinery used for production of emulsion sausages may affect the different quality characteristics of obtained meat batter and cooked sausages. Comparing the characteristics of emulsion sausage produced by the paddle mixers and bowl cutters may be useful for meat processors. To the best of our knowledge, there is no previous research compared characteristics of meat batters and final product produced by paddle mixers and bowel cutters. Therefore, the main objective of the current study was to compare the physic-chemical and sensory characteristics of meat batters and cooked sausages produced by paddle mixer and bowl cutters.

Materials and Methods

1. Experimental design

Three trials based experiment (with three replicate each) was performed to compare the physicochemical and sensory characteristics of meat batters and cooked emulsion type beef and chicken sausage produced by either paddle mixer or bowl cutter.

2. Materials

Imported deep frozen beef (chuck and neck cuts) was purchased from a local store within the 1st third of its shelf life. Fresh chicken breast meat and chicken skin were purchased from local procedures, deep frozen and stored at -18°C till use.

3. Meat batter formulation

Emulsion beef sausage was produced following the Good Manufacturing Practices Guidelines with the rate of 80% beef meat containing 20% fat, 1.7% sodium chloride, 3000 ppm polyphosphates, 500 ppm ascorbic acid, 100 ppm sodium nitrite, 5% corn starch, and rest was cold water. Frozen beef blocks were firstly flacked then minced using 5 mm Ø

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mincing plate. Minced beef was firstly chopped in a bowel cutter with NaCl, sodium tripolyphosphate, sodium nitrite, ascorbic acid and spices for short time before cold water was added and finely the starch was added at 2°C. After that the meat batter was chopped to final temperature of 8°C. Another emulsion beef sausage was produced with the paddle mixer using the same procedure except the beef was firstly minced at 2mm Ø. Concerning the chicken luncheon, the same procedures in both bowel cutter and paddle mixer were followed with a final temperature not exceeding 5°C. Each experiment was repeated three times in the same time. After that prepared batters were filled used automatic filler in polyamide casing and kept refrigerated for three hours before thermal treatment using humid cooking program to 72°C core temperature.

4. Investigations

4.1. Sensory evaluation

Beef and chicken luncheon samples for sensory examination were evaluated by 5 well-trained panelists. All the samples were randomly coded and the panelists were asked to score the color, flavor, taste, tenderness, juiciness and overall acceptability using a numerical-score value from o to 8 according to their quality with 0 being low or undesirable and 8 being highly desirable (AMSA, 1995). Prior to the analysis panelists were trained in the definition and intensities of all investigated sensory parameters

4.2. Proximate chemical analysis

The samples were analyzed for estimation of moisture, protein and fat contents following the procedure of AOAC (1995). Samples from the three patches representing each trial were rendered into uniform mass then used for the following chemical analysis: Moisture content was estimated by drying 10 grams sample in a previously weighed dish at 100°C in hot air oven for 16-18 hours. Ether extractable fat was evaluated by mixing three grams prepared sample into a thimble with sand, then heating for one hour in 125°C and finally extracted with petroleum ether (boiling point 60-80°C) for 6 hours with the temperature of extraction unit adjusted to ensure condensation rate of 5 drops/seconds. After the extraction was completed, the petroleum ether was evaporated in a boiling water bath, and the flask was dried in an oven at 100°C for 30 minutes, cooled in desiccator and weighed, where the fat content was estimated by the difference in the weight of the flask before and after extraction correlated to the weight of the sample.

Protein content was evaluated by digesting half gram from previously prepared sample with 3.5g potassium sulphate, 0.1g copper sulphate and 10 ml 98% sulphuric acid using VELP Scintifica digester (DK 6) at 445°C for 45 minutes. After that the tube was removed from the digester, cooled and 75 ml demineralized water was added. The tube containing the digested sample was attached to the distillation unit (VELP Scintefica UDK 126 D) and the start bottom was pressed to add 75 ml sodium hydroxide (40%) and to start the steam distillation. A receiving titration flask containing 25 ml boric acid (4%) was placed on the distillation unit to receive the distillate. When the distillation stop (>150 ml), the flask was removed and 5 drops methyl red indicator was added and titrated with 0.02N hydrochloric acid solution to a red end-point. The total nitrogen content of the sample was calculated using 6.25 as factor for conversion of nitrogen to crud protein:

For ash determination, five grams sample were weighed into porcelain dish and dried at 100°C in hot air oven for 4hours. After cooling, gentle heating was applied till content turned black (carbonization). The dish was transferred to a muffle furnace and ignited

4.3. Physicochemical examination

4.3.1. Emulsion stability.

Emulsion stability was measured using the procedures of Hughes et al (1997), with modifications as described by Colmenero et al. (2005). Twenty five grams of meat batter were centrifuged for 15 minutes at 6000 rpm, heated at 70°C for 60 minutes, and then centrifuged again for 20 minutes at 6000 rpm. The pellet was removed and weighted, while the supernatant was poured into pre-weighted crucible and dried overnight at 100°C. The volume of total expressible fluid (TEF) and the percentage of fat were calculated as follows:

TEF= (weight of the centrifuge tube and the sample) - (weight of the centrifuge tube and pellet).

% TEF=TEF/original sample weight ×100.

% fat= (weight of crucible + dried supernatant) - (weight of empty crucible)/TEF ×100.

4.3.2. Shear force

Three cubes from each luncheon loaf were prepared with dimension 1x 1x1 cm. Six cores of 1.27 cm diameter were removed parallel with the sliced surface from each loaf. Each core was sheared once with a Warner–Bratzler shear force (WBSF) device attached to an Instron Universial Testing machine (Model 2519 105; Instron Corp., Canton, MA, USA) with a 55-kg tension/compression load cell and a crosshead speed of 200 mm/min. An average shear force value was calculated and recorded for each sample according to the procedure outlined by Shackelford et al. (2004).

4.3.3. Measurement of soluble and insoluble collagen content

4.3.3.1. Hydroxyproline standard curve

A fifty mg amount of L-hydroxyproline (BDH Chemicals Ltd, England) was dissolved in 100 ml distilled water by adding 1 drop of H_2SO_4. Ten ml from the previous solution was diluted to 100 ml with distilled water to get a working standard. An actual working solution was prepared by diluting 10, 20, 30, 40 ml from the previous working standard solution to 100 ml with distilled water. From the diluted working standard, 0.1, 0.2, 0.3 and 0.4 were made up to 1 ml with distilled water (representing 1, 2, 3 and 4 µg hydroxyproline standards). A standard graph was plotted with different concentration of hydroxyproline using Unico (1200Series, USA) spectrophotometer against the blank at 540nm (Nueman and Logan, 1950).

4.3.3.2. Collagen content

Soluble and insoluble collagen contents of cooked meat samples were determined according to the procedure of Nueman and Logan (1950) and Mahendrakar et al. (1988). Two grams of meat sample cooked in water bath were hydrolyzed with 40 ml of 6 N HCl in a hot air oven (Heraeus D-63450 Hanau, Germany) at 105°C for 18 hours. The hydrolysate was filtered, and the volume was adjusted to 50 ml with distilled water. pH of 25 ml aliquot was adjusted to 7.0 with 40% NaOH and the volume was made to 50 ml with distilled water. One ml from the obtained aliquot was mixed with 1 ml each of 0.001 M copper sulfate, 2.5 N NaOH and 6% H_2O_2 (For blank,1 ml distilled water was used instead of the aliquot). After mixing, the tubes were kept at room temperature for 5 minutes with occasional shaking. The tubes were then heated at 80°C for 5 minutes in a water bath (Kubota YCW-04M, Japan) with frequent rigorous shaking, then cooled in ice, and 4ml of 3N H_2SO_4 and 2 ml of 5% 4-dimethylaminobenzaldehyde in n-propanol were added. After thorough mixing, the tubes were heated again at 70°C for 16 minutes in water bath. Absorbance of the test sample was measured at 540 nm against the blank using Unico (1200 Series, USA) spectrophotometer.

$$\text{Hydroxyproline (g/100g)} = \frac{O_U \times C_s \times T_A \times T}{O_S \times A \times V \times W \times 1000 \times 1000} \times 100$$

The calculation for estimating the hydroxyproline (g/100 g) in meat was outlined by Woessner (1961) using the following equation:

O_U	Optic density of the unknown	C_s	Concentration of the standard
T_A	Total volume from which aliquot was taken	T	Total volume made
O_S	Optic density of the standard	A	Aliquot taken
V	Volume of solution used for neutralization	W	Weight of the sample taken

Collagen content= Hydroxyproline solubilize% × 7.25

4.3.4. Measurement of protein solubility

Sarcoplasmic protein solubility was determined by homogenizing one gram sample in 10 ml of ice-cold 25 mmol/l potassium phosphate buffer (pH 7.2) using polyton (SDT- 1810, Tekmar Co., Germany) stomacher at the lowest speed. The homogenate was left to stand in a shaking water bath (GFL-1083, Germany) at 4±°1C overnight. The mixture was then centrifuged at 1500g for 20 minutes (Joo et al., 1999), and the protein concentration of the supernatant was determined using Kjeldahl method (Tyszkiewicz and Klossowska, 1997). Total protein solubility was determined by homogenizing 1 g of muscle powder in 20mL of ice-cold 1.1 mol/L potassium iodide in a 100 mol/L phosphate buffer (pH 7.2). The procedures for homogenization, shaking, centrifugation, and protein determination are described above. The myofibrillar protein solubility was obtained by determining the difference between the total and sarcoplasmic protein solubility.

5. Statistical analysis

All data were analyzed using SPSS Statistics 17.0. Data of sensory, emulsion stability, shear force, chemical, physicochemical parameters of raw meat batter and cooked luncheon sausage prepared in bowel chopper and paddle mixer were analyzed using Paired –Samples T Test to compare results among samples

Results and discussion

Sensory quality

Table (1): Sensory panel scores of beef and chicken emulsion sausage produced by differenttechniques

	Beef		Chicken	
	Bowel chopper	Mixer	Bowel chopper	Mixer
Color	$6.78^{a}\pm0.67$	$6.44^{b}\pm0.53$	$6.33^{a}\pm0.52$	$6.00^{b}\pm0.89$
Flavor	$6.33^{a}\pm0.50$	$6.56^{a}\pm0.53$	$6.83^{a}\pm0.41$	$6.67^{a}\pm0.52$
Taste	$6.67^{a}\pm0.50$	$7.22^{a}\pm0.44$	$6.50^{a}\pm0.84$	$6.33^{a}\pm0.52$
Tenderness	$6.78^{a}\pm0.67$	$6.44^{b}\pm0.53$	$6.33^{a}\pm0.52$	$6.00^{b}\pm0.89$
Juiciness	$6.78^{a}\pm0.67$	$6.44^{b}\pm0.53$	$6.33^{a}\pm0.52$	$6.00^{b}\pm0.89$
Over all acceptability	$6.67^{a}\pm0.50$	$6.44^{b}\pm0.53$	$6.33^{a}\pm0.52$	$6.33^{a}\pm0.52$

* a-b : Means with different superscripts for eachtype differ significantly at P<0.05.

It has been established that emulsion system formulation and processing operations generally affected sensory properties of finished products (Maindarkar et al., 2012). In this respect, data in Table (1) indicted presence of differences in all investigated sensory attributes for emulsion luncheon sausage produced by either bowel cutter or paddle mixer in both beef and chicken sausage. Luncheon produced by bowel chopper rated significantly (P<0.05) higher scores for color than those produced by mixer. For instance, when the myoglobin content was kept constant, the color of emulsion type products was mostly influenced by processing conditions (Pietrasik and Li-Chan, 2002; Tobin et al., 2012). Moreover, chicken and beef luncheon produced by bowel chopper rated significantly (P<0.05) higher scores for both tenderness and juiciness than those produced by mixer. Tenderness scores was also correlated with the shear force values (Table 2) i.e. objective measurement of the tenderness supported the sensory panel assessment where, higher shear force values recorded higher scores for tenderness by the panelists. In this concern, Zhuang-Li et al. (2014) reported that texture profile analysis parameters were affected by the processing method in cooked batters prepared by using bowel cutter or beating machine with blunt paddles. However, differences in flavor and taste scores were non- significant

Data of emulsion stability for different both beef and chicken meat batters produced (Table 2) showed that sausage produced by paddle mixer had significantly (P<0.05) lower total release fluid and slightly higher released fat indicating higher emulsion stability than those produced by bowel chopper. Emulsion stability is an indicator of non-separated fat and water retained by meat proteins. Higher emulsion stability means lower percentage of total fluid released, water released and fat released after heat treatment (Sarıcoban et al., 2010). The obtained results could be explained on the basis that optimum emulsion stability directly depends on size of fat droplets (Lee et al., 1981) where lower fat was released with bowel cutter due to significant reduction of fat particle size during chopping, the equipment used to emulsion formation (Ponce et al., 2000), the chopping process which impact the final product yield and quality (Allais et al., 2004) and the mixing temperature (Priyadarshi, 2013).

Table (2): Emulsion stability and shear force values of different emulsion sausage produced by different techniques

	Beef luncheon		Chicken luncheon	
	Bowel chopper	Mixer	Bowel chopper	Mixer
TEF	14.90^a±2.93	5.50^b±0.09	5.75^a±0.38	3.38^b±0.52
RF	2.27^a±0.08	2.31^b±0.24	2.29^a±0.07	2.37^b±0.08
Shear force	0.32^a ± 0.02	0.31^b ± 0.03	0.29^a ± 0.12	0.25^b ± 0.06

* a-b: Means with different superscripts differ significantly at $P<0.05$.

The values of shear force was significantly ($P<0.05$) lower in luncheon sausages produced by paddle mixer than those produced by bowel chopper. The difference was more evident in chicken luncheon sausages (Table 3) indicating that the prepared emulsion sausage by bowl chopper was more tender than that prepared by mixer. Textural attributes of emulsified sausage are dependent upon meat particle size, its proteins (Anjaneyulu et al., 1995), formation of a protein gel matrix (Smith, 1988; Zogbi and Benejam, 2010) and protein matrix stability (Christensen, 2012).

Data of proximate chemical analysis (Tables 3& 4) indicated presence of non-significant differences for both that beef and chicken emulsion produced by either bowel chopper or paddle mixer. Comparison between chemical composition of raw and cooked emulsion preparing by the two different techniques indicated that moisture content in emulsion subjected to thermal processing was lower than that in raw emulsion. However, fat and protein content were higher compared to raw batter, which was a result of water loss. The obtained data was in agreement with those reported by Borchert et al. (1967). Moreover, Simonin (2012) observed an increase in fat content during cooking meat batter.

Table (3): Proximate chemical analysis of beef emulsion sausage produced by different techniques

	Luncheon batter		Cooked luncheon	
	Bowel chopper	Mixer	Bowel chopper	Mixer
Moisture	59.17^a ± 0.69	60.13^a ± 0.35	64.50^a ± 0.80	64.84^a ± 0.55
Fat	16.07^a ± 1.04	14.35^a ± 0.64	9.18^a ± 0.79	9.45^a ± 0.55
Total protein	11.03^a ± 0.19	13.07^a ± 0.27	11.59^a ± 0.25	13.29^a ± 0.35
Total soluble proteins	6.50^a ± 0.11	4.71^b ± 0.10	6.53^a ± 0.11	4.66^b ± 0.12
Sarcoplasmic proteins	2.10^a ± 0.17	2.03^a ± 0.11	2.01^a ± 0.13	2.04^a ± 0.11
Myofibrillar proteins	4.40^a ± 0.14	2.68^b ± 0.07	4.52^a ± 0.09	2.61^b ± 0.05
Connective tissue protein	0.06^a ± 0.02	0.07^a ± 0.05	0.18^a ± 0.02	0.09^a ± 0.07

* a-b: Means with different superscripts differ significantly at $P<0.05$.

Table (4): Proximate chemical analysis of chicken emulsion sausage produced by different techniques

	Luncheon batter		Cooked luncheon	
	Bowel chopper	Mixer	Bowel chopper	Mixer
Moisture	63.79^a ± 0.60	64.10^a ± 0.17	67.20^a ± 0.56	66.95^a ± 0.54
Fat	12.62^a ± 0.61	11.99^a ± 0.79	6.80^a ± 0.46	6.11^a ± 0.24
Total protein	11.56^a ± 0.40	13.73^a ± 0.30	11.74^a ± 0.38	13.77^a ± 0.30
Total soluble proteins	7.67^a ± 0.12	6.12^b ± 0.12	7.72^a ± 0.12	6.18^b ± 0.11
Sarcoplasmic proteins	2.75^a ± 0.15	2.78^a ± 0.18	2.70^a ± 0.10	2.74^a ± 0.08
Myofibrillar proteins	4.92^a ± 0.05	3.41^b ± 0.05	5.02^a ± 0.04	3.44^b ± 0.05
Connective tissue protein	0.14^a ± 0.05	0.16^b ± 0.04	0.33^a ± 0.02	0.23^a ± 0.04

* a-b: Means with different superscripts differ significantly at $P<0.05$.

Sarcoplasmic proteins and connective tissue proteins content revealed non-significant differences between emulsions produced by bowel chopper and paddle mixer with the exception that connective tissue proteins was slightly and significantly higher in meat batter produced by paddle mixer in beef batter (Tables 3&4). However, total soluble proteins were significantly lower and myofibrillar proteins were significantly higher in beef and chicken batters produced by bowel chopper. The obtained results were in agreement with Knipe (2004) who found that the speed of bowl chopper is one of its advantages that allow protein extraction and emulsion stability. However, mixer achieves less protein extraction with less batter temperature as compared with bowl chopper.

After thermal processing, beef and chicken emulsion produced by both bowel chopper and paddle mixer had higher total soluble proteins, myofibrillar proteins and connective tissue proteins than in raw emulsion, on contrary to sarcoplasmic proteins which were not affected by cooking of batter. Simonin (2012) claimed that increase in fat content and concentration of solubilized myofibrillar proteins of batter during cooking leads to greater water binding and fat emulsification of the resulting meat gels. Myofibrillar proteins will help immobilize fat particles and form a three-dimensional network of filaments that contributes to the overall texture (Asghar et al., 1985 and Pegg, 2004) as well as the water- and fat-binding properties of the finished product (Pegg, 2004). Otherwise, the gelation properties of this extracted protein necessary to produce acceptable texture, yield, flavor and shelf life.

Conclusion

It can be concluded that the best chopping/emulsifying equipment available on the market is bowel chopper for production of the luncheon as these machine improved physicochemical parameters, sensory quality of luncheon sausage compared with mixer. Use of mixer achieves less protein extraction from meat and emulsion stability as compared with bowl chopper that contribute to the overall texture as well as the water- and fat-binding properties of the finished product.

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الملخص العربي

مقارنة خصائص مستحلبات اللحوم باستخدام خلاط و هراس اللحوم

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قسم الرقابة الصحية علي اللحوم و منتجاتها- كلية الطب البيطري- جامعة القاهرة

(الكلمات الدالة: ثبات المستحلب ، قوة الشد، الميكروسكوب الإليكتروني النافذ، الميكروسكوب الإليكتروني الماسح ، المستحلب ، الانشون)

يعتبر لانشون اللحوم المصري من اكثر انواع منتجات اللحوم انتشارا في الأسواق المصرية وغالبا ما تصنع هذه المنتجات من اللحم البقري. ومن الأدوات التي غالبا ما تستخدم في تصنيع هذه المنتجات خلاط اللحوم. ولكن لتصنيع كمية كبيرة من مستحلب اللحوم يحتاج خلاط اللحوم لساعات طويلة ولزيادة الطلب علي هذه المنتجات في مصر اتجه المنتجون لتحديث الأجهزة المستخدمة في هذا النوع من المنتجات، حيث لجا الكثير من المنتجين لاستخدام هراس اللحوم لما يوفره من وقت مما يؤدي الي إنتاج كميات كبيرة من المنتج في دقائق معدودة.هناك ارتباط وثيق بين ثبات المستحلب والجهاز المستخدم في تصنيعه لهذا تم تصميم التجربة محل الدراسة لدراسة الفرق بين خلاط وهراس اللحوم وأعقب ذلك دراسة تأثير تلك الأجهزة علي المستحلب المصنع من لحوم كل من البقر والدجاج عن طريق الاختبارات الحسيه، دراسة الخواص الفيزوكيميائية وتشمل درجة ثبات المستحلب، قوه الشد بالإضافة إلى الفحص الهستولوجي باستخدام كل من الميكروسكوب الضوئي والإليكتروني النافذ والماسح قبل وبعد التسوية حتى يساعد علي اختيار الجهاز الأمثل لإنتاج منتجات اللحوم المستحلبه بجودة عالية. وقد أظهرت النتائج أن للأجهزة المستخدمة تأثير معنوي على معايير الجودة التي تم دراستها حيث أظهرت وجود اختلافات معنوية في معايير الجودة الحسية التي تم دراستها باستثناء النكهة والطعم للمستحلب المصنع من اللحم البقري وايضا من لحوم الدجاج. حيث بدء القائمون بالفحص الحسي إعجابهم بلون وطراوة وعصيريه وكذلك القبول العام للمنتج المصنع بواسطة هراس اللحوم مقارنة بخلاط اللحوم. هذا وقد أظهرت الدراسة وجود ارتباط معنوي بين مقاييس طراوة اللحوم سواء الحسية منها أو عن طريق الأجهزة (قوة الشد) والأجهزة المستخدمة حيث سجل المنتج المعد بواسطة هراس الحم ارتفاع في قوة الشد مقارنه بخلاط اللحوم .وقد دلت نتائج العينات الي ان المستحلب الناتج عن استخدام هراس اللحوم أكثر فقدا في نسبة المياه والدهن بعد التسوية. ولكن كان أكثر الآثار وضوحا هو تأثير هراس اللحوم علي أنواع البروتين المختلفة قبل وبعد التسوية علي الرغم من ثبات نسبة البروتين الكلي المستخدم في التصنيع لكل من خلاط وهراس اللحوم أوضحت النتائج ارتفاع ملحوظ في البروتينات الكلية الذائبة وكذلك بروتين الألياف العضلية. وقد كان هناك أيضا تغيرات هستولوجية باستخدام الميكروسكوب الضوئي حدثت في مكونات المستحلب بواسطة هراس اللحوم حيث أظهرت العينات صغر حجم كرات الدهن ووجود غلاف من بالبروتين حولها مع توزيعها بشكل جيد. مقارنه بالعجائن المعدة بخلاط اللحوم مما جعل المستحلب اقل ثباتا مقارنة بنظيره. وفيما يتعلق باستخدام كل من الميكروسكوب الإليكتروني النافذ والماسح أثبت وجود غشاء بروتيني يحيط بكرات الدهن المختلفة الحجم بينما في حالة استخدام خلاط اللحوم لوحظ اختفاء هذا الغشاء حول معظم كرات الدهن وإذا وجد في بعض منها كان مليئا بالثقوب التي تؤدي الي حدوث تسريب لكرات الدهن وفقد الكثير منها إثناء التسوية. والجدير بالذكر إن الترابط بين البروتين و الدهن مهم للحفاظ علي ثبات المستحلب . وبذلك أكدت النتائج أن استخدام هراس اللحوم سيكون أفضل في أنتاج مستحلب ثابت حراريا