

Features of Red Meat for Meat Quality Assessment towards Islamic Practices

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Abstract— Features of images are useful in the food industry for quality assessment and grading of food especially red meat. Features in some extent can describe important traits that determining the quality of red meat such as sensory characteristic, freshness and palatability of red meat. There does, however, exist opportunities to understand the relationship of these features in another aspect of quality that is based on religious aspect which different practices is applied. Thus, future efforts need to be focused on towards food quality in Islamic practices. This paper gives an overview on features of red meat for quality assessment and Islamic practices in food consumption. The characters of slaughtered meat and some perspectives on the future trends of these techniques toward Islamic practices are also presented.

Index Terms— Meat quality, texture features, Islamic slaughtering.

1 INTRODUCTION

FOOD quality assessment and grading is an important process in the food industry to produce and maintain high-quality food for consumers. This process is applied in a variety of food products, especially red meat such as beef, lamb and pig due to its large market share in the food industry. The recent method used in quality assessment and grading of red meat is by determining the quality attributed using image features. Image feature is the attribute of images that are extracted as indicators that describes the quality of red meat. The quality attributes of red meat can be determined by marbling score, muscle colour, fat colour, and tightness of meat [7]–[9].

However, with the current awareness and demands of halal supply of meat product, the definition of meat quality has changed which assimilated with the practices of the religion. Islamic religion practices a different method of slaughtering, processing and preparing the meat and meat products. Thus the attribute that describes the quality of meat might be different. Therefore, a review of the image feature of red meat available would contribute to the research of Islamic practices in the food industry.

Consequently, the objective of the current paper is to summarise features of red meat for meat quality assessment, to discuss their feasibilities toward Islamic practices, and to give some future perspectives.

2 MEAT QUALITY IN ISLAMIC PERSPECTIVES

Generally, meat quality is categorized into two by Farouk et al. [1]: 1) conventional quality and 2) spiritual quality.

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Conventional quality defined the quality of meat based on inherent or perceived physical characteristics of meat while spiritual quality is another aspect of quality that is based on the religion and ideology of the consumers. Spiritual quality derives from the perspective of religious laws and guidelines around eating that need to be adhered by its followers. For example, an Islamic believer perceived the quality of meat based on the guidance of Islamic law and practices of halal (permitted) and haram (prohibited) concept.

To some of the faith group such as the Muslims, the spiritual quality is important as such that if the minimum requirements are not been met, the food will be considered spiritually worthless and deemed unlawful (haram) even though it is of the highest grade in conventional perspective [1]. The spiritual quality is vital to the Muslims since the food that is consumed will safeguard the Muslims from spiritual and physical afflictions. Therefore, spiritual quality is the foundation of importance in choosing meat before any other quality considerations.

2.1 Islamic Dietary Law and Practices

Meat production for the Muslim consumer goes through different practices than conventional meat production. It is based on Islamic dietary law and practices that enshrined in the holy Quran.

Basically, Islamic practices the concept of halal and toyyib while some are “makrooh” (questionable) and haram (prohibited). Halal means good to be consumed in terms of process and ingredient, while toyyib is good quality in terms of nutrition and taste [2]. The method of slaughtering is one of the main halal requirement other than the animal itself must be of halal (acceptable) species [3],[4]. In general, anything that is not explicitly specified as prohibited (haram) in the holy Quran and Hadith (the practice of Prophet Muhammad) such as cow, sheep and goat can be consumed. Animals that explicitly specified as prohibited (haram) are as follows:

1. Pigs, boars and swine.
2. Carnivorous animals that hunt with its teeth such as lions, cats and dogs
3. Animals with pointed tusk such as an elephant.
4. Animals that use claws or talons to hunt or defend such as eagles, vultures and falcons.
5. Animals that lives both in water and land such as frogs, crocodiles and turtles.
6. Carrion and animals that died by other causes than proper slaughtering.
7. Animals that are slaughtered and sacrifice to someone other than Allah.
8. Pest and venomous animals such as snakes, rats and scorpions.
9. Animals that are forbidden to be killed such as donkey and honeybee.

Other prohibited things are such as blood and alcohol also cannot be consumed. The basic reasons behind the prohibition of certain animals and drinks are due to its impurity and harmfulness that it may have such as pigs and swine. It is not only harmful to the physical health of the person that consumed it but the character and spiritual abilities are also affected.

2.2 Islamic Slaughtering Method

Animals that is not prohibited (haram) needs to be slaughtered before it can be consumed. In Islamic perspectives, the aim of slaughtering is to drain the flowing blood as quickly and as much as possible [1]. The process of removing the blood is necessary since blood is considered impure and should not be consumed. Meat that contains more blood is not fit for consumption as it will effect and endanger the health of human. Slaughtering an animal in Islamic practices have a special requirement that needs to be followed. The requirements are as follows:

1. The animal to be slaughtered must be of a halal species.
2. The slaughterer must be an adult and sane Muslim.
3. At the time of slaughter, the name of Allah must be invoked.
4. The knife use for slaughtering must be sharp.
5. The throat of the animal must be cut therefore severing the trachea, esophagus and both the carotid arteries and jugular veins in fast and complete bleeding, bringing about an instant death of the animal.
6. The slaughtering must be in one stroke without lifting the knife to the throat.
7. No stunning is used before slaughtering, that might lead to the death of the animal.

In Islam, it is important that the animal to be slaughtered is treated gently and kindly before and during the slaughtering process. Therefore some requirements are customary and desirable practices such as follows [4]:

1. The animal should have proper rest and water.
2. Avoid stressful conditions.

3. Avoid sharpening the knife in front of the animal.
4. The knife should be re-sharpened before slaughtering.
5. Hidden the knife from the animal and slaughtering out of sight of other animals to be slaughtered.

2.3 Characterization of Slaughtered Meat by Islamic Practices

In Islamic practices of slaughtering method (Halal slaughter) , the process and procedures must be humane so that the slaughtering can be painless and minimize the anxiety of the animal resulting in a different quality meat than other methods (non-slaughtered method). The meat that is slaughtered according to halal slaughtering method is called slaughtered meat or properly slaughtered meat. Slaughtered meat is a product of animals that is slaughtered properly by cutting and severing the major blood vessels in the neck, for instance, halal and kosher method, while improperly slaughtered meat is when the animal is stunned before the slaughtering process or garrotte is used. Method such as using poisonous gas or breaking the neck to kill the animal is considered non-slaughtered meat as well as animal that is already dead by other means

Due to the method for the slaughtering procedure of halal method, slaughtered meat has most of its blood removed. As a different methods drains the different amount of blood, the volume of blood left are also differs. Toward cutting those major blood vessels in the neck, blood is drained properly since using this method promotes faster exsanguination. While slaughtered carcass has only one-third of the total blood in the live animal, non-slaughtered carcass has more blood than that [6]. Besides, a different volume of blood leads to the different quantity of microorganisms; more blood means more microorganisms left inside the meat. Furthermore, the tissue of non-slaughtered meat and slaughtered meat has significantly different dielectric constant values. The former has higher readings than the latter [6], [7], [5] because of the electrical properties of biological tissues depends on the fluids content of the flesh. As shown in Figure 1, the non-slaughtered carcass has traces of blood while the slaughtered carcass is clean without blood.



Fig. 2. Traces of blood can be seen in non-slaughtered carcass while the slaughtered carcass is clean [5].

3 FEATURES OF RED MEAT

Image features are categorised into four major features: colour, texture, size and shape. Each feature contained information that needed for the applications of assessment and grading of meat. The proper combination of these features will increase the accuracy of the application and might reveal certain quality attributes that single image features cannot be identified [8]. Frequently used features to represents red meat quality attributes is colour, size and texture features.

3.1 Colour Features

Colour is an important feature for image representation other than size and texture. It contains basic information about the image that is corresponding to human vision and perception. Colour feature can be extracted to represent a sensorial attribute of meat quality. Usually colour feature of an image is obtained statistically. Frequently used statistical description of colour feature is mean and standard deviation of the intensity values of the image's pixels in different colour spaces [14], [29] that includes RGB, HSI/HSV, HSL, CIE, and YIQ. Table 1 summarises the different colour spaces and statistical descriptor for colour evaluation of red meat.

3.2 Size Features

One of the most important quality attributes in red meat is the intramuscular fat known as marbling. Marbling refers to the white flecks of fat presents within the lean muscle in the meat which contribute to the sensory characteristic of meat. There also a connection between degrees of marbling to the palatability of red meat.

Marbling is derived from size feature of meat image [9]. The first attempt to measure marbling in meat is done by McDonald et al. based on total visible fat area but it is unreliable. Then, the density of fleck is considered to measure marbling degree which is described in terms of small, medium and large as well as overall fleck densities [10],[11], [12]. Further works of marbling features were described with five fleck size histogram properties (mean, standard deviation, skewness, kurtosis and interquartile range) as well as overall fleck densities [13], [14].

3.3 Texture Features

Generally, the texture of an image is referred to such properties as fineness, coarseness, smoothness, granulation, randomness, and graininess of an image [22], [23]. In food images, texture can in some extent reflect the cellular structure of food and thus can be used as an indicator of food quality [24]-[26].

Texture feature is categorised into four type of image texture: statistical texture, structural texture, model-based texture and transform-based texture. The statistical texture is mostly used features in the food industry because of its high accuracy and less computational time [26], while other texture features such as model-based texture and transform-based texture not frequently use as often as statistical texture. Besides that, application based on structural feature is still limited in the food industry [27], and thus will not be reviewed. Table 2 summarises texture feature and its application in the quality assessment of red meat.

4 DISCUSSION

Differentiating between slaughtered and non-slaughtered meat is one of the aspects towards identifying characteristic of spiritual quality in meat. According to Farouk et al. [1], diverse in slaughtering process can affect the quality and appearance of the meat. As explained in previous section, the main characteristic of slaughtered meat is the volume of blood remained in the flesh of meat is lower than non-slaughtered meat which may affect the meat tissue resulting in the different characteristic that can be detected and measured such as the colour of the flesh and the moisture content of meat. Based on this characteristic, certain features of red meat might have the potential for finding the differences of slaughtered and non-slaughtered meat.

Colour feature has been used to predict colour score [10], [11], [15], [17], [21], freshness [18], [19], moisture content [16], palatability [14], and eating qualities [13]. Meanwhile, current research has successfully differentiating slaughtered and non-slaughtered poultry meat (chicken) in terms of colour of the flesh. Although poultry meat is in white meat category, it shows that there is the possibility of using red meat features for differentiating slaughtered and non-slaughtered meat.

TABLE 1. SUMMARY OF COLOUR FEATURES FOR RED MEAT COLOUR EVALUATION APPLICATION

Author	Colour Space	Colour Features	Application	Ref
Beef				
Unklesbay et al.	RGB	mean, standard deviation, skewness and kurtosis	Detection of colour changes during cooking	[15]
Tan et al.	RGB	mean and standard deviation	Prediction of sensory colour responses	[11] ^b
Zheng et al.	RGB, HSI	mean and standard deviation	Correlating colour to moisture content	[16]
Jackman et al.	RGB	mean, standard deviation, skewness, kurtosis and interquartile range	Prediction of eating qualities	[13] ^a
Jackman et al.	RGB, YIQ, CIE XYZ, L*a*b	mean, standard deviation, skewness, kurtosis and interquartile range	Prediction of palatability	[14] ^a
Sun et al.	RGB, HSI	Mean and standard deviation,	Prediction of colour score	[17]
Chian et al.	RGB, HSI	Mean and mean interval value	Degree of freshness	[18]
Pork				
Lu et al.	RGB, HSI	Mean and standard deviation	Evaluation of fresh pork loin colour	[19]
O'Sullivan et al.	RGB, Hunter L*a*b*	Mean and standard deviation	Prediction of the sensory visual quality	[20]
Sun et al.	RGB, HSI, L*a*b*	Mean and standard deviation	Prediction of pork colour score	[21]

^a combine with texture and size features

^b size features are also used

TABLE 2. SUMMARY OF TEXTURE FEATURES FOR RED MEAT QUALITY ASSESSMENT APPLICATION

Author	Texture Features			Application	Ref
	ST	MBT	TBT		
Beef					
Amin et al	GLCM, GLRLM			Predicting intramuscular fat	[28], [29]
Zhang et al.	GLCM			Prediction of fat content of beef	[30]
McCaughey et al.	GLCM			Fat content estimation of slaughtered and live beef	[37]
Huang et al.	GLCM		WT	Determination of physical and chemical properties of beef	[31]
Shiranita et al.	GLCM			Determination of meat quality	[32]
Li et al.	GLCM, GLRLM			Evaluation of beef tenderness	[12] ^a
Shiranita et al.	GLCM			Meat quality grading compared to professional graders	[33]
Shiranita et al.				Meat quality grading with neural network	[34]
Basset et al.	GLCM , GLRLM , NGLDM	FRM	FT	Indication of meat characteristic (physical feature)	[35]
Ballerini & Bocchi		FRM		Prediction of fat content	[36]
Li et al.	GLCM , GLRLM			Tough and tender classification of beef	[23] ^a
Jackman et al.			WT	Prediction of eating qualities	[13] ^a
Jackman et al.			WT	Prediction of palatability	[14] ^a
Lamb					
Chandraratne et al.	GLCM, GLRLM, GLDM			Prediction of lamb tenderness	[37] ^b
Pork					
Berg et al.	GLCM	FRM		Estimation of pork eating quality parameter	[38]
Cernadas et al.	GLRLM , GLCM, NGLDM,		CM, WT	Prediction of pork loin sensorial characteristic	[39]

GLCM (Grey level co-occurrence matrices), GLDM (Grey level difference method), FOS (First-order statistical) NGLDM (Neighbouring grey level dependence matrix), WT (wavelet-based method), GLRLM (Grey level run length matrix), FT (Fourier transform), FRM (Fractal model), Motion, CM (Convolution mask).

^a colour and size features are also used

^b size features is use as well

This indicates that the process of slaughtering from pre- to post slaughtering and slaughtering properly have indicators that can be detected and measured.

5 CONCLUSION

This review covers the features of red meat for quality assessment and meat quality y in Islamic practices. In quality assessment and grading, features of images are used to describe the red meat quality characteristic. There are three basic features of images for red meat: colour, size and texture. Among them, colour features can determine a slaughtered and non-slaughtered poultry meat. Thus future trends are towards determining the quality of slaughtered red meat. Consequently, there is a potential use of image features towards Islamic practices.

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