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A Review on Dietary Fibre and Functional Properties of Cucumis melo L.

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Agriculturally, *Cucumis melo* L. (melon) has become waste to the melon farmers because it is thrown at either immature or mature undersize stage. Most fruits like *Cucumis melo* L. has high content of fibre, this in this article the review on fibre is discussed to understand the potential fibre that may be present in this fruit. *Cucumis melo* L. also exhibit good functional properties which shows it has good potential to be used in food industry as on one of the ingredient.

Keywords: *Cucumis melo* L, melon, maazoun melon, proximate analysis, functional properties, health benefits, food waste, peels, seed and flesh

Introduction

Melon comes from the family of Cucurbitacae and also known as *Cucumis melo* L. It is predominantly found in countries like Asia and Africa. Around 85.2% of melon farmers are found in Peninsular Malaysia alone (Nazeem et al., 2016).It is mostly planted at the areas like Johor, Kedah, Kelantan, Pahang and Terengganu. Around 7.1% of agrofood land in Malaysia is planted with melons (Ismail et al., 2010).Sasikumar (2011) stated that melon has been used for centuries to treat some diseases like kidney problems, fever, urinary ulcer, fever, bile obstruction and many others. However in Malaysia, melon has become one of the agricultural waste because it is either thrown at immature or undersize mature stages.

The key to obtaining a high quality diet is recommended with the availability of high dietary fibre in the food intake. It is a prevention and treatment to consume high dietary fibre products to aid colon cancer, gastrointestinal disorders, obesity, coronary heart diseases and diabetes (Tadmor et al., 2010). Usually dietary fibre is rich in cereals but dietary fibre that comes from fruit and vegetable sources could be more physiologically competent (Navarro-Gonzalez et al., 2011). The major production of *Cucumis melo* L. in Malaysia comes from Terengganu, Kelantan, Pahang, Johor and Kedah, there are also high demand for this fruit in the area of Perak (Thakur, 2015). The dietary fibre in *Cucumis melo* L. can be made up of both soluble and insoluble dietary fiber. The soluble part consist of pectin, beta glucan, galactomannan gums and the insoluble part are lignin, cellulose, and hemicellulose (Zeb, 2016). Pectin has a very good probable in lowering the blood cholesterol level especially low-density-lipoprotein-cholesterol fraction without affecting the amount of high-density-lipoprotein-cholesterol and triglycerides (Bidkar, 2012). Aydin & Gocmen (2015) stated that pectin capable of suppressing the glucose-response curve that helps in glucose metabolism. Pectin also used as food-additive to give gelling properties in food products (Ittiyavirah, 2013). Nowadays, natural ingredients are chose over the synthetic ingredients to be used in food application. Thus, there are increasing usage of fruits and vegetable raw material to substitute the already existing synthetic ingredients (Mallek-Ayadi et al., 2016). Healthy waste products that comes from fruits and vegetables has advantage on its economic and environmental

sources (Thakur, 2015). The functional properties of *Cucumis melo* L. is explored and studied in article. The objective of this review paper is to study more on the functional properties and characterization of dietary fibre in *Cucumis melo* L.

A review on dietary fibre

Dietary is the parts of plant cell that is resistant human digestive enzymes which may consist of hemicellulose, oligosaccharides, gums, waxes, lignin, pectins and cellulose. Human small intestine does not digest these dietary fibre and adsorption does not take place, but there will be a limited fermentation that will take place in the large intestine. Dietary fibre has been consumed for centuries has multiple benefits to human. The two simple categories of dietary fibre is the soluble and the insoluble parts. The soluble parts are mucilages, pectin and gums that can form thick gummy liquid texture when it is mixed with water while cellulose, lignin and hemicellulose are insoluble in water. In recent years many potential food industry market has developed high fibre food products due to its importance in consuming. Also these days food researchers are trying to find new variety of natural that contain good source of fibre in it (Garcia-Anguilar et al., 2015). Incorporation of fibre has been a trend especially in foods like beverages, spices, vegan cheeses, sauces, canned foods, snack foods and frozen foods (de Melo et al., 2000).

Classification of dietary fibre

Based on ways of digestion, gastrointestinal solubility, type of polysaccharide, physiological categories, and role in plant, these dietary fibre can be classified (Navarro-Gonzalez et al., 2011). Using aqueous enzyme solution as a replica for human digestive enzymes, the classification of dietary fibre can be made under controlled pH and using an invitro system (Ajila et al., 2010).

Cellulose

Cellulose is major plant cell component which is connected linearly with many glucose units that has β-1,4 glucosidic bonds (Arora, 2011). Due to its strong hydrogen bonding with microfibrils, cellulose has great resistance to biological degradation, mechanical strength and low aqueous solubility. Strong alkali does not dissolve cellulose but it can be dissolved in acid which is that it is called "amorphous" (Ajila et al., 2010). This shows the reason behind the indigestion of cellulose in human digestive tract to any extent.

Hemicellulose

After removal of water soluble and pectic substances polysaccharides, hemicellulose can be solubilized in aqueous alkali (Atef et al., 2013). The hemicellulose is smaller in size than size of cellulose which has linkage of β-1,4 glucosidic bonds as backbone. Hemicellulose also has many sugar like component such as xylose, galactose, mannose and arabinose (de Melo et al., 2000).

Lignin

Lignin contains 40 oxygenated phenylpropane units such as sinapyl, coniferyl and coumaryl alcohols that has gone through dehydrosenarative polymerization, which shows that lignin is not a polysaccharide but it's a random complex polymer (Bahloul et al., 2014). The methoxyl content and molecular weight may differ in lignin (Ismail et al., 2010). Lignin is very inert fibre because it has carbon-carbon linkage and strong intramolecular bonding. Compared to any other natural occurring polymer, lignin has greater resistance (Morais et al., 2015).

Pectin

D- galacturonic acid is the main constituent in the complex group of pectin substances and structural components of plant cell. Colonic bacteria can completely metabolized pectin and pectin are water-soluble fibre (Ittiyavirah, 2013). Pectins may effect intestinal transit time and reduce the rate of gastric emptying due to its gelling behaviour (Mallek-Ayadi et al., 2018). This attribute clearly shows that pectin has hypoglycemic properties.

Gums and mucilages

Gums and mucilages are secretory plant cells that are not constituted with cell wall component (Mallek-Ayadi et al., 2016). Gums and mucilages

has tendency to form gel binding with water and other organic material. In response to trauma gums form sticky perspiration (i.e. gum Arabic and guar gum) (Wen et al., 2015). Soluble dietary fibre gives the attribute that has ability to undergo partial enzymatic hydrolysis (Caliskan & Polat, 2012). Guar gum comes from the seed of *Cyamopsis tetragonolobus* (guar) which is known as galactomannans (Hoque & Iqbal, 2015). Gums expresses the characteristics that soluble fibre applies according to its physiological effects (Liara et al., 2014). Gum Arabic are also a complex mixture of arabinogalacton polysaccharide and glycoprotein which is obtained from acacia tree. To prevent enormous of plant seed mucilages are secreted in the plant (Nazeem et al, 2016).

Functional Properties in melon peels

Table 1 shows the functional properties of melon peel powder. The water holding capacity of food is needed in order to determine the optimal addition of water to obtain desirable texture of food product. The water holding capacity of maazoun melon was 5.36g water/peel. According to Al-Sayed and Ahmad (2013) the sharlyn melon peel and watermelon rind has higher value than maazoun peel which had 7.70g water/g peel and 7.13g water/g rind, respectively.). Al-Sayed and Ahmad (2013) stated that watermelon has lower water holding capacity which is 1.65g oil/ g rind the sharlyn melon has (2.4 oil/g peel) of oil holding capacity which is similar to maazoun melon peel (2.23g oil/g peel). Oil holding capacity is important property to stabilize food with high percentage of oil emulsion or fat. Certainly up to two times of melon peel mass has ability to retain oil. This characteristics of melon peel should be explored to strengthen fat retention capacity in meat products which normally tend to lose oil retention during cooking. This is very essential in yield maintaining and flavour retention (Ghanem et al., 2012).

Colour measurement of melon peel

Fruit peel is an important attribute for consumer's acceptability. Table 1 shows the colour measurement in maazoun melon peel. According to Chen et al. (2015) ravi melon peel (-7,64) is lower than maazoun melon peel (-2.36). Wen et al. (2015) stated that hami melon (7.47) has lesser a* value which shows lighter in green colour than that of maazoun melon peel. The ripening and storage periods may give variety of effect on the a* value, due to the changes in chlorophyll pigments that simplifies into smaller compounds in the peel tissues of melon (Parveen et al., 2012). Hami melon peels (24.76) has lower b* value than maazoun melon peel (30.19), but both has lower b* value than ravi melon peels, where the ravi melon peel is more yellow in colour. The most lightest colour of melon peel variety is the maazoun melon peel. Ravi melon peels (35.35) has lower L* value than maazoun melon peels (68.63) and maazoun melon peel has higher L* value than ravi melon peels (66.0) (Chen et al., 2015). The cultivar, growing condition, genotype, environmental factors and other harvest conditions directly gives effect to the pigments of peel colour in melon (Wen et al., 2015). The successions of carotenoids, flavonoids and chlorophyll affects the colour of melon peel due to pigment changes during maturation (Tadmor et al., 2016).

Table 1: Functional properties and colour of maazoun variety peel flour (*Cucumis melo* L.)

Parameter	Value
Water retention capacity (g water/g peel)	5.36±0.17
Oil retention capacity (g oil/ g peel)	2.23±0.11
Colour	
L*	68.63±0.98
a*	-2.36±0.04
b*	30.89±0.51

Functional properties in melon seed flour

Table 2 shows the functional properties of maazoun seed flour. The oil holding capacity of maazoun seed is 30.08g/oil g which is greater than seinat melon seed flour (23.67g/ oil g), this shows that maazoun seed can be used in meat product making. The electrostatic oil repulsion

can be stopped by adding protein that can function as surface emulsifying agents. An emulsifying capacity is done by mixing protein which can lower the surface tension between water and air. Siddeeg et al (2014) stated that the foam capacity of watermelon seed flour (18.21%) is lesser than maazoun melon seed (19.97%). From the functional properties observed, the water holding capacity and oil holding capacity has the potential to be used in meat and bakery products.

Colour measurement in melon seed flour

Table 2 shows the CieLab coordinate values of maazoun melon seed. The L* value is 66.31± 0.18, a* (3.25± 0.01) and b* (20.63±0.04) value was found in maazoun melon seed. The L*, a* and b* value in maazoun melon seed variety is lower than of that tibish melon seed flour.. This proves that maazoun melon seed has more carotenoid compounds due to its higher yellow pigments. The different colour of melon seed is due to its cultivar and storage condition. The usage of this melon seed flour may aid in colour addition to certain type of food products.

Table 2: Functional properties and colour of maazoun variety seed flour (*Cucumis melo* L.)

Parameter	**Value**
Bulk density(gmL^{-1})	0.65±0.03
Powder swelling (cm3 g^{-1})	2.07±0.12
Emulsifying capacity (%)	30.08±0.11
Foaming capacity (%)	19.97±0.02
Colour	
L*	66.31±0.18
a*	3.25±0.01
b*	20.63±0.04

CONCLUSION

Based on this review, the types of fibre and their cha racteristics corporation could be learned. Besides that, maazoun melon variety seed and peel has good potential to exhibit useful functional properties that can be used in food application.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

MS perform electronic database search and wrote the manuscript. NS, NH and ZZ supervised, design the experiment and reviewed the manuscript. All authors read and approved the final version.

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