JOURNAL OF AGROBIOTECHNOLOGY 2019, VOL 10(1S):1-12
e-ISSN: 2180-1983
https://journal.unisza.edu.my/agrobiotechnology/index.php/agrobiotechnology/index

Physical and Sensory Evaluation of Muffin Incorporated with Rubber Seed (*Hevea brasiliensis*) Flour, Pumpkin (*Cucurbita moschata*) Flour and Cassava (*Manihot esculenta crantz*) Flour

Nor Hidayah Abu Hassan, Noroul Asyikeen Zulkifli* and Lee Hoon Ho

School of Food Industry, Faculty of Bioresources and Food Industry,
Universiti Sultan Zainal Abidin, Besut Campus, 22200 Besut, Terengganu, Malaysia

***Corresponding author: asyikeenzulkifli@gmail.com**

Received: 05/08/2019, Accepted: 06/10/2019, Available online: 31/10/2019

ABSTRACT

This study was conducted to evaluate the physicochemical and organoleptic properties of muffin incorporated with different type of composite flour. In this study, three composites flour were produce with ratio 50:50 which are rubber seed and cassava flour (RCF), rubber seed and pumpkin flour (RPF) and cassava and pumpkin flour (CPF) and 100% wheat flour was used as control, to study their effect towards structural properties of muffin. The physicochemical and organoleptic properties (moisture, volume, texture, water activity, colour, pore size and sensory acceptance) of control and supplemented muffins were assessed. From the analysis, RPF showed the firmest texture 2.04±0.33 while RCF have high springiness 51.14±2.51 among the composite flour formulation. The addition of rubber seed flour in the formulation helps to improve the cell number of muffin which is 70 and 83 for RCF and RPF respectively. The RCF and CPF show lower moisture content than control which are 25.76±1.14 and 26.25±1.80 respectively. In terms of consumer acceptance, the RCF have the highest overall acceptability among tested composite flour. The incorporation of rubber seed flour into the RCF formulation improves the physical and organoleptic properties of the muffin.

Keyword: Rubber seed, Pumpkin, Cassava, Muffin, Physicochemical, sensory evaluation

INTRODUCTION

Composite flour defined by Milligan et al., (1981) as a mixture of flours, starches and other ingredients intended to replace wheat flour totally or partially in bakery and pastry products. Composite flours used were either a binary or tertiary mixture of flours from some other crops with or without wheat flour also agreed by (Shittu et al., 2007). Based on Hugo et al., (2000) and Hasmadi et al., (2014), composite flour is considered advantageous in developing countries which can reduce the importation of wheat flour. Application of composite flour in various food products can be economically advantageous if the wheat importation can be reduced or eliminated and bread and pastry products demand can replace the uses of wheat flour with domestically grown products reported by Food and Health Organization (FAO) (Jisha et al., 2008).

Rubber tree (*Hevea brasiliensis*) has been reported to have a lot of industrial and household products. In the plantation, the yield of seeds per annum was estimated to be 1400-2000 kg rubber seeds per ha per year (Eka, 2011) and normally regarded as waste. The seeds were recognized as a good source of vegetable because from the composition of the rubber seed contain protein which can be food for human. Pumpkin comes from genus *Cucurbita* of family Cucurbitaceae and fruits such as cucumber, squash, cantaloupes which extensively grown in tropical and subtropical countries. There are various food products made from pumpkin because it is a good source of carotene, pectin, mineral salts, vitamin and other nutrient which are very beneficial to human health. Pumpkin also rich with β-carotene which gives the yellow or orange colour to pumpkin and also high in carbohydrates and minerals (Lee, 1983). Cassava (*Manihot esculenta* Cranz) was considered as low risk crop which can adapt readily to a wide variety of agro-ecological conditions. It can stay on the ground unharvested for a long period of time and can withstand climatic variation (Oluwaniyi & Oladipo, 2017).

This study is the efforts to promote and encourage the uses of composite flour from local crops instead of wheat flour in muffins production. In this study, rubber seeds were used as a protein source Eka (2011), cassava flour highly containing starch Morgan and Choct (2016), and pumpkin flour contains a high nutritional value such carotenoid that can enhance the immune response. Currently, there is no study regarding the uses of those crops can produce high quality muffin. The production of composite flour would control the crops wastage, reduce the usage of wheat flour and increase the economic value due to reduce import rate of wheat flour. Besides, the product produce from composite flour is cheaper in price than commercial wheat flour. Thus, this study will be done to determine which flour combination is suitable for muffin production and have same quality with wheat flour. Also to produce muffins which are fit for human consumption.The objective of this study is to determine the physical and sensory evaluation of muffin incorporated with composite flour.

MATERIALS AND METHODS

Sampling of crops

The rubber seeds were obtained from Lembaga Getah Malysia located at Tok Dor, Jertih, Terengganu. The pumpkin and cassava were purchased from fruit stall at Tembila, Besut, Terengganu.

Flour preparation

The rubber seed undergo shell removal and washed to remove the foreign materials. The skin of pumpkin and cassava were removed, washed, sliced into 2mm thickness, soaking in 0.2% sodium metabisulphite and rinse. The purpose of soaked into 0.2% sodium metabisulphite to prevent browning occur during drying process. Then, the crops was dried at 60˚C for 24 hours by using cabinet dryer and undergo milling and sieving by using 250 µm mesh sieve.

Composite flour preparation.

The composite flour of RCF, RPF and CPF were produce with ratio (50:50). The RCF was supplemented with rubber seed flour and cassava flour. The RPF was supplemented with rubber seed and pumpkin flour while CPF was supplemented with cassava and pumpkin flour. In addition, 100% wheat flour was used as a control. Each treatment was mixed thoroughly to achieve uniformity of the blends.

Baking test

Muffin making process

The dry ingredients such as wheat flour or composite flour (RCF, RPF and CPF) baking powder, powder milk and salt were mixed. Then, the fat (butter) and 20% powdered sugar were blended in a hand mixer for 5 minutes or fluffy to create a soft and creamy consistency. Then, the egg was mix with other 80% of powdered sugar for 7 minutes until pale in colour. When the creaming process completed, the dry ingredient was added. The mixture was then mixed by using spatula until completely mix. The batter was added in a portion of 30g to muffin cup. Finally, the muffin was baked at 180˚C for 20 minutes. After baking process, the muffin was allowed to cool before further analysis.

Physical and sensory evaluation of the muffins

The physical characteristics such as moisture content, water activity, colour, texture, pore size and sensory evaluation of muffin samples were evaluated.

Moisture content

Moisture content was determined based on oven drying method (AOAC, 2000). The result was expressed as % of dry matter. The empty crucibles was weighed and recorded as W1. Two grams of sample was weighed and placed into crucible. The weight of crucible and fresh sample was labelled as W2. Crucible contain samples was dried in an oven at 105 ˚C for overnight and weight (W3). The reading was recorded for further calculation.

Water activity

The water activities of samples were analysed using an Aqua lab water activity meter model 4TE (USA). The sample was placed in the water activity meter and the data was obtained in triplicate.

Colour measurement

Crust and crumb colour was measured using the Chroma meter Minolta (CR-300 Trimulus Color Analyzer, Japan). The colour attributes Hunter L*, a* and b* values was recorded and L* defines lightness, a* denotes the red/green value and b* the yellow/blue value. The L* axis has the following boundaries: L=100 (white or total reflection) and L=0 (black or total absorption). Along a* axis, a colour measurement movement in the –a direction depicts a shift toward green; + a movement depicts a shift toward red. Along the b* axis, -b* movement represents a* shift towards blue; +a* shows towards yellow. Four measurements were taken from each sample.

Texture analysis

Texture parameters (springiness and firmness) of muffin samples was measured objectively by using a texture analyzer TA-XTPlus as adopted by the standard method by AACC, method 74-09 (AACC, 2000). All samples were prepared and baked on the day of the test. The probe was calibrated according to the instruction before conducting the test. A cube sample (2 cm x 2 cm x 2 cm) was cut from the middle of sample and was placed centrally beneath the probe in order to meet with a consistent flat surface. The compression test was selected in texture analysis using a 5 kg load cell and sample was compressed to 45% of its original height. The strain required for 45% compression was recorded using the following conditions: pre-test speed: 1.0 mm/s, test speed: 1.7 mm/s, post-test speed: 10 m/s, compression distance: 25% and trigger type: auto 5 g. The data was collected as the average of three readings.

Pore size

The pore sizes of the muffins were determined by preparing 4 cm x 4 cm of slices from the middle of the crumb. The images of the crumb were captured using a Canon EOS 60D and analysed on ImageJ system.

Sensory evaluation

Muffin was cooled for 1-2 hour at room temperature (25 ˚C). Sensory evaluation was performed using 30 panellists comprising of graduate students of the Faculty of Bioresources and Food Industry, Universiti Sultan Zainal Abidin. Samples were randomly assigned to each panellist. The panellist was asked to evaluate each muffin for appearance, crumb texture, crust and crumb colour, taste, odour and overall acceptability. A 7-point hedonic scale was used where 1 = dislike very much to 7 = like very much.

Statistical Analysis

Statistical analysis was performed using one way ANOVA to calculate mean rank. One way ANOVA was performed to compare the mean values of physicochemical and sensory evaluation. SPSS statistical software version 14 was used to analysed data and significant were determined at $p<0.05$.

RESULTS AND DISCUSSION

Physicochemical properties of the muffin samples

Effect of composite flour on moisture content of muffin

The moisture content of flour is very important in maintaining the flour from mould and insect infestation (Ayub et al., 2003). The moisture content that is suitable for storage stability and longer shelf life is 9 and 10% Ayub et al., (2003) and others study also show that 14% also suitable to maintain the shelf life of the flour**.** According to Table 1, there is significant difference ($p<0.05$) in the moisture content of flour between the formulation control, RCF, RPF and CPF. The CPF show the higher moisture content than RCF, RPF and control with the value 12.08±0.13, 7.54±0.03, 10.26±0.06 and 11.81±0.12 respectively.

Table 1. Moisture content of composite flour

Formulation	Moisture Content
Control	11.81 ± 0.13^{c}
RCF	7.54 ± 0.03^{a}
RPF	10.26 ± 0.06^{b}
CPF	12.08 ± 1.84^{d}

(a-d): Significant different ($p<0.05$) among formulation
RCF: rubber seed and cassava flour
RPF: rubber seed and pumpkin flour
CPF: cassava and pumpkin flour

Referring to Chandra et al., (2015), the moisture content of wheat flour is 13.28%. The moisture content of pumpkin flour, cassava flour and rubber seed flour is 10.96%, 10.38% and 3.99% respectively (Aristizábal et al., 2017; Saeleaw and Schleining, 2011; Eka et al., 2010). The incorporation of the flour into composite will reduce the moisture content of the flour which is same with finding Chandra et al., (2015), where the moisture content of composite flour decrease with increase other proportion of flour. The high moisture content of both cassava and pumpkin flour cause the high moisture content of CPF than other formulation. The high moisture content of CPF still can maintain it shelf life and quality because it is not exceed the 14% of recommended moisture for storage.

According to Table 2, the moisture content of RPF muffin has no significant difference ($p>0.05$) with control but RCF and CPF have significant difference ($p<0.05$) with control. The control was shown to have the highest value of 28.19±1.05 while the RCF and CPF have the lowest value of 25.76±1.14 and 26.25±1.80. The higher value shows the high moisture content in the baked muffin which susceptible to undergo spoilage. The moisture content of flour will influence the moisture content of the baked product. It is shown in Table 1 and 2 where the moisture content of flour influence the moisture content of muffin. The wheat flour show the higher moisture content than RCF and RPF thus resulted the high moisture content of muffin. The moisture content of RCF flour is the lowest among formulation resulted the baked muffin incorporated with RCF also show the lowest moisture content among formulation.

Although the CPF showed highest moisture content compared to other composite flour. However after baking, the moisture content of muffin incorporated with CPF show the lowest value than RPF and control. According to Clark and Aramouni (2018), flour can hold into moisture due to the cell wall structure in the wheat cells as well as the tendency for flour proteins to adsorb ambient moisture. Both the cassava and pumpkin are gluten free type and low in protein content, causing the adsorption of moisture very low and CPF cannot maintain the moisture during baking process. According to Charlotte Atchley (2016), the protein has it function to adsorb and hydrate the flour and different protein content would affect the adsorption capacity and retain the moistness of baked goods.

Table 2. Moisture content of muffin with different formulation

Formulation	Moisture Content
Control	28.19 ± 1.05^{b}
RCF	25.76 ± 1.14^{a}
RPF	26.68 ± 0.82^{ab}
CPF	26.25 ± 1.80^{a}

(a-b): Significant difference ($p<0.05$) among formulation

According to Table 2, the moisture content of control muffin showed highest than composite flour formulation. The control was made from wheat flour which is carbohydrate rich substrate that may contain high hydrophilic biopolymer which are strongly bind with water molecule and increase the water binding capacity (Chisté at al., 2015). Whereas, the RCF and RPF are protein rich substrate, which contain rubber seed (known to have high in protein content) causing the hydrophilic biopolymer presence are lower and reduce the water binding capacity of flour (Chisté et al., 2015). The composite flour formulation would help to improve the shelf life and storage stability of muffin products due to low moisture content than control.

Effect of composite flour on water activity of muffin

According to Table 3, there is significant difference ($p<0.05$) between the RPF and CPF with control but RCF has no significant difference with control. The control showed the highest water activity than RPF and CPF with value 0.88±0.02, 0.83±0.01 and 0.82±0.01 respectively. The RCF which incorporated with cassava and rubber seed flour have comparable characteristic of water activity with wheat flour. The cassava mainly contain of starch and it has higher water binding capacity compared to wheat flour (Eriksson et al., 2014).

Table 3. Water activity of muffin with different formulation

Formulation	Aw
Control	0.88±0.02[b]
RCF	0.88±0.01[b]
RPF	0.83±0.01[a]
CPF	0.82±0.01[a]

(a-b): Significant difference ($p<0.05$) among formulation

Whereas, rubber seed flour contain high proportion mineral content which can bound to more water. From the study, the combination of both rubber seed flour and cassava flour will produce muffin which contain high water activity than other composite flour formulation. According to Aukkanit and Sirichokworrakit, (2017), the water activity of pumpkin flour is 0.38%, thus causing the addition of pumpkin flour into the both CPF and RPF lowering the water of the muffin. The high proportions of water activity lead to the microbial spoilage. The RCF with water activity 0.88% susceptible for yeast spoilage (Rousseau & Donèche, 2015).

Effect of composite flour on crust colour of muffin

For the lightness (L*), there is no significant difference ($p>0.05$) between the RPF and CPF with control but there is significant difference ($p<0.05$) between RCF with control. The control showed the highest L* value than RCF which are 71.04±1.90 and 52.82±5.42 respectively (Table 4). The L* value indicates the whiteness or lightness colour of the muffin crust. The highest L* value cause the muffin have lighter crust colour whereas low L* value cause the muffin have darker crust colour. The control has the lighter colour than composite flour formulation due to higher pigment content in composite flour formulation reduce the lightness of composite flour.

Table 4. Crust colour of muffin with different muffin formulation

Formulation	Colour		
	L*	a*	b*
Control	71.04±1.90[c]	-0.36±0.43[a]	32.27±1.20[a]
RCF	52.81±5.42[b]	4.73±1.44[b]	30.99±2.53[a]
RPF	43.03±0.70[a]	9.30±2.63[c]	46.02±2.88[b]
CPF	45.84±1.88[a]	9.91±1.58[c]	52.24±3.45[c]

(a-c): Significant difference ($p<0.05$) among formulation

For the green or red value (a*) there is significant difference ($p<0.05$) between the RCF, RPF and CPF with control with value 52.81±5.42, 43.03±0.70, 45.84±1.88 and 71.04±1.90 respectively meanwhile, there is no significant difference ($p>0.05$) between the RPF and CPF. The control shows the -a* value which indicates the green colour due to the wheat flour does not contain red pigment like other composite flour formulation. The +a* value indicates the crust colour of muffin shift more towards red colour. The RPF and CPF has highest +a* value due to the muffin with addition of pumpkin flour has β-coretene rich food usually impart red, yellow, orange and yellow colour to the food (Simon, 1997).

Next for the blue or yellow colour (b*), there is significant difference ($p<0.05$) between RPF and CPF with control with value 46.02±2.88, 52.24±3.45 and 32.27±1.20 respectively meanwhile between the composite flour formulations show the significant difference ($p<0.05$) among the formulation. The +b* value indicates the crust colour of muffin shift more towards yellow colour whereas –b* indicate shift towards blue colour. The highest +b* value shows the increase in yellowness of the muffin crust. Among the formulation, the RPF and CPF shows the highest +b* value than other formulation due to the incorporation of pumpkin into the formulation increase the yellowness of the muffin where the β-carotene impart the yellow colour to the muffin (Lee, 1983).

Effect of composite flour on crumb colour of muffin

For the Lightness (L*) of the crumb there is significant difference ($p<0.05$) between the RCF, RPF and CPF with control. The control shows the highest value of L* than RCF, RPF and CPF, 68.35±2.14, 58.77±3.25, 43.10±2.55 and 56.21±1.14 respectively. The RPF shows the lowest L* value than RCF and CPF. The brown colour of rubber seed flour combine with carotene pigments in the pumpkin flour causing the RPF to become darker than other formulation thus reduce the L* value of the crumb.

Then, for the green or red (a*) value of the crumb there is significant difference ($p<0.05$) between the RCF, RPF and CPF with control, where the value are 1.44±0.45, 7.74±0.80, 7.96±0.96 and -2.70±0.23 respectively meanwhile between the composite flour formulation show significant difference ($p<0.05$) between the RPF and CPF with RCF. Both the RPF and CPF show the highest +a* value than other formulation. The combination of pumpkin flour in RPF and CPF does not give change in redness value for both formulations.

Next, for the blue or yellow colour (b*) there is significant difference ($p<0.05$) between the RPF and CPF with control, where the value are 52.87±1.69, 65.63±1.37 and 28.04±0.54 respectively meanwhile, among composite flour formulation show significant difference ($p<0.05$) between the RPF and CPF with RCF. The CPF show the highest b* value than RPF and RCF due to the addition of rubber seed flour in both RPF and RCF reduce the yellowness of the crumb. The Maillard reaction resulted from the addition of milk and sugar to the control formulation contribute to the yellowness of the crumb (Gallagher, 2003).

Table 5. Crumb colour of muffin with different muffin formulation

Formulation	Colour		
	L*	a*	b*
Control	68.35±2.14^{c}	-2.70±0.23^{a}	28.04±0.54^{a}
RCF	58.77±3.25^{b}	1.44±0.45^{b}	28.18±1.34^{a}
RPF	43.10±2.55^{a}	7.74±0.80^{c}	52.87±1.69^{b}
CPF	56.21±1.14^{b}	7.96±0.96^{c}	65.63±1.37^{c}

(a-c): Significant difference ($p<0.05$) among formulation

Effect of composite flour to the texture of muffin

Based on Table 6 the firmness of muffin there is significant difference ($p<0.05$) between the RCF and CPF with control with value 2.98±0.84, 6.53±0.84 and 1.86±0.28 respectively meanwhile, among the composite flour formulations showed significant difference ($P<0.05$) between the RCF and CPF with RPF (Table 6). The CPF showed the highest value of firmness (6.53±0.84) than RCF, RPF and control. The higher the firmness value, the harder the texture of muffin. Both the cassava and pumpkin flour are gluten free. Cassava and pumpkin flour lacks of gluten causing them unable upon hydration to form the cohesive visco-elastic dough (Eriksson et al., 2014). Cassava flour is very starchy flour, increase in its content in the composite flour assist the retrogradation upon cooling and also produce firm and compact bread because it will increase the dough viscosity (Defloor et al., 1995). Same going with RCF which has higher firmness value than RPF due to retrogradation of cassava, where crystallization of amylose and amylopectin cause increase the hardness of RCF.

Table 6. Firmness and springiness of muffin with different muffin formulation

Formulation	Firmness (kg)	Springiness (g)
Control	1.86±0.28[a]	53.17±3.17[b]
RCF	2.98±0.84[b]	51.14±2.51[b]
RPF	2.04±0.33[a]	42.45±0.64[a]
CPF	6.53±0.84[c]	49.69±1.85[b]

(a-c): Significant difference ($p<0.05$) among formulation

For the springiness of muffin, there is no significant difference ($p>0.05$) between the RCF and CPF with control meanwhile, among composite flour formulations show significant difference ($p<0.05$) between RCF and CPF with RPF. The RPF shows the lowest springiness than control, RCF and CPF with value 42.45±0.64, 53.17±3.17, 51.14±2.51 and 49.69±1.85 respectively. The low springiness of muffin indicates the low elasticity of the muffin. The fats or oils content up to 30% will reduce the springiness and cohesiveness of the baked products (Mancebo et al., 2017). According to Eka et al., (2010), the rubber seed flour contain high fat content (68.54g/100g) which then effect the springiness of the muffin. It is also supported by the Różyło et al., (2014), the addition of pumpkin flour reduced the elasticity and cohesiveness of the bread. The RPF is made up of both the rubber seed and pumpkin flour which resulted reduces the springiness of the muffin.

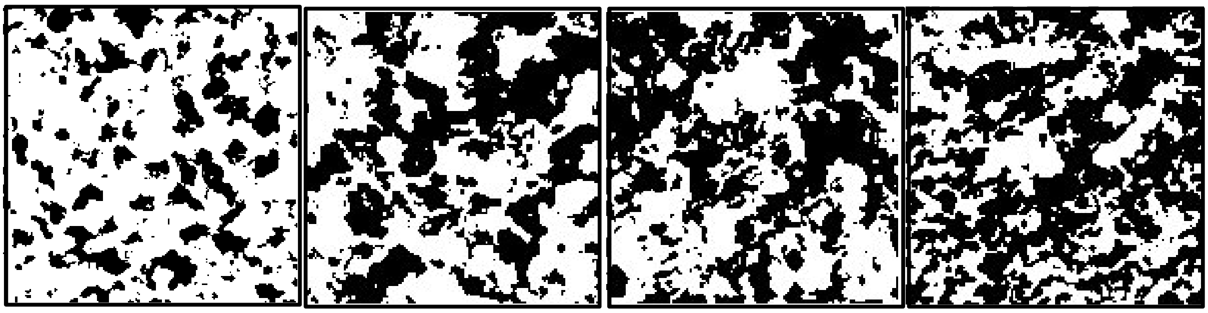
Effect of composite flour to the pore size of muffin

According to Table 7, the CPF show the lowest cell number while the control has the highest cell number. For the cell size, CPF shows the largest cell size than control, RCF and RPF. The highest cell numbers shows by the control, RCF and RPF due to the high protein content presence in the wheat flour for the control and rubber seed flour for RPF and RCF. The presence of protein in the muffin helps to improve the structure and will influence the gluten network formation (Ortolan & Steel, 2017). The cell number of RPF and RCF are lower than the control.

This is due the presence of rubber seed flour which is known to have high fat content which is 68.53g/100g (Eka et al., 2010). The function of fat is to disrupt the formation of gluten network by coating the flour particle with fat thus resulted in shorten network (Kaylegian, 1999). The cell size is also influence by the protein content of the flour. Both the cassava and pumpkin flour which incorporated in CPF are gluten free types of flour thus cause the production of non-uniform pore size (Figure 1). The cell size and cell number also influence the texture of muffin. The CPF shows the highest firmness than other formulation due to large cell size and low cell number resulted compact texture of muffin.

Table 7. Effect of composite flour to the pore size of baked muffin

Muffin	Control	RCF	RPF	CPF
Cell number	130	70	83	66
Cell size (mm^2)	6	9	8	11



CONTROL RCF RPF CPF

Figure 1. Binary image of muffins crumb using image J system

The organoleptic properties of muffin samples

Based on Table 8, there is significant difference ($p<0.05$) between RCF, RPF and CPF with control in term of appearance. Most of the panellist preferred control more than other formulation. The additions of composite flour into the muffin formulation causing the non-uniform appearance of muffin and reduce the acceptance of panellist towards the appearance of muffin. Next, there is no significant difference ($p>0.05$) between the colour of RCF and control. Most of the panellists preferred the brown colour of muffin than yellow colour impart by the pumpkin to the RPF and CPF. Then, for the aroma, there is no significant difference ($p<0.05$) between the RCF and control. Between the composite flour muffins, most of the panellist preferred RCF more than other formulation.

Table 8. Sensory evaluation attributes of muffin incorporated with composite flour

ATTRIBUTES	CONTROL	RCF	RPF	CPF
Appearance	5.90 ± 1.03^{c}	5.20 ± 0.98^{bc}	4.10 ± 1.14^{a}	4.63 ± 1.19^{ab}
Colour	5.40 ± 1.19^{b}	5.47 ± 1.16^{b}	4.13 ± 1.26^{a}	4.33 ± 1.30^{a}
Aroma	5.30 ± 1.26^{b}	5.23 ± 1.27^{b}	4.20 ± 1.21^{a}	4.23 ± 1.45^{a}
Texture	5.77 ± 0.90^{c}	4.83 ± 0.91^{b}	3.40 ± 1.00^{a}	4.27 ± 1.01^{ab}
Taste	5.93 ± 0.91^{c}	4.73 ± 0.87^{b}	3.63 ± 1.35^{a}	3.73 ± 1.41^{a}
Overall	5.93 ± 0.78^{c}	5.10 ± 0.84^{b}	3.90 ± 1.18^{a}	4.10 ± 1.05^{a}

(a-c): Significant difference ($p<0.05$) among formulation

Then, for the texture there is significant difference ($p<0.05$) between the RCF, RPF and CPF. Between the composite flour formulations most of the panellist preferred texture RCF more than other formulation even though base on texture analysis, RPF is the firmest than other formulation. For the taste, there is significant difference ($p<0.05$) between the RCF, RPF and CPF. The muffins incorporated with RCF shown to have higher acceptability than RPF and CPF. The rubber seed flour which incorporated in RCF imparts the nutty flavour and it is preferred by the panellist. The addition of pumpkin flour in higher percentage to the muffins formulation cause the unpleasant aroma and taste (Różyło et al., 2014).

For the average acceptability within the composite flour formulation, most of the panellists preferred the control compare to others. But intern of tested muffin samples, RCF as the best compare to RPF and CPF. The incorporation of rubber seed and cassava flour in the RCF has the ability to produce the muffin which comparable with control.

CONCLUSION

The crops successfully process into flour to increase their shelf life and make it timely available. The composite flour produced influence the physical properties of muffin. The RPF shows the highest moisture content compared other composite flour formulation. Thus, this will influence the texture properties where the RPF show the firmest among other formulations while the RCF and CPF have low moisture content than control which can improve the shelf life of the products. The RCF showed the properties comparable to the control muffin in terms of water activity and springiness. Among the tested composite flour the RCF showed the nearest as control intern of physical and sensory properties. Thus the incorporation of the underutilize crops into flour would reduce the waste and can improve the country economic.

CONFLICT OF INTEREST

The authors declare no conflicts of interest regarding the publication of this paper.

ACKNOWLEDGEMENT

This work was supported by research grants from UniSZA/2017/DPU/05.

REFERENCES

AACC 2000. Approved Methods of the AACC. 10th Edition, American Association of Cereal Chemists, St. Paul.

AOAC 2000. Official Methods of Analysis. 17th Edition, The Association of Official Analytical Chemists, Gaithersburg, MD, USA. Methods 925.10, 65.17, 974.24, 992.16.

Aristizábal, J., García, J. A., & Ospina, B. (2017). Harina de yuca refinada en panificación: Una revisión. *Ingenieria E Investigacion*, *37*(1), 25–33.

Aris, T., & Nadiah, W. (2010). Potential use of Malaysian rubber (Hevea brasiliensis) seed as food , feed and biofuel, 534, 527–534.

Ayub, M., Wahab, S., & Durrani, Y. (2003). Effect of Water Activity (A w) Moisture Content and Total Microbial Count on the Overall Quality of Bread. *International Journal of Agriculture & Biology*, **8530**:5–3.

Aukkanit, N., & Sirichokworrakit, S. (2017). Effect of Dried Pumpkin Powder on Physical , Chemical , and Sensory Properties of Noodle, (1), 14–18.

Chisté, R. C., Cardoso, J. M., Silva, D. A. da, & Pena, R. S. (2015). Hygroscopic behaviour of cassava flour from dry and water groups. *Ciência Rural*, *45*(8), 1515–1521.

Chandra, S., Singh, S., & Kumari, D. (2015). Evaluation of functional properties of composite flours and sensorial attributes of composite flour biscuits. *Journal of Food Science and Technology*, **52(6)**:3681–3688.

Charlotte, E. (2004). Starch in food: structure, function and applications. CRC Press, downloaded from http:// en.wikipedia.org/wiki/Farinograph"

Clark, E. A., & Aramouni, F. M.(2018). Evaluation of Quality Parameters in Gluten-Free Bread Formulated with Breadfruit (Artocarpus altilis) Flour. *Journal of Food Quality*, 1-12

Defloor, I., Leijskens, R., Bokanga, M. and Delcour, J. A. (1995). Impact of genotype, crop age and planting season on the bread making and gelatinization properties of flour produced from cassava (Manihot esculenta Crantz). *Journal of the Science of Food and Agriculture,* 68: 167–174

Eka H.D. (2011). The Effect of Physical Treatment and Fermentation On Chemical And Nutritional Composition Of Malaysian Rubber Seed. Master Thesis. Universiti Sains Malaysia.

Eka H.D., Aris, T., & Nadiah, W. (2010). Potential use of Malaysian rubber (Hevea brasiliensis) seed as food. *Feed And Biofuel*, 534, 527–534.

Eriksson, E., Koch, K., Tortoe, C., Akonor, T. P., & Oduro-Yeboah, C. (2014). Evaluation of the physical and sensory characteristics of bread produced from three varieties of cassava and wheat composite flours. *Food and Public Health*, *4*(5), 214–222.

Gallagher, E., Gormley, T. R., & Arendt, E. K. (2003). Crust and crumb characteristics of gluten free breads. *Journal of Food Engineering*, *56*(2–3), 153–161.

Gurung, B., Ojha, P., & Subba, D. (2016). Effect of mixing pumpkin puree with wheat flour on physical, nutritional and sensory characteristics of biscuit. *Journal of Food Science and Technology Nepal*, **9**:85.

Hasmadi, M., Siti Faridah, A., Salwa, I., Matanjun, P., Abdul Hamid, M. and Rameli, A. S. (2014). The effect of seaweed composite flour on the textural properties of dough and bread. *Journal of Applied Phycology* 26:1057–1062.

Hugo, L. F., Rooney, L. W. and Taylor, J. R. N. (2000). Malted sorghum as a functional ingredient in composite bread. *Cereal Science* 79(4): 428-432.

Jisha, S., Padmaja, G., Moorthy, S. S., & Rajeshkumar, K. (2008).Pre-treatment effect on the nutritional and functional properties of selected cassava-based composite flours. *Innovative Food Science & Emerging Technologies,* 9(4):587-592.

Kaylegian, K. E. (1999). The production of specialty milt fat ingredients. *Journal of Dairy Science*, 82: 1433-1439

Lee, F.A. (1983). Basic Food Chemistry.AVI Publisher, Westport.

Mancebo, C. M., Martínez, M. M., Merino, C., de la Hera, E., & Gómez, M. (2017). Effect of oil and shortening in rice bread quality: Relationship between dough rheology and quality characteristics. *Journal of Texture Studies*, *48*(6), 597–606.

Milligan, E. D., Amlie, J. H., Reyes, J., Garcia, A. and Meyer, B. (1981). Processing for production of edible soy flour. *Journal American Oil Chemistry Social* 58:331.

Morgan, N. K., & Choct, M. 2016. Cassava: Nutrient composition and nutritive value in poultry diets. *Animal Nutrition*, 2(4): 253-261

Oluwaniyi, O. O. & Oladipo, J. O. (2017).Comparative Studies on the Phytochemicals, Nutrients and Antinutrients Content of Cassava Varieties. *Journal of turkish chemical society.* JOTCSA, 4(3): 661-674

Oladunmoye, O. O., Aworh, O. C., Maziya-Dixon, B., Erukainure, O. L., & Elemo, G.N. (2014). Chemical and functional properties of cassava starch, durum wheat semolina flour, and their blends. *Food Science & Nutrition*, 2(2), 132–138. In, dos Santos, S. S., Melo, D. M., da Silva, L. A., Zago, T. A. S., Pontes, A. R., & Pinedo, R. A. (2017). Technological Use of Cassava and Passion Fruit Flours in Preparing Cookies. *Journal of Culinary Science and Technology*, *15*(1), 54–63.

Ortolan, F., & Steel, C. J. (2017). Protein Characteristics that Affect the Quality of Vital Wheat Gluten to be Used in Baking: A Review. *Comprehensive Reviews in Food Science and Food Safety*, *16*(3), 369–381.

Rousseau, S., & Donèche, B. (2015). Effects of water activity (a_w) on the growth of some epiphytic micro-organisms isolated from grape berry. *Journal of Grapevine Research*, *40*(2), 75–78.

Różyło, R., Gawlik-Dziki, U., Dziki, D., Jakubczyk, A., Karaś, M., Różyło, K., … Rózylo, K. (2014). Wheat Bread with Pumpkin (Cucurbita maxima L.) Pulp as a Functional Food Product. *Food Technology and Biotechnology*, *52*(4), 430.

Saeleaw, M., & Schleining, G. (2011). Composition , Physicochemical and Morphological Characterization of Pumpkin Flour. 11th International Congress on Engineering and Food - "Food Process Engineering in a Changing World".

Shittu, T., Raji, A. O., & Sanni, L. O. (2007). Bread from composite cassava-wheat flour: Effect of baking time and temperature on some physical properties of bread loaf. *Food Research International.* 40: 280–290.

Simon, P.W. (1997). Plant pigments for color and nutrition. *HortScience*, 32: 12-13.

How to cite this paper:
Abu Hasan N. H., Zulkifli N. A. & Ho L. H. (2019). Physicochemical and Organoleptic Properties of Muffin Incorporated with Rubber Seed (*Hevea brasiliensis*) Flour, Pumpkin (*Cucurbita moschata*) Flour and Cassava (*Manihot esculenta crantz*) Flour. Journal of Agrobiotechnology*, 10*(1S), 1-12