Consumer acceptance of chocolate formulated with functional ingredient

D R A Muhammad¹, F Zulfa², D Purnomo², C Widi atmoko² and D L N Fibri³

¹ Dept. of Food Science and Technology, Faculty of Agriculture, Universitas Sebelas Maret Jl. Ir. Sutami 36A Kentingan, Surakarta 57126 Indonesia
² Vocational School of Agricultural Product Technology, Universitas Sebelas Maret Jl. Imam Bonjol, Sumbersoko, Pandean, Kec. Mejayan, Madiun, Jawa Timur 63153 Indonesia
³ Dept. of Food and Agricultural Product Technology, Faculty of Agricultural Technology, Universitas Gadjah Mada Jl. Flora 1 Bulaksumur Yogyakarta 55281 Indonesia.

Corresponding author: dimasrahadian@staff.uns.ac.id

Abstract. Giving added-value on locally-based agricultural products such as mung bean, fenugreek seed and moringa leaf is considered as an effective way to support the sustainability of agriculture and environment. In this study, powdered mung bean, fenugreek seed and moringa leaf were added into chocolate bar formula. The purpose of this study was specifically to determine the effect of powdered mung bean, fenugreek seed and moringa leaf addition on the consumer acceptance of chocolate bar. The ingredients were added at concentration of 5%, 10% and 15%. A 7-point scale scoring method was used to perform a hedonic test with 60 panelists for colour, taste, texture, aroma and overall attributes. One-way ANOVA followed by DMRT was carried out to analyse the result statistically. The results show that the addition of mung bean, fenugreek seed and moringa leaf significantly decrease the panelists’ acceptance on the chocolate bar at all parameters. As such, the chocolate control obtained an overall score of 6.2 while the chocolate formulated with mung bean, fenugreek seed and moringa leaf got a score range of 3.8–4.7, 2.1–2.9 and 4.5–4.8, respectively. The similar trends were also found at aroma and taste attributes. The decrease of panelists’ acceptance depended on the type of the additional ingredient. The results obtained in this study show the importance of ingredient selection in the making of functional chocolate.

1. Introduction
Cocoa (Theobroma cacao L.), the main ingredient of chocolate, is produced in 32 of 34 provinces in Indonesia with total cocoa plantation area about 1.7 ha. This country was the third cocoa producing country in the world in 2013 with total production of 375,000 tonnes cocoa beans. However, the production continuously decreases and hence the production dropped to 240,000 tonnes in 2018 [1]. This condition was caused by the fact that cocoa farming was considered to have less profit than other activities, and thus the farmer had less motivation to grow and maintain cocoa trees. To overcome this problem, cocoa farming and agro-industrial practises shall adopt sustainable agricultural system. In the sustainable agricultural system, several factors including environmental conservation, agricultural production, farm profit, and community well-being must be taken into account and hence farmers,
food industries, distributors, retailers, consumers, and waste managers have significant roles in this system [2,3]. Thus, giving added value to agricultural products can be an alternative way to support sustainable agricultural system particularly in cocoa commodity as it can increase profitability of farmers and food industry.

Increasing added-value of cocoa can be carried by producing high-quality chocolate containing high-levels of phenolic compounds [4–6]. In fact, phenols have gained high attention nowadays by scientists because of its potential health effect, and hence potentially used for the formulation of functional food [7,8]. Many studies have shown that raspberry leaves, nettle leaves, mangosteen pericarp, blackberry, goji berry, black mulberry, peanut skins, ginger and cinnamon effectively improved the phenolic content and the antioxidant activity of chocolate [9–16]. However, till date, there is no study regarding the supplementation of powdered mung bean (Vigna radiata), fenugreek seed (Trigonella foenum-graecum) and moringa leaf (Moringa oleifer) in chocolate. These materials have nutritional potential and functional properties [17–19], and hence may improve the health-promoting properties and increase the added-value of chocolate. Nevertheless, previous studies showed that the supplementation of functional ingredients in chocolate may affect sensory properties and also consumer acceptance of the chocolate [20,21].

Knowing the consumer acceptance of food is crucial since it can be used to predict the product positioning in the market. Investigating consumer acceptance can be carried out by sensory analysis. This is a well-established scientific measurement to identify, analysis and interpret product attributes using human senses. Thus, this study aims to investigate the consumer acceptance of chocolate formulated with powdered mung bean, fenugreek seed and moringa leaves.

2. Materials and Methods
Mung bean, fenugreek seed and moringa leaf were obtained from traditional market in Madiun, East of Java. The materials were prepared using a consecutive step of drying, grinding and sieving to obtain powder with particle size around 80 mesh. A block of Tulip milk chocolate compound (PT Freyabadi Indotama, Karawang, Indonesia) was melted in a microwave. The molten milk chocolate compound was then mixed with powdered mung bean, fenugreek seed and moringa leaf at a concentration of 5, 10 and 15% (w/w). Afterward, the formulated chocolates were manually tempered and moulded. Before de-moulding, the chocolates were incubated for 2 h. Finally, the chocolates were packed using aluminium foil and stored properly for the further analysis.

Sensory evaluations of the formulated were conducted by 60 untrained panelists using hedonic test method with a 7-point scale to measure the level of liking for every formula in the parameter of appearance, aroma, taste, texture and overall. Panelists indicated the level of liking by giving numerical scores, in which 1 represented “extremely dislike”, 4 represented “neither like nor dislike” and 7 represented “extremely like”. One-way ANOVA followed by Duncan Multiple Range Test at the confidence level of 95% was carried out to analyze the result statistically.

3. Results and discussion
Figure 1 shows the level of consumer acceptance of chocolate formulated with various concentration of mung bean, moringa and fenugreek seed. Supplementation of mung bean, moringa and fenugreek seed significantly affected the consumer acceptance. In general, color, aroma, texture and appearance are important factors determining the overall quality of foods and furthermore the consumer acceptance.
Figure 1. Consumer acceptance of chocolate formulated with various concentration of mung bean (A), moringa (B) and fenugreek seed (C).

Chocolate control obtained the highest score at the parameter of appearance, taste, texture aroma and overall, which was at a level of 5.73, 6.17, 5.57, 5.43 and 6.27, respectively. Supplementation of powdered mung bean (5–15%) slightly decreased the consumer acceptance at the parameter of appearance to the score range of 4.97 and 5.20, and texture to the score range of 4.27 and 4.57. It is hypothesized that mung bean powder entered to the chocolate matrix weakening the inter-particle interaction in the chocolate matrix. Particle-particle interaction is positively correlated to the hardness of the chocolate [4]. Another reason of the decrease of consumer acceptance at the parameter of texture might be due to the initial particle size of the added ingredients which was 80 mesh (equal to 177 micron). It has been reported that grittiness can be perceived in chocolate with particle size bigger than 35 microns [4].

The effect of mung bean powder at the parameter of taste and aroma was more pronounced than the parameter of appearance and aroma. The consumer acceptance level at the parameter of taste and aroma decreased to a range of 3.27–4.53 and 3.87–4.63, respectively. The higher concentration of mung bean, the lower consumer acceptance. Mung bean is known to contain phenols and some other compounds causing astringency [22]. The natural compounds in the mung bean may alter the taste and aroma of the chocolate. The aroma and taste seemed to be important quality parameter of chocolate. It was indicated by a significant drop of the consumer acceptance at overall parameter where the decrease of the consumer acceptance at this parameter was directly proportional with the aroma and taste parameters.

The similar phenomenon was also found in the supplementation of powdered moringa leaves. The addition of moringa leaves at the concentration of 5–15% somewhat decreased the consumer
acceptance at the parameter of appearance to the score range of 4.50 and 4.70, and also texture to the score range of 4.13 and 4.90. Interestingly, there was also a slight impact of moringa leave powder to 4.30–4.70 and 4.07–4.57, respectively. It was shown that the parameter of taste and aroma, the impact of mung bean powder was more pronounced than that of moringa leaf powder. Hence, the overall scores of chocolates with moringa leaves were higher than the overall scores of chocolates with mung bean at all concentration. This indicates that moringa leaf is more potential to be added to chocolate formula in the making of commercial functional chocolate compared to mung bean.

The supplementation of fenugreek seed into chocolate resulted in the lowest level of consumers acceptance among the modified chocolate. Significant drops of the consumer acceptance were observed at the parameters of appearance (4.13–4.23), taste (1.74–2.43), texture (3.61–4.00), aroma (2.58–3.13) and hence overall (2.13–2.93). The alteration of consumer acceptance at the attribute of appearance was less pronounced than the other parameters. It can be understood because the panelists did not need to smell, taste or bite the sample and only used their eyes when giving the score. When the panelists smelled, tasted or bite the chocolate formulated with fenugreek seed, the panelist perceived the natural compounds originating from the fenugreek seed which are undesirable. As reported, fenugreek seed contained sapogenin, phenols (mostly raphonticin and isovitexin), diosgenin, trigogenin, gitongenin, coumarin and alkaloids [23]. These compounds are hypothesized to significantly alter the aroma and to exhibit bitter taste and even caused the chocolates obtained scores close to “extremely dislike”.

Thus, this research clearly shows that supplementation of mung bean, moringa and fenugreek seed significantly affected the consumer acceptance of chocolate. Even though the materials naturally contain bioactive compounds potentially used for improving the health-promoting of chocolate, the use of these materials must consider their impact on the sensory properties of the chocolate. Ingredient selection in the making of functional chocolate is highly recommended.

4. Conclusion
To conclude, chocolate formulated with mung bean, fenugreek seed and moringa leaves had a lower panelists’ acceptance than chocolate control particularly at the attribute of aroma and taste. Chocolate with moringa leaves had the highest level of acceptance among the modified chocolate formula strongly indicating that the decrease of panelists’ acceptance was ingredient type dependent. Furthermore, the level of consumer acceptance was also influenced by the concentration of the ingredient supplemented in the chocolate. This study emphasizes the importance of ingredient selection in the making of functional chocolate.

Acknowledgements
This work was funded by Universitas Sebelas Maret through Program Penelitian Program Studi di Luar Domisili (PDD) Universitas Sebelas Maret di Kabupaten Madiun Tahun Pelaksanaan 2019 (Grant No. 2297/UN27.21/PN/2019).

References
[1] Statistic of Indonesia 2020 Produksi Tanaman Perkebunan 1–2
[2] Pandey G 2018 Environ. Technol. Innov. 11 299–307
[3] Scott N R, Chen H and Cui H 2018 J. Agric. Food Chem. 66 6451–6
[4] Muhammad D R A, Saputro A D, Rottiers H, Van de Walle D and Dewettinck K 2018 Eur. Food Res. Technol. 244 1185–202
[5] Muhammad D R A, Praseptiangga D, Van de Walle D and Dewettinck K 2017 Food Chem. 231 356–64
[6] Muhammad D R A, Gonzalez C G, Sedaghat Doost A, Van de Walle D, Van der Meeren P and Dewettinck K 2019 Food Bioprocess Technol. 976–89
[7] Muhammad D R A, Sedaghat Doost A, Gupta V, bin Sintang M D, Van de Walle D, Van der Meeren P and Dewettinck K 2020 Food Hydrocoll. 100 105377
[8] Muhammad D R A and Dewettinck K 2017 *Int. J. Food Prop.* **20** 2237–63
[9] Belščak C A, Komes D, Benkovič M, Karlović S, Hečimović I, Ježek D and Bauman I 2012 *Food Res. Int.* **48** 820–30
[10] Muhammad D R A, Tuenter E, Patria G D, Foubert K, Pieters L and Dewettinck K 2020 *Food Chem.* **340** 127983
[11] Gültekin Ö M, Karadaʇ A, Duman Ş, Özkal B and Özçelik B 2016 *Food Chem.* **201** 205–12
[12] Lončarević I, Pajin B, Fišteš A, Tumbas Šaponjac V, Petrović J, Jovanović P, Vulić J and Zarić D 2018 *Lwt.* **92** 458–64
[13] Sim S Y J, Ng J W, Ng W K, Forde C G and Henry C J 2016 *Food Chem.* **200** 46–54
[14] Morais Ferreira J M, Azevedo B M, Silva F G D e, Luccas V and Bolini H M A 2016 *Int. J. Food Sci. Technol.* **51** 2114–22
[15] Dean L L, Klevorn C M and Hess B J 2016 *J. Food Sci.* **81** S2824–30
[16] Belščak-Cvitanović A, Komes D, Durgo K, Vojvodić A and Bušić A 2015 *J. Food Sci. Technol.* **52** 7723–34
[17] Dahiya P K, Linnemann A R, Van Boekel M A J S, Khetarpaul N, Grewal R B and Nout M J R 2015 *Crit. Rev. Food Sci. Nutr.* **55** 670–88
[18] Roberts K T 2011 *J. Med. Food* **14** 1485–9
[19] Falowo A B, Mukumbo F E, Idamokoro E M, Lorenzo J M, Afolayan A J and Muchenje V 2018 *Food Res. Int.* **106** 317–34
[20] Ilmi A, Praseptiangga D and Muhammad D R A 2017 *IOP Conf. Ser. Mater. Sci. Eng.* **193** 1–6
[21] Muhammad D R A, Lemarcq V, Alderweireldt E, Vanoverberghe P, Praseptiangga D, Juvinal J G and Dewettinck K 2020 *J. Food Sci. Technol.* **57** 1731–9
[22] Singh B, Singh J P, Kaur A and Singh N 2017 *Food Res. Int.* **101** 1–16
[23] Wani S A and Kumar P 2018 *J. Saudi Soc. Agric. Sci.* **17** 97–106