Potential of gathot (fermented cassava) from livestock feed to analog rice

A Ratnaduhita\textsuperscript{1,2,*}, Y Pratama\textsuperscript{3}, A M P Nuhriawangsa\textsuperscript{2}, Y B Pramono\textsuperscript{3} and L R Kartikasari\textsuperscript{2}

\textsuperscript{1} Department of Livestock Production, Akademi Peternakan Karanganyar, Karanganyar, Indonesia 57716
\textsuperscript{2} Department of Animal Science, Faculty of Agriculture, Universitas Sebelas Maret, Surakarta, Indonesia 57126
\textsuperscript{3} Department of Food Technology, Faculty of Livestock and Agriculture, Universitas Diponegoro, Semarang, Indonesia 50275

*Corresponding author: astariratna@gmail.com

Abstract. The objective of this research was to analyze the potential of gathot as an analog rice ingredient with the addition of red bean CMC as a binder, according to water absorption value, crude fiber content, and aftertaste by hedonic test. This study consisted of 4 treatments, and each treatment was repeated 5 times. The treatment was the addition of CMC in the manufacture of analog rice made from gathot flour and red bean flour with a level of 0; 1; 2; 3%. The test includes water absorption, crude fiber content, and aftertaste with a hedonic test. The data were analyzed by Completely Randomized Design (CRD) and processed using SPSS 23.0. Gathot's analog rice showed water absorption 49.37%, crude fiber content 0.57 g/mL, and aftertaste 3.24. Gathot's analog rice with the addition of red bean flour and CMC as binder influences the water absorption value and crude fiber content. The optimal concentration of CMC in gathot's analog rice is 1%, with the water absorption value of 163.37% and crude fiber content of 5.37%.

1. Introduction
Gathot is a local Indonesian product derived from spontaneously fermented cassava with blackish patches almost on its surface. Fungus \textit{Acremonium charticola}, which causes blackish patches on gathot contains high tannin and phenol and good probiotic for the digestive tract, while the other fungus, \textit{Rhizopus oryzae}, contains high flavonoid \cite{1}. Gathot is commonly known as a traditional snack served with grated coconut, while the other processed products are for livestock feed.

Livestock feed made from gathot commonly has high protein content due to the fermentation of the fungus \textit{A. charticola} during the process of making cassava into gathot. In addition, the fungus in gathot also plays an important role in breaking down lignocellulosic, thereby increasing the availability of nutrients for livestock \cite{2}. The probiotic content in gathot is also beneficial for the digestive tract of livestock \cite{3} as well as flavonoid content which is an antioxidant compound for boosting the host immune system \cite{4}.

Gathot utilization in society is still limited to traditional food with its not long storage period. In contrast, gathot may potentially be processed into other processed products by utilizing amylose and amylopectin in gathot's polysaccharide. Previous studies have reported concerning gathot utilization as
a food product. It has been processed into steamed sponge cake [5], gluten-free noodles [6], and edible film [7]. Gathot may be served as gathot flour for an extended storage period. Gathot flour contains amylose 33.8% and amylopectin 39.41% [5]. Amylose and amylopectin content is an important indicator for analog rice characteristics.

Analog rice is an "imitation" rice shaped like rice. It can be made from non-rice flour with the addition of water [8]. The manufacture of analog rice is carried out by beginning the formulation, steaming, printing, and drying process to obtain rice-like products [9]. Analog rice that has been made first includes analog rice made from corn flour, but corn is considered inappropriate because of its high glycemic index content [10]. Most analog rice is made with common ingredients, but locally widely consumed ingredients are still very little, like gathot. Because the fiber content of gathot is still low, it is necessary to add other ingredients that are rich in fiber, one of which is red beans.

Analog rice made from gathot and red beans has been previously researched, but the study results indicate that additional binders are still needed for better performance. Thus, this research aims to analyze the potential of gathot as an analog rice ingredient with the addition of red bean CMC as a binder, according to water absorption value, crude fiber content, and aftertaste by hedonic test.

2. Materials and methods

2.1. Materials

The materials included commercial dried gathot obtained from a producer in Gunungkidul, Yogyakarta, red bean, and carboxymethyl cellulose (CMC) as a binder. The instruments employed included a grinder, 80-mesh screen, dry sterilization oven, and analytical balance.

2.2. Methods

The method in this study was experimental, and data were analyzed using a completely randomized design. The data resulting from the test or analysis were analyzed statistically using Duncan Multiple Range Test (DMRT) at a significance level of 5% [11]. All of the data were analyzed using the SPSS 23.0 program.

First, dried gathot was inserted into the grinder, ground for about 30 seconds several times until fine powder was resulted, and screened using an 80-mesh screen that became gathot flour. Red bean flour was added to make analog rice. Red bean was soaked by water 1:10 within 24 hours, then steamed for 90 minutes and dried with food dehydrator 60°C for 6 hours. The dried red bean was mashed by a grinder to be a red bean flour.

The second step was the manufacture of analog rice, which refers to the previous method [9] with several modifications, starting from mixing 80 g of gathot flour, 20 g of red bean flour and CMC according to the treatment (0, 1, 2 and 3% (b/v) mixed with water 170 ml. The dough was steamed at 80-90°C, then put the dough into noodle maker and put into food dehydrator to be dried for 24 hours with 60°C. The dried analog rice was mashed and sifted by 80 mesh sieve then packed into the pouch for storage. The analog rice sample was tested for water absorption [12] and crude fiber content [13].

The third step was to make gathot's analog rice into cooked rice by soaking it for 30 seconds and then steaming it for 20 minutes. The cooked analog gathot was ready to be eaten and tested for aftertaste by hedonic test [14].

3. Results and discussion

3.1. Water absorption

One of the parameters that determine the quality of rice is water absorption. Water absorption is the ability of a product to absorb water to the maximum [12]. Starch granules absorb water and bind to the hydroxyl groups of amylose and amylopectin molecules so that granules swell after the water is absorbed [15].
Figure 1. Water absorption of gathot's analog rice
Note: Different superscript letter shows the significant difference (P<0.05)

The result shows that gathot analog rice with CMC addition with levels of 0, 1, 2, and 3% as a binder has water absorption of 137.66; 163.38; 169.13, and 177.18%, respectively. Results showed that the increase in CMC level significantly (P<0.01) influences water absorption value. Water absorption is affected by the levels of amylose in foodstuffs. The composition of starch, called amylose and amlopectin, is a factor that affects the value of water absorption in analog rice [16]. The amylose content in analog rice is usually about 20-24% to produce rice that is "pulen" or not "pera" [17]. As a reference, there has been an analysis of water absorption in "mentik" rice by 361.91% and in black rice by 462.61%. This value is higher compared to gathot analog rice. The low water absorption value in analog rice is due to the high levels of amylose in gathot. Gathot flour contains amylose levels of 33.8% [18].

The addition of fiber from red bean flour also affects the absorption of analog rice water to be lower than rice in general. The addition of fiber can cover the surface of the material so that water absorption by granules is hampered [19]. The absorption value of water is seen to increase along with the addition of CMC concentration. The highest water absorption is in the treatment of CMC concentration addition of 3%. This is because CMC is a hydrocolloid that can bind and hold water properly. The hydroxyl group in CMC interacts with water, so the higher the CMC concentration is added, the higher the water absorption [20].

3.2. Crude fiber content
Fiber includes indigestible carbohydrates [21]. Dietary fiber is different from the crude fiber. Crude fiber is the rest of the dietary fiber left after being extracted with solvents, dilute acids, and alkalis [22].

The result shows that gathot's analog rice with CMC as a binder has crude fiber content of 4.60, 5.00, 6.78, and 7.42%. Statistical analysis results indicated that CMC concentration significantly (P<0.05) influences crude fiber content.

Levels of crude fiber Increased along with the addition of CMC concentration due to cellulose's presence. CMC is derived from cellulose which is part of both dietary fiber and crude fiber [23]. The presence of CMC also causes the crude fiber content in this analog rice, but also comes from gathot and red beans which in all four treatments have the same concentration of 80% and 20%. Based on theoretical calculations, the fiber content in gathot and red beans obtained a fiber content of 5.28% [24,25], and the figure is much higher than the fiber content in rice of 1.3% [26].
The crude fiber constitutes one-fifth of all dietary fiber [22]. This indicates that a portion of the total fiber in this gathot's analog rice is not counted because it is extracted with solvents. The high crude fiber content produced is because the crude fiber is not damaged or lost during the drying process. Cellulose is difficult to decompose or break down and can survive at high-temperature drying for a long time [27].

3.3. Aftertaste by hedonic test
Taste plays an important role in a food product [28]. The food product can be liked and accepted by panelists if it has a taste that suits the panelists. Food products sometimes have a taste left behind and can still be felt even though the food has been consumed, called aftertaste [29]. Aftertaste sometimes causes the panelist's acceptance rate to decrease when left behind aftertaste disturbs the panelist's sensory.

The addition of CMC concentrations affects the rate of panelist acceptance of the resulting analog rice flavor (Figure 3). The most preferred or most accepted taste by panelists is rice analog with CMC 0% with a score of 3.24. Panelists prefer to like analog rice which at least leaves the bitter aftertaste. The taste is strongly influenced by its temperature, concentration, and interaction with other foodstuffs [30]. Gathot itself has a bitter aftertaste when consumed regularly due to the presence of compounds.
that cause the appearance of a bitter taste. The addition of CMC causes the bitter-causing compound to bond. The hydrocolloid properties in CMC work to encapsulate bitter particles and other flavors and lock them so that these compounds are not easily lost due to the high-temperature heating process [31].

4. Conclusion
Gathot's analog rice with the addition of red bean flour and CMC as binder influences increased the water absorption value and crude fiber content. The optimal concentration of CMC in gathot's analog rice is 1%, with the water absorption value of 163.37% and crude fiber content of 5.37%.

References
[1] Sugiharto S, Yudiarti T and Isroli I 2016 Antioxidants 51 1–6
[2] Kazda M, Langer S and Bengelsdorf F R 2014 Energy Sustain Soc. 4 6
[3] Kabir S M 2009 Int. J. Mol. Sci. 10 31–46
[4] Brambilla D, Mancuso C, Scuderi M R, Bosco P, Cantarella G, Lempereur L, Di Benedetto G, Pezzino S and Bernardini R 2008 Nutr. J. 7 29
[5] Kurniawati N 2019 J. Tata Boga 81 40–47
[6] Purwandari U, Tristiana G R and Hayati 2014 J. Int. Food Research 215 16–23
[7] Ratnadewita A, Nuhriawangsa A M P and Kartikasari L R 2021 Livest & Anim. Res. 19 227–237
[8] Noviasari S F, Kusnandar and Budijanto 2013 J. Tekn Ind. Pangan 24 194–200
[9] Budi F S, Hariyadi P, Budijanto S dan Syah D 2013 J. Pangan 22 263–274
[10] Hidayat B, Akmal S, Muslihudin M and Suhada B 2017 Assessment 61 19–24.
[11] Kristilya S, Sigit N and Jose R 2010 A Study on Anava Advance Examination in the Completely Randomized Design (Bengkulu: Faculty of Mathematics and Natural Sciences, UNIB)
[12] Dewi S K 2008 Pembuatan produk nasi instan berbasis Fermented Cassava Flour sebagai bahan pangan alternatif (Bogor: Fakultas Teknologi Pertanian Institut Pertanian)
[13] Setyowati W T and Nisa F C 2014 J Pangan & Agro 2 224–231
[14] Agusandi A, Supriadi A and Lestari S D 2013 J. Fishtech. 2 22–37
[15] Tester R F, Karkalas J and Qi X 2004 World's Poultry Sci. J. 60 186–195
[16] Herawati H and Widowati S 2016 Buletin Tekn. Pasca Panen 5 37–44
[17] Luna P, Herawati H, Widowati S and Prianto A B 2019 J. Pen. Pascapanen Pert. 12 1–10
[18] Kurniawati N 2019 J. Tata Boga 8 40–53
[19] Kumalasari R, Setyoningrum F and Ekafitri R E 2015 J. Pangan 24 37–48
[20] Putra G H, Nurali E J, Koapaha T and Laluan L E 2013 COCOS 2 1–9
[21] Kusharto CM 2006 J. Gizi Pangan 1 45–54
[22] Sinaga A I L 2017 Studi pembuatan mie kering kaya serat dengan proporsi tepung terigu dan tepung ganyong pada persentase soda abu yang berbeda (Malang: Universitas Muhammadya Malang).
[23] Prawitasari R H, Ismadi V D Y B and Estiningdiar 2012 Anim. Agric. J. 1 471–83
[24] Puastuti W, Yulistiani D and Susana I W R2014 JITY 19 143–151
[25] USDA 2014 National Nutrient Database for Windows Standard Reference Release SR 16032 (Washington: Nutrient Data Laboratory, Agriculture Research Service)
[26] USDA 2011 National Nutrient Database for Windows Standard Reference Release SR 20044 (Washington: Nutrient Data Laboratory, Agriculture Research Service)
[27] Nilasari O W, Susanto W H and Maligan J M 2017 J. Pangan Agro. 5 15–26
[28] Winarno F G 2004 Kimia Pangan dan Gizi (Jakarta: Gramedia Pustaka Utama)
[29] Widiantoko R K and Yuniangta 2013 J. Pangan Agro. 2 54–66
[30] Tamara S 2004 Usaha peningkatan stabilitas nektar buah jambu biji (Psidium Guajava L) dengan penambahan gum arab dan CMC (Carboxy Methyl Cellulose) (Yogyakarta: Universitas Wangsa Manggala).
[31] Setyadji L, Kasigiti, Broto W, Thahir R and Setyaningsih D 2018 J. Pen. Pascapanen Pert. 7 32–42
[32] Kusmiandany E, Pratama Y and Pramono Y B 2019 *J. App. Food Tech.* 6 9–11