Antihyperglycemic Effect and Antioxidants Properties of Black Rice
(Oryza sativa L. indica) Cereal and Anthocyanin Extract on
Health and Histopathology of Hyperglycemic Rats

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Abstract: Black rice (Oryza sativa L. indica) is rich in anthocyanin hence it could be used as functional food such as cereal for hyperglycemic patient. Black rice cereal supplemented with black soybean (Glycine max L. Merr) (RSC) was prepared as isocaloric feed for three groups of hyperglycemic rats. The first group (F0) was treated only with RSC, while the other two also receive 40 ppm (F4) and 80 ppm (F8) black rice bran anthocyanin extract (BRE). Non-hyperglycemic and hyperglycemic rats which were fed with standard feed were used as control (C) and hyperglycemic group (H) respectively. After 6 weeks experiments, blood glucose level, insulin resistance and MDA value were decreased in treatment groups, which were more significant in F4 and F8 than F0, while FRAP was increased. RSC and BRE alleviated inflammatory and steatosis in pancreas, liver and kidney as shown by the tissue preparation with Hematoxylin and Eosin (H&E) staining.

Key words: Black rice cereal, anthocyanin extract, hyperglycemia, insulin, antioxidant, histopathology

INTRODUCTION
Anthocyanin pigment is a natural antioxidant which is belong to the phenolic compounds (flavonoid) and provide protection from various types of oxidants through several mechanisms (Castaneda-Ovando et al., 2009; Kong et al., 2003). Its antioxidant activity has been shown inhibit neuronal and cardiovascular diseases, anticarcinogenic, antineoplastic, antiviral and antiinflammatory (Konczak and Zhang, 2004; Stintzing and Carle, 2004). Anthocyanin has antidiabetic activity by stimulated the secretion of insulin from pancreatic β cells and suppress postprandial glucose levels (Ghosh and Konishi, 2007). Anthocyanin from black rice has been shown to have high antioxidant activity and ability to suppress insulin resistance and plasmatic oxidants level (Guo et al., 2007).

Black rice (Oryza sativa L. indica) is a rice cultivar which is rich in dark anthocyanin pigment on its aleuron layer. It only gains its popularity around a decade in Java although this island historically has some varieties of black rice such as cempo ireng, melik and jiltheng (Kristantini, 2009). While black steamed rice was referred in the 19th century Javanese culture encyclopedia Serat Cethini, it is debatable whether it was intended for black rice or white rice which was colored with black glutinous rice (Haryono, 1998; Sunjata et al., 2014). But it historically has been known as the food for the kings of Surakarta Sultanate (Kristantini, 2009). Unfortunately, black rice is not a preferable staple food even for diabetic patients because of its relative hard texture and distinct flavor than common white rice. Black rice processing into cereal is expected can improve its sensory quality while still obtaining its benefits as functional food. However, cooking or processing may reduce anthocyanin level and antioxidant potential of black rice by more than 60% (Hartati, 2012; Hiemori et al., 2009). Putri (2015) found that black rice anthocyanin extract which was heated up to 135°C had a very high degradation rate which lead to complete destruction of anthocyanin. However, Kuniich et al. (2015) found that cooking process increase the bioavailability of anthocyanin because the heat would destroy the cell walls and would be more easily to be accessed by our digestive system. This study was evaluating whether the processing of black rice into cereal still retains its antihyperglycemic and antioxidative properties on hyperglycemic rats. The cereal was substituted with black soybean (Glycine max L. Merr) to increase the anthocyanins level and nutritional properties. Furthermore, different dose of black rice bran anthocyanin extracts (BRE) fortification was done to alleviate the deleterious effect of processing on black rice cereal supplemented with black soybean (RSC).

MATERIALS AND METHODS
Chemicals and reagents: The reagents 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,4,6-tripyridyl-s-triazine (TPTZ),