Total fungi profile in dried corn using traditional drying system in Kendal, Central Java Province, Indonesia

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ABSTRACT. Harvesting method is the key factor to receive agriculture product with maximum value on its categories including microbiological content. Recent study exposed the total fungi as the effect from the drying technology in the Kendal, Central Java Province as traditional drying method that has been used in the most field. Harvesting period was done at 100 day of plantation with the following step: reducing the top leaf then followed by drying in the field for 7 days. The corn was obtained from 15 plants in 3 separated areas. The fresh corn was then transferred to the laboratory and analyzed for total fungi. As result, the total of fungi was able to be detected at amount of more than 1 Log CFU/ml. This finding was very important information for the distributor to choose best handling of storage. As conclusion, the total fungi of corn using traditional drying was able to be analyzed and exposed.

1. Introduction
Corn is part of the food crop sub-sector which contributes to the enlargement of the upstream industry and stimulates the downstream industry, which largely play a part to the national economic growth [1]. Corn is also a prominent national commodity with high economic value and has big opportunity to be developed because of its position as the main source of carbohydrates and protein after rice [2]. Preservation may give important role for national stability stock and among used preservation, drying method was commonly used in wide area. There are 2 types of corn drying methods, called sun drying and artificial drying [3]. In sun drying that utilizes surrounded natural energi that was susceptible to bacteria, yeast and mold contamination [4]. Aspergillus is a fungi that may presence in most seed from sun drying method and plays a key role for the level of aflatoxin [5,6]. As recognized, this fungi has widest and most abundant distribution area in
tropical areas [7-10]. Therefore, total fungi monitoring system in corn may provide an applicable method to restrict aflatoxin level.

Since the consideration of total fungi may also serve to restrict aflatoxin level in corn and no total fungi data is available on the dried corn with sun drying method, this research was conducted to analyse total fungi that was obtained from sun drying method. Total fungi may provide a valuable data to set the proper drying technology using natural energy.

2. Material and Methods
2.1. Material
Corn was obtained from Sukomangli Village, Kendal Regency, Central Java, with a distance of 58 km from Semarang City, Indonesia. A dry medium culture plate from 3M Petrifilm™ for yeast and mold, vacuum container and laminar air flow were used in this experiment as main equipments.

2.2 Method
Corn was harvested from 37x126 m² of land size on the day 100 of plantation and the prepared for drying process by defoliation. Analysis of the total fungi was done in the Central Laboratory for Research and Services Diponegoro University (CORES-DU) without preservation.

a. Sample preparation
Corn obtained from farmers after defoliation process for 7 days without opening the corn husks. Corn was transferred to the laboratory for each days. As much as 15 corn plants were chosen using purposive sampling method from 3 different areas in the land. The unhusk corn was then transferred to the laboratory without any preservation for further analysis.

b. Total Fungi Analysis
Analysis of total fungi was done by taking 2 grams of corn kernels and 18 ml sterile water then putting them into a sterilized tube. This step was done in laminar air flow to avoid contamination. One piece of corn was calculated for the total fungi from 3 different area, i.e. bottom, middle, and top. The analysis was done for three times repetition. The corn in sterile water was then homogenized using vortex and swapped into petrifilm using the procedure that was provided by manufacture. The data were then presented as average±SD in Log CFU/ml unit.

3. Results and Discussion
As mentioned in the method section, corn was harvested and dried using sun drying after defoliation for 7 days as can be seen at Fig. 1. Initially the appearance color of husk corn was green, then it was changed into brown as drying process was applied. The results of total fungi in corn are presented in a graph as shown in Fig. 2.
Figure 1. Photo of corn field in Kendal Regency on the 7th day after defoliation

The corn was obtained from Kendal regency that has an altitude of 530 masl, with temperatures approximately from 28–31°C with 69% relative humidity. As the record from metrology database this area has 288 mm of rainfall rate and sufficient sunshine. These conditions are in accordance with the optimum conditions for the growth of corn plants at an optimum height of 0-600 masl, optimum rainfall of 100-295 mm, optimum temperature of 25 – 35°C, relative humidity of 60 – 70% and with sufficient sunlight. [12].

Figure 2. The total fungi in corn that was obtained using sun drying method for 7 days

Based on the Fig. 2, it can be seen that fungus was appeared in the corn at the beginning of drying process resulting the 1.45±1.20 Log CFU/ml of total fungi in the day 1. Highest value in the total fungi was appeared in the day 3, i.e. 3.05±1.30 Log CFU/ml, indicating the large fungal contamination in the land. This may be
explained using the metrology data that was stated highest intensity of rainfall rate on the day of harvesting. Along the drying process, the total fungi remained less changes until 7 days of drying process indicating less growth of fungi in corn. This may be due to the corn land was in the proper location that has less microbial contamination. As well known, the growth in total fungi may be influenced by the moisture content during drying process of the corn [13]. Fungal growth is thought to have existed since the beginning of drying due the microbial contamination from soil that may transferred to the corn plants. Previous studies have explained that wind, soil, rainfall are important factors in the growth of fungi in post-harvested agricultural products [14-16].

4. Conclusion
Based on these results it can be concluded that fungi has detected in the beginning of drying process using sun while the highest contamination was also detected during drying process due to the high rate of rainfall on that day. Overall, drying process using sun showed less change in total fungi during 7 days of drying.

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References
[1] Dewanto FG, JJMR Londok, RAV Tuturoong and WB Kaunang 2013 J. Animal Nutrition and Feed 32 5 1-8.
[2] Notosusanto AN and MP Sirappa 2005 J. Agricultural Research and Development 24 (2): 70-79.
[3] Antu ES. 2016. J. Technopreneur 4 1 24-27.
[4] Priyati A, Sukmawaty, GMD Putra, DA Setiawati and SH Abdullah 2019 J. Independent Society 1 41-47.
[5] Rasheed U, H Wu, J Wei, X Ou, P Qin, X Yao, H Chen, AJ Chen and B Liu 2019 Int. J. Food Microbiology 310 108307.
[6] Jayaratne WMSC, AHMAK Abeyratne, HKS De Zoysa, DMRBN Dissanayake, TC Bamunuarachchige, VY Waisundara and S Chang 2020 Heliyon 6 10 e05319.
[7] Figueiredo CC, WM Farias, TR Coser, AM de Paula, MRS da Silva and J Paz-Ferreiro 2019 European Journal of Soil Biology 93 103092.
[8] Rich JO, AM Anderson, TD Leathers, KM Biscoff, S Liu, CD Skory 2020 Microbial contamination of commercial corn-based fuel ethanol fermentations. Bioresource Technology Reports 11 100433.
[9] Sarrocco S and G Vannacci 2018 Crop Protection 110 160-170.
[10] Asare Bediako K, D Dzidzienyo, K Ofori, SK Offei, JY Asibu, RA Amoah and J Obeng 2019 Food Control 104 152-156.
[11] Wahyudi AE, R Linda and S Khotimah. J. Protobiont 1 1 8-11.
[12] Sumajow AYM, JEX Rogi and S Tumbelaka 2016 J. Agriculture Socio Econom. 12 (1): 65 - 72.
[13] Arsyad M. 2018. J. Agropolitan 5 1 44-52.
[14] Santoso H, T Koerniawati and N Laily 2011 J. Agrise. 11 3 151 - 163.
[15] Xu J, J Meng and LJ Kuackenbush 2019 J. Field Crops Research. 236 1 1 –13.
[16] Villa, VY, AM. Legowo, VP Bintoro and AN Al-Baarr 2014 Intl J. Dairy Science 9 1 24–31.