KnE Life Sciences

Knowledge E
Engaging minds

Conference Paper

Proximate, Crude Fiber and Starch Content of Maize Hybrids Developed in Indonesia in Natural Climatic Condition

Edy Suryadi[1], D. Ruswandi[2], H. Marta[3], and I. Musfiroh[4]

[1]Department of Agricultural Engineering, Faculty of Agro-Industrial Technology, Universitas Padjadjaran, Bandung
[2]Department of Agrotechnology, Faculty of Agriculture, Universitas Padjadjaran, Bandung
[3]Department of Food Industrial Technology, Universitas Padjadjaran, Bandung
[4]Pharmaceutical and Chemical Medicine Analysis, Faculty of Pharmaceutical, Universitas Padjadjaran, Bandung

OPEN ACCESS

Abstract

Corn is one of strategic commodities becoming the main priorities to be developed in Indonesia. Aside from being a strategic foodstuffs, corn contains starch which is used for an excipient in pharmaceutical raw materials of "filler" or filler material for tablets. However, until now local starch production cannot meet the needs of the pharmaceutical industry in Indonesia, and still relies on imported starch. The purpose of this research was to develop maize hybrids from Universitas Padjadjaran which has high of starch and meet the quality for an excipient of pharmaceutical preparations. This research was conducted to determine a formation of a single cross hybrid based on the diallel crosses. Evaluation of fused power was determined by proximate analysis and starch analysis. The selection of hybrid high yield power was done in monocropping and agroforestry systems. The results retrieved 28 types of hybrid corn that comes from 7 different types of strains of mutant reproduction results. The lowest moisture content was the corn M7DR 7.4.1 (9.45%), whereas the highest moisture content of corn was DR. 8 (16.03%). Low starch content was obtained from maize hybrid code 4.8.8 while the highest was obtained from maize hybrid code 18.5.1 ranging from 30-40%. Therefore, corn hybrid 18.5.1 has a potential to be developed as an excipient of various raw materials in the field of pharmacy.

Keywords: corn, a hybrid, starch, excipient pharmacy.

1. Introduction

Modern corn cultivar is not only a source of carbohydrate but also protein including amino acids such as lysin and tryptophan which are useful for the growth of the fetus to prevent miscarriage. In addition, corn is well-known as a source of tokoferol, vitamin A, and unsaturated fats that are very useful for diet of in modern lifestyle. Boyer and Shannon [1] explained that the main components of corn seed is carbohydrates

(72% of weight of the seed). It contains the starch mostly in its endosperm. Mature endosperm consists of 86% starch and around 1% sugar. Starch can be used as an excipient of pharmaceutical in medicines, health and beauty and as raw material of a variety of processed foods such as noodles, uncooked noodles, Chinese sausages, ice cream, etc. It is suggested that the use of corn in secondary and tertiary industries is worth trillion IDR. The assembly of the superior corn cultivar that has high quality, high nutrition and adaptive with specific environment in Indonesia will determine the success of the food security program and self sufficiency in corn. This will be an indicator of success of agricultural development in Indonesia. Maize hybrid cultivars with excelling quality has the potency of high results, i.e 10 tons/ ha. Despite having a high yield potential, the result power of their superior cultivars is different in each biogeophysic environment. Anggia, et al. [2] showed that a hybrid corn DR served as A, B, E, F and G as well as the hybrid cultivar check C7, Pioneer 12, and Bisi 2 have different result power in eight different locations spreading in West Java, Lampung, North Sumatra, Central Java and East Java. Therefore, the production of hybrid cultivar that has high result and high nutrition and specific to the biogeophysic of Indonesia environment needs to be done. Marta et al. [3] have identified the womb proximate Unpad mutant strains. Based on testing, Unpad mutant strains have higher protein, carbohydrates, fiber and ashes than commercial cultivar such as P 21, Pertiwi, and Bisi 2. Mutant strains have own proteins, ash, carbohydrates, and fibers in a row is M5 DR 1.1.3 (10,21%; 0.95%; 71,68%; 1.69%); M5 DR 3.1.2 (9.03%; 1.19%; 79,82%; 2.71%); M5 DR 7.1.9 (11,11%; 1.34%; 70,02%; 2.05%); M5 DR 7.4.1 (11.84%; 1.25%; 70,99%; 2.09%); M5 DR 7.4.2 (esp. Num%; 1.45%; 75,04%; 2.49%); M5 DR 9.1.3 (up 10.52%; 1.3%; 79,83%; 1.64%); M5 DR 14.2.2 (11,12%; 1.51%; 75,4%; 2.29%). Therefore, it needs to be done hybrid corn development program which is important to fulfill the standards of pharmaceutical excipient.

This research aimed to develop corn hybrid variety with superior results and suitable for excipient pharmacy. The genetic material used is Unpad mutant thread [4] which is developed from DR thread [5] using iradiasi gamma rays. Mutant strains is used as a potential hybrid clan elders because it has a wide genetic and its variability in agronomic characters [2, 19, 22]. Ruswandi et al. [4] successfully qualifying the mutant strain corn and spacious well sweet corn.

Based on the best fused value of growth component characters, components results and the results on the sweet corn Unpad sorted as 15 thread sweet corn that has a potency to be made as a hybrid clan elders i.e. M5SR 17.2.3, M5 SR 25.1.2, M5 SR 25.4.1, M5 SR 25.5.1, M5 SR 52.7.1, SR 4, SR 25, SR 30, SR 31, SR 34, SR 40, SR 41, SR 43, SR 47, SR 52 and 17 field corn mutant strains potentially made as a hybrid clan elders namely M5DR 4.1.3, M5BR 153.2.2, M5DR 18.4.1, M5BR 153.4.1, M5DR 3.1.4, M5DR 18.3.1, M5DR 14.3.1, M5DR 14.3.8, M5BR 153.4.1, M5BR 153.6.1, M5DR 16.2.1, M5DR 4.8.8,

M5DR 1.6.3, M5DR 18.8.1, M5DR 7.3.2, M5DR 7.3.1, M5DR 9.1.3 and M5DR 3.1.2. Although it can be identified by fused power mutant strains potential results, important fact about nutrition and potency as a pharmaceutical excipient of strains and its cross-linked hybrid are not well known. Therefore, the identification of the fused power result character, nutritional mutant strain and also the appropriate superior corn hybrid with pharmaceutical excipient standards needs to be done.

The main purposes oh this research were: (1) to get the combination of cross-linked that is potential to be developed as superior mutants hybris based on fused power, nutritional fact, and in accordance with the pharmaceutical excipient; (2) to get information about fused corn hybrid results of Unpad that will be assembled, (3) to identify hybrid nutrition corn of Unpad that will be assembled; (4) to estimate pharmaceutical excipient potential of Unpad hybrid corn that will be assembled; (5) to determine production system and powerful hybrid dissemination and high nutritional facts in accordance with standard pharmaceutical excipient.

2. Materials and Method

2.1. Purification and its Multiplication or Mutant Seed Generation M8 Universitas Padjadjaran

Purification and its multiplication of Unpad seed mutants was conducted by doing as many as twenty selfing plants on each of the eight strains of mutant M8 generation. The corn was dried and peeled. The seeds were stored in a refrigerator at the temperature of 10 °C.

2.2. The formation of a single Cross Hybrid Based Diallel Rail

The formation of a single cross hybrid was done by crossing of twenty plants at each of the eight strains of mutant M8 generation based on the diallel crosses of method 2. The used Mutant were M8 DR 1.1.3; M8 DR 3.1.2; M8 DR 7.1.9; M8 DR 7.4.1; M8 DR 7.4.2; M8 DR 9.1.3; and M8 DR 14.2.2. The results (single cross hybrid) were dried and the seeds was stored at the refrigerator.

2.3. Evaluation of Power Components based on the Result of the merge, the content of Proximate and Starch Content

Evaluation and selection of hybrid power join result and high nutrient content as well as standard an excipient in pharmaceutical locations were grown in monocropping and agroforestry systems in two years. This experiment was conducted in the Arjasari

Experimental Field I and II, aiming to select cross hybrid that have hybred power join results and the content of an excipient in pharmaceutical based on the value of DGK. In this experiment, a single cross hybrid resulted in 28 strains of M8 generation with 8 elder were planted in a plot line using a random design of four groups and repeated 2 times. The plot size was a single plots of 5 m with the distance between crops in rows was 25 cm. The measured variables were the result and the components of the results of such as weight per ha, weight per 1000 seeds, the number of cob per plot, the weight of cob per plot, corn seed weight, percent rendemen, seed water content, harvest time, blooming time, plant height, and the diameter of the corn cob. Analysed nutrent content included the level of the digested starch, the ratio of digested amilose/amilopectin, resistant starch levels, the composition of the amino acids (tryptophan and lysin), the composition of fatty acid, the amount of oil and mineral type, beta karoten and tocopherols. The statistics analysis was performed following Singh & Chaudhary [6] for the analysis of dialel Griffing method 2 to GGE biplot.

The stages of analysis dialel Griffing 2 were (i) computed the Anova for the dialel methods of Griffing 2; (ii) Estimated F value; (iii) calculated values of the DGK and DGU; and (iv) Estimated heterosis values. After the values of DGU and DGK were obtained, then assessment was continue to find the best genotypes of ten ranks of six of most important characters i.e. weight per hectare (kg), seed weight per plot (g), the weight of the seeds per plant (g), the weight of 100 seeds (g), seed weight per cob (g), and the number of seeds per cob. The ranks were determined basing on the value of DGU: (a) the granting of the highest rank, started from the number one on genotypes with high DGU value for each character and the lowest DGU placed in the lowest ten rank or numbers; (b) after being sorted by rank for each character and given the weight values for the six most important characters, is the number of the weight value for all characters is one; (c) the most important weight values on the six characters weight per hectare (kg) = 0.250, seed weight per plot (g) = 0.200, seed weight per plant (g) = 0.150, seed weight of 100 seeds (g) = 0.150, seed weight per cob (g) = 0.150, the number of seeds per cob = 0.100; (d) the total value of weights derived from multiplication of the rank for each character with the weight of the value of the characters; (e) after the total value of the weights was obtained, they were sorted from most small value to the most value, where the total value of the smallest weight gain of the smallest starting from rank one, and the largest total value weight gain the greatest rank; (f) the genotype has taken rank one to ten, which was later genotypes were genotypes that have a value of DGU's best for six of the most important characters. The same method was used in the assesment of nutritional and pharmaceutical characters.

3. Results and Discussion

TABLE 1: Its reproduction or mutant thead.

No	Name of the Entry	Number of seeds formed
1	MDR 1.1.3	1800
2	MDR 3.1.2	1600
3	MDR 7.1.9	2600
4	MDR 7.4.1	2000
5	MDR 7.4.2	1200
6	MDR 9.1.3	1400
7	MDR 14.2.2	1400

TABLE 2: The formation of a hybrid of single cross.

No	Name of the Entry	No.	Name of the Entry
1	MDR 1.1.3	15	MDR 3.1.2 × 7.4.1
2	MDR 3.1.2	16	MDR 3.1.2 × 7.4.2
3	MDR 7.1.9	17	MDR 3.1.2 × 9.1.3
4	MDR 7.4.1	18	MDR 3.1.2 × 14.2.2
5	MDR 7.4.2	19	MDR 7.1.9 × 7.4.1
6	MDR 9.1.3	20	MDR 7.1.9 × 7.4.2
7	MDR 14.2.2	21	MDR 7.1.9 × 9.1.3
8	MDR 1.1.3 × 3.1.2	22	MDR 7.1.9 × 14.2.2
9	MDR 1.1.3 × 7.1.9	23	MDR 7.4.1 × 7.4.2
10	MDR 1.1.3 × 7.4.1	24	MDR 7.4.1 × 9.1.3
11	MDR 1.1.3 × 7.4.2	25	MDR 7.4.1 × 14.2.2
12	MDR 1.1.3 × 9.1.3	26	MDR 7.4.2 × 9.1.3
13	MDR 1.1.3 × 14.2.2	27	MDR 7.4.2 × 14.2.2
14	MDR 3.1.2 × 7.1.9	28	MDR 9.1.3 × 14.2.2

3.1. Duplication Of The Mutant Strain

The results of multiplication and the appearance of potential strains are presented in Table 1. Strain-strain are used either for testing or as eldershybrids.

3.2. Formation Of Single Cross Hybrids

Single cross hybrid formed from strains that have been copied are shown in Table 2. Single cross hybrids were then used in the trials of truth or multilocation testing varieties.

3.3. Chemical Composition

Chemical composition data includes: moisture content, ash conten, protein content, fiber content and starch content in 15 selected Maize Hybrid Elder can be seen in Table 1. Based on the results of the laboratory analysis, it can be seen that corn with the lowest water content was the corn M7DR 7.4.1 (9.45%) whereas the highest moisture content of corn is DR. 8 (16.03%). High water content caused the maize to be easily damaged. Dried peeled corn should have a moisture content of <12%. Peeled corn with high water content can undergo rapid reduction processes due to microbial activity.

Fat content ranged from 2.48% (corn 18.5.1) up to 4.80% (maize 6.203.1). In general the dried peeled corn has fat content of 2.1 to 3.4%. Corn with fat content above 3% belongs to the corn with a high fat content. If we compared fat content of the testing peeled corn with the fat content of comercial peeled corn, the testing peeled corn is higher in fat content. Peeled corn with a high fat content can potentially be used for manufacture of corn oil.

Protein content ranged from 6.99% (corn 18.8.1) up to 10.83% (maize 6.203.77). In general peeled corn protein content ranged 7-9%. Peeled corn with protein content above 9% is peeled corn with high protein. A food with High protein is potentially used to make high protein processed food products, such as the manufacture of bread, biscuits, cookies and others. To know the qualitycorn protein, it should be known amino acid composition and its digest. Quality Protein Maize (QPM) is a special type of corn that contains of two important amino acids namely lysine and tryptophan which is twice higher than the usual corn. QPM was discovered by Linn Bates in 1962, now the QPM maize is utilized to improve healthness and the quality of the feed. QPM varieties were first released in Indonesia.

As Srikandi Kuning-1 and Srikandi White-1 with productivity 7.0 t/ha. Srikandi Kuning-1 have 10.38% protein and more than twice bigger than a general corn. While the coarse fibre levels were 0.86% (corn 1.13) up to 2.04% (maize M7DR7).

Corn that has the lowest ash content is corn M7DR 9.1.3 (0.82%), while corn that has the highest ash content is corn 1.1.3 (1.47%). The ash content in corn strain in this research is higher compared with the level of as peeled corn in general. The level of ash was a mixture of inorganic components or minerals that are located on a food ingredients. Food material consists of 96% inorganic material and water, while the remaining elements are minerals. The element is also known as organic substances or the level of ash. The level of ash can show the total minerals in a food ingredients. Therefore, it is most likely that the mineral level of corn in this research result is greater than the level of minerals of common corn.

The starch of main corn strain ranged between 38.79 and 52.92 %. The lowest starch was on hybrid corn 4.8.8 code while the highest was obtained on corn hybrid of the

TABLE 3: Chemical Composition.

No	Samples	Water content (%wb)	Fat content (%wb)	Protein content (%wb)	Ash content (%wb)	crude fiber content (%wb)	Starch content (%wb)
1	1.1.3	13.62	3.21	8.20	1.47	0.89	41.81
2	4.8.8	13.37	3.96	7.92	1.29	1.28	38.79
3	18.8.1	9.91	4.35	6.99	1.27	1.92	47.82
4	18.5.1	15.23	2.48	8.24	1.21	1.33	52.92
5	6.203.1	9.62	4.80 hkd	9.66	1.36	1.43	48.86
6	6.203.77	10.72	3.93	10.83	1.47	1.36	49.15
7	6.673	10.33	2.87	7.31	1.05	0.95	42.11
8	DR.8	16.03	2.60 hkd	8.13	1.21	0.99	45.88
9	DR.18	9.54	3.26	7.49	1,42	1.66	46.31
10	M7DR 3.1.4	14.15	4.10	8.23	1.32	1.45	47.93
11	M7DR 7.4.1	9.45	4.72	7.08	1.19	1.73	51.72
12	M7DR 7.1.9	10.15	4.09	8.34	1.38	1.49	46.79
13	M7DR 10	10.04	4.20	8.18	1.10	1.63	46.41
14	M7DR 9.1.3	9.54	4.55	8.27	0.82	1.39	46.52
15	M7DR 14.2.2	9.81	4.43	8.23	1.39	1.53	49.14

code 18.5.1. The level of starch on peeled corn ranged between 30 and 40%. The level of starch was above 40% including peeled corn with the high level of starch. Starch content can be used as the raw material of various seafood products food. It also can be used in pharmacy as excipient drugs.

4. Conclusion

The level of proximate and level of starch from 15 main strains varies among them. The levels of water ranged 9.45-16.03% db, the level of fat 2,48-4.80 hkd% db, proteins contents 6.99-10,83% db, ash content 0.82-1.47% db, and the level of starch 38,79-52,92% db. Corn with high starch content is corn 18.5.1.

References

[1] Boyer, C.D. and J.C. Shannon. 2003. Carbohydrates of the kernel. In: White, P.J., and Johnson, L.A. 2003. A: Chemistry and technology 2 nd edition. St. Paul, Minnesota, USA: American Association of Cereal Chemistry Inc.

[2] Anggia, E.P. and D. Ruswandi. 2011. The stability of hybrid corn DR Unpad on multilokasi tests in Indonesia *in the* proceedings of the National Seminar on glorification based on local wisdom facing the challenges of globalization. Purwokerto, 8-9 July 2011. This. 378-387. Soedirman University Publishers.

[3] Marta et al

[4] Ruswandi, D, A. Karuniawan, and F. Hendrayana. 2012. The final report of the Graduate Grants: mutant Selection genjah old corn based on molecular markings and stabilitasnya in supporting food security in Indonesia. The Universitas Padjadjaran

[5] Pixley, K.V. and Bjarnason, M.S. 2002. The Stability of grain breads Yield, Endosperm Modification, and Protein Quality of Hybrid and Open-Pollinated Quality Protein Maize (QPM) Cultivars.Crop Sci. 42:1882-1890

[6] Singh, R. K., and B. D. Chaudary. 1977. Biometrical Method in Quantitative Genetic analysis. Kalyani Publishers. New Delhi. Ludhiana.

[7] Akaria, N. and D. Ruswandi. 2011. The appearance of mutant corn fenotipik generation M2 in Indonesia *in the* proceedings of the National Seminar on glorification based on local wisdom facing the challenges of globalization. Purwokerto, 8-9 July 2011. This. 335-352. Soedirman University publishers.

[8] Azrai, M. 2007. The integration of genes to lysine and tryptophan by the resilience of disease bulai utilize molecular markings MAS in order to the development of hybrid corn. Dissertation. Graduate School IPB. Bogor.

[9] Baihaki Hakim, A. 2000.Techniques designed and research analysis of glorification.Agriculture faculty Unpad.

[10] Baker, R. J. 1978.Issues in Diallel Analysis. Crop Sci. 18(4): 533-536.

[11] Banziger, M., G.O. Edmeades, D. Beck, and M. The Bell. 2000. Breeding for drought and nitrogen stress tolerance in maize. CIMMYT. Mexico

[12] Becker, H.C., and Leon.1988. Stability analysis in plant breeding. Plant Breeding, 101: 1 - 23

[13] Duvick, S., Pollack, L., and White, P. 2003. A Heart-Friendly oil? New- high-oleic a varieties make its possible. Agricultural Research. *Plant, microbial decay, and Insect Genetic Research, Genomics and Genetic Improvement, an ARS National Program. USDA. Mrs.*

[14] Anggia, E.P., N. Rostini, Tri Hastini, E. Suryadi, S. Ruswandi, and D. Ruswandi. 2009. Corn hybrid selection DR Unpad in Indonesia based on the method Eberhart - Russel and PRINCELY. Had been childless Vol. 20 (2): 134-154.

[15] Hallauer, A.R. & Miranda Filho., J.B. 1981. Quantitative Genetics in Maize Breeding 1st. Iowa State University Press/Ames.

[16] Lawton, J. W. and Wilson, C. M. 2003.Proteins of the kernel. In: White P. J. and L.A. Johnson (eds.) a: Chemistry and Technology, 2nd edition. T. Paul, Minnesota, USA: American Association of Cereal Chemistry Inc.

[17] Laztuty, R. 1996. The Chemistry of Cereal proteins, 2nd edition. CRC Press Inc., Florida: Boca Raton.

[18] There Milad Ibrahim, Lydia Elias Wahba and Mohamed NajebBarakat. 2011. Identification of RAPD and ISSR markers associated with the flag leaf senescence under water stressed conditions in wheat (*Triticumaestivum* L.). Aust. J. The crop. Sci. 5(3):337-343

[19] Ruswandi, D, N. Wicaksana, M.B. Pabendon, M. Azrai, M. Rachmady, A. Ismail, N. Carsono, F. Damayanti, and F. Kasim. 2005. Molecular characterization of quality protein maize and downy mildew resistance lines based on Simple Sequence Repeats (SSRs) marker. Had Been childless

[20] Ruswandi, D. I. Olives, S. Ruswandi, and N. Rostini. 2008. The union power and heterosis resistance to pests warehouse (Sitophilus zea-mays) thead- thead QPM DMR and based on the analysis of the line x tester. *Had Been childless, Vol. 19, No. 1,* **96** *January-June 2008 had been childless, Vol. 19, No. 1,* **96** *January-June 2008*

[21] Ruswandi, D, A. Karuniawan, and F. Hendrayana. 2011. The final report of the Graduate Grants: mutant Selection genjah old corn based on molecular markings and stabilitasnya in supporting food security in Indonesia. The Universitas Padjadjaran.

[22] The United Nations. 2014. The Millennium Development Goals Report. The United Nations. New York.

[23] Valentina, A.I. and Ruswandi, D. 2011. The appearance of mutant corn fenotipik generation M2 in Indonesia. *The proceedings of the National Seminar: Glorification based on potential and local wisdom facing the challenges of globalization. UNSOED. Purwokerto.*