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Increased Amylopectin Content Potential in Corn Grains of Quality Protein Maize (QPM)

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Abstract. Maize can be developed as an alternative staple food in anticipation of dependence on rice consumption which continues to increase along with the increase of population. In order for increase corn consumption it needs to be assembled to improve corn nutrition and taste at an affordable price. The objective of this research was to increase amylopectin content in QPM corn grains without reducing the potential of protein quality and production potential. The method used in this research was Back Cross Breeding. This research was done until the formation of Genotype F2. Stages of the method that has been done were started by hybridization between corn Variety of Srikandi Putih (Recipient's parents) and corn Local Waxy Corn (Donor Parents). Recipient parents were planted in 3 rows and donor parents in 1 row. Each row consisted of 40 plants. The crosses resulted in the genotype F1. Genotype F1 planted in 2 rows and then selfing 21 plants to yield Genotype F2. The research results showed that amylopectin content of corn grains in F1, F2, Parent of Srikandi Putih Variety and Local Waxy Corn were 92,57%, 91,31%, 81,92% and 97,80%, respectively. At this stage of the study, it is concluded that there was a change of amylopectin content of grains in Genotype F1 and Genotype F2 due to crosses compared to their parents.

1. Introduction

Maize can be developed as one of the basic staple foods in anticipation of the dependence on rice consumption which is increasing until now. The productivity of corn produced by breeders is already high, including Srikandi Putih Variety. Generally corn crops are used for animal feed, only a small portion is used for food and food industries. Along with the increasing number of population then the staple food needs must also be met. Therefore it is necessary to diversify staple food, one of them by utilizing corn as an alternative staple food. To make corn as an alternative staple food, it is necessary to improve its quality and taste to be tasty and nutritious. The merging of two good properties of two different corn varieties can be done if their genetic diversity is available.

High quality protein maize (Quality Protein Maize, QPM) is available and available on the market, but its flavor is not pulverized (so rough) to human consumption, as well as Local Waxy Corn is also available and available in the South Sulawesi Region. This Local Waxy Corn is one of South Sulawesi's typical corn with a taste that is very tasty and popular people, both young corn and processed old seeds because it contains high amylopectin, but the lack of low production and protein content is less. Disadvantages of both types of corn need to be removed with certain plant breeding techniques to obtain high protein corn and feels pulverized. Corn with special properties can be established through repetitive and programmed plant breeding programs [1]. In waxy corn there is a wx recessive gene in homozygote (wxwx) that affects the chemical composition of starch, causing tasty and savory taste. Backcross breeding methods can be applied to integrate the donor genes from high amylopectin-specific corn to high quality protein corn and high productivity. Thus, corn will be obtained which has the desired special properties.

Amylopectin content in Waxy Corn nearly 100%. Ordinary corn endosperms consist of a mixture of 72% amylopectin and 28% amylose [2]. According to [3], the endosperm content of pulut corn is almost



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entirely amylopectin. In Waxy Corn there is a wx recessive gene in homisigot (wxwx) that affects the chemical composition of starch, causing tasty and tasty flavors. The yield of waxy corn is generally low, only 2-2.5 t/ha and can not stand the disease of downy mildew. Waxy corn is highly related to the high content of amylopectin in starch. Starch consists of two glucose polymer compounds, namely amylose and amylopectin. The weight of amylose and amylopectin molecules depends on the amylose botanical source which is a component with a straight chain, while amylopectin with branched chain. Amylose is a straight-line helical-shaped polysaccharide with α -1.4 glycosidic bond. The branching point of amylopectin is an α -1.6 bond. The number of glucose molecules in the amylose chain ranges from 250 to 350 units [4]. Starch is composed by at least three main components, namely amylose, amylopectin, and intermediate materials such as lipids and proteins. These components affect the functional properties and amylographic of corn flour [5]. The results showed that the protein content of Waxy corn Takalar and Waxy corn Gorontalo was relatively the same, 0.78% and 0.79% respectively. Comparison of amylopectin and protein content between maize Variety of Srikandi Putih and Local Waxy corn showed amylose content in corn of Srikandi Putih 30.60% (amylopectin 69.40%), protein 1.22%. Waxy corn Takalar contains 5.79% amylose (94.21% amylopectin) and its protein content is only 0.79% [6]. These two properties need to be combined to obtain high amylopectin and high protein corn as well. The objective of this research is to increase amylopectin levels in QPM corn kernels without reducing the potential of protein quality and production potential.

2. Materials and methods

The study was conducted in Bajeng Gowa Regency, South Sulawesi Province. This study is a follow-up of the first study. The materials used in this research are: corn seed of Varieties Srikandi Putih, corn seed of Local Variety Waxy corn, F1 seed, and F2 seed. This research only reached the formation stage of Genotype F2. Stages of the method that has been done is started by hybridization between corn Variety Srikandi Putih (parent Receiver) and corn Local Pulut (parent Donor). The resulting crosses result in the genotype F1. Genotype F1 planted 2 lines then selfing 21 plants and yielded Genotype F2. Design research in the field as follows: This research consists of 2 processes. Process 1 using cross breeding cross-pollination method, which is Hybridization Method between Varieties of Srikandi Putih and Local Waxy corn. Srikandi Putih Variety as female parent (P1) planted 3 rows while Local Waxy corn as male parent (P2) planted 1 row. Each line consists of 40 plants and repeated 3 times. The crosses result will produce F1 generation. Then proceed to Process 2 designed with Block Random Design. Treatment is Plant Genotype, ie Srikandi Putih Variety, Local Waxy corn Variety, F1 and F2 Generation. Repeated 3 times.

3. Result and discussion

3.1. The length and diameter of Cobs (cm)

Table 1. The length and diameter of the cobs in the various genotypes tested.

Treatment	Length of the cobs	Diameter of the cobs
Srikandi Putih Variety (parent ♀)	17.8a	4.6a
Local Waxy Corn (parent ♂)	16.1ab	3.5b
F1	14.7b	3.6b
F2	16.8ab	4.7a

Note: the numbers followed by the same letter are not different at the LSD 0.05 test level

Table 1 shows the longest length of cobs in Srikandi Putih Variety and is significantly different from Local Waxy Corn Variety while the genotype F1 and F2 are not significantly different. Furthermore, the cob's diameter on Srikandi Putih Variety and F2 genotype were not significantly different but both were significantly different from Local Waxy Corn and F1 genotype. This shows that the character of length

and diameter of cob has started to change the nature of the positive direction. It is known that the length and diameter of the ear is influenced by many genes.

3.2. Weight of 100 seeds and weight of seeds per plant (g)

Table 2 shows the weight of 100 seeds in Srikandi Putih Variety highest and significantly different with all genotypes tested while Local Waxy Corn Variety with genotype F1 were not significantly different but both were significantly different with genotype F2. The highest seed weight per plant in the Srikandi Putih Variety was significantly different from all genotypes tested. Furthermore Genotype F1 and F2 were not significantly different but both were significantly different from Local Waxy Corn. This shows that in general there has been a change in the nature of the descendants of F1 and F2 but it seems still inconsistent between the weight of 100 seeds with the weight of seeds per plant. This is due to segregation in the crossing process so that production in each generation varies. Differences in genetic makeup is one of the factors causing plant appearance diversity [7]. [8] describes that genetic variability is the diversity of individual traits in a population arising from genetic factors. Genetic variation can occur due to mixing of breeding materials, genetic recombination as a result of crossing and mutation or polyploidization.

Table 2. The weight of 100 seeds and weight of seeds per plant in the various genotypes.

Treatment	Weight of 100 seeds	Weight of seeds per plant
Srikandi Putih Variety (parent ♀)	36.0a	79.0a
Local Waxy Corn (parent ♂)	31.8b	19.0c
F1	32.7b	26.8b
F2	23.4c	24.3b

Note: the numbers followed by the same letter are not different at the LSD 0.05 test level

3.3. Amylopectin and Seed Protein levels (%)

Table 3 shows the highest levels of amylopectin in Local Variety of Waxy Corn and significantly different from all genotypes tested, but the amylopectin levels between the genotype F1 and F2 were not significantly different but both were higher and significantly different from the Srikandi Putih Variety. Furthermore, the highest protein content in the Srikandi Putih Variety and significantly different with all genotypes tested. The protein content in Genotype F1 did not differ significantly with the Genotype F2 but both were significantly higher than the Local Waxy Corn Variety.

Table 3. Levels of Amylopectin and Seed Protein of various genotypes tested.

Treatment	Amylopectin	Protein
Srikandi Putih Variety (parent ♀)	81.92c	10.4.a
Local Waxy Corn (parent ♂)	97.80a	8.60c
F1	92.57b	9.3b
F2	91.31b	9.4b

Note: the numbers followed by the same letter are not different at the LSD 0.05 test level

This indicates that there has been a positive nature change in F1 and F2 but not yet stable. The amylose and amylopectin composition in the genetically controlled seed kernels. In general, Dent corn and pearl corn of endospermic types contain amylose 25-30% and amylopectin 70-75% of total starch. Waxy Corn has a starch content of nearly 100% amylopectin. The presence of a single waxy (wx) gene that is recessive to epistasis located on chromosome nine affects the chemical composition of starch, resulting in very little amylose accumulation [9]. Another study showed that QPM varieties released for the first time in Indonesia were composite maize of Srikandi Kuning-1 and Srikandi Putih-1 with productivity of 7.0 t/ha [10]. Srikandi Kuning Variety contain 10.38% protein, lysine 0.477% and

tryptophan 0.093%, while Srikandi Putih Variety contains protein 10.44%, lysine 0.410% and tryptophan 0.087% [11]. The results showed that the protein content of Waxy Corn Takalar and Waxy Corn Gorontalo was relatively the same, 0.78% and 0.79% respectively. Comparison of amylopectin and protein content between maize variety of Srikandi Putih and Waxy Corn showed amylose content in corn of Srikandi Putih 30.60% (amylopectin 69.40%), protein 1.22%. Waxy Corn Takalar Corn contains 5.79% amylose (94.21% amylopectin) and its protein content is only 0.7% [6]. The results of research [12] that the F1 protein (genotype crossed by Srikandi Putih Variety x Local Waxy Corn Variety) increased 8.1% compared to the parent of Local Waxy Corn Variety.

4. Conclusion

- Character of production of Srikandi Putih Variety has started to appear on Genotype F1 and F2 but not yet stable.
- Character of amylopectin content Local Waxy Corn Variety has been seen in Genotype F1 and F2 but not yet stable.
- Character of protein content of Srikandi Putih Variety has been seen in Genotype F1 and F2 but not yet stable.

Advanced research is needed to obtain new genotypes with high production characters with high levels of amylopectin and stable proteins to be prepared into new variety.

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