BARLEY TESTING FOR QUALITY AT THE EXPERIMENT STATION

by
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North Dakota is now the largest barley producing state. It has therefore become advisable to inaugurate a barley quality improvement program to insure that barley varieties are grown which will return the highest proceeds to the grower and which will raise the quality of the barley in the state. This improvement program has already been started with the appointment of a barley breeder to the Station staff. However, to develop new varieties of better quality it is necessary to know their value as early as possible. This necessitates the use of suitable equipment for ascertaining those properties of barley which are responsible for quality. The more important of these are extract, diastase, nitrogen, and hull content. This equipment has been purchased by the Experiment Station and installed in the Department of Cereal Technology.

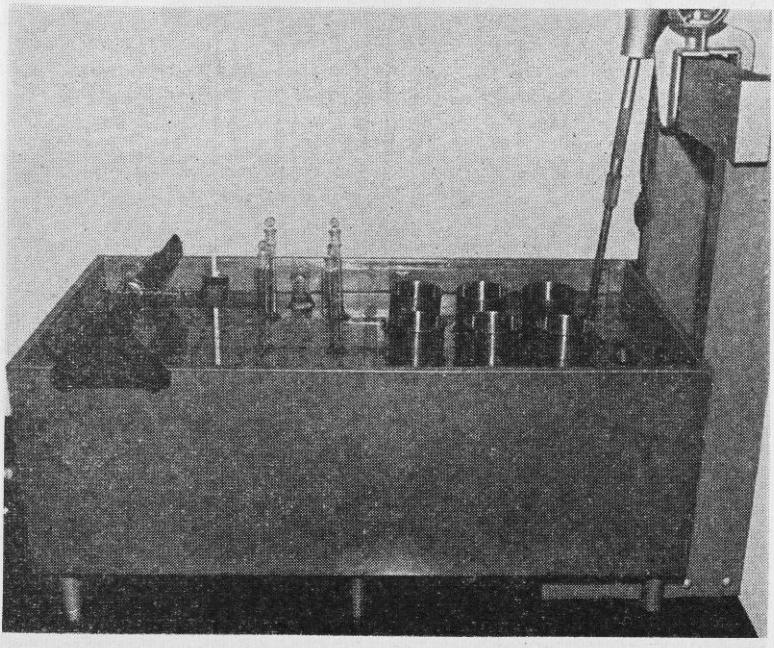

Fig. 1. Constant temperature bath controlled accurately at 20° C. and used in determining barley extract and diastase. This bath is constructed from stainless steel with double walls and bottom to supply insulation. At right section of the bath are six brass malting beakers which are employed in determining extract. These contain barley meal and enzyme solutions. In left section of bath are four 200 ml. volumetric flasks used in measuring the diastatic power of barley. The water is thoroughly agitated by the stirrer shown at right end of the bath.

Essentially the method employed in determining extract consists of extracting ground barley meal with a suitable enzyme solution and determining the quantity of soluble material extracted from the barley

over an 18 hour period. This extraction takes place in a water bath shown in Fig. 1, which is accurately controlled at 20° C. (68° F.). During this time the extraction of the soluble material and preliminary conversion of starch to sugar occurs. This procedure is followed by heating the extract with constant mechanical stirring in a special bath, illustrated with accessories in Fig. 2. The extract is heated first at 50° C. (122°F.) for 10 minutes, during which time the activity of the starch-converting enzymes is at a maximum. The temperature is then raised (1° per minute)

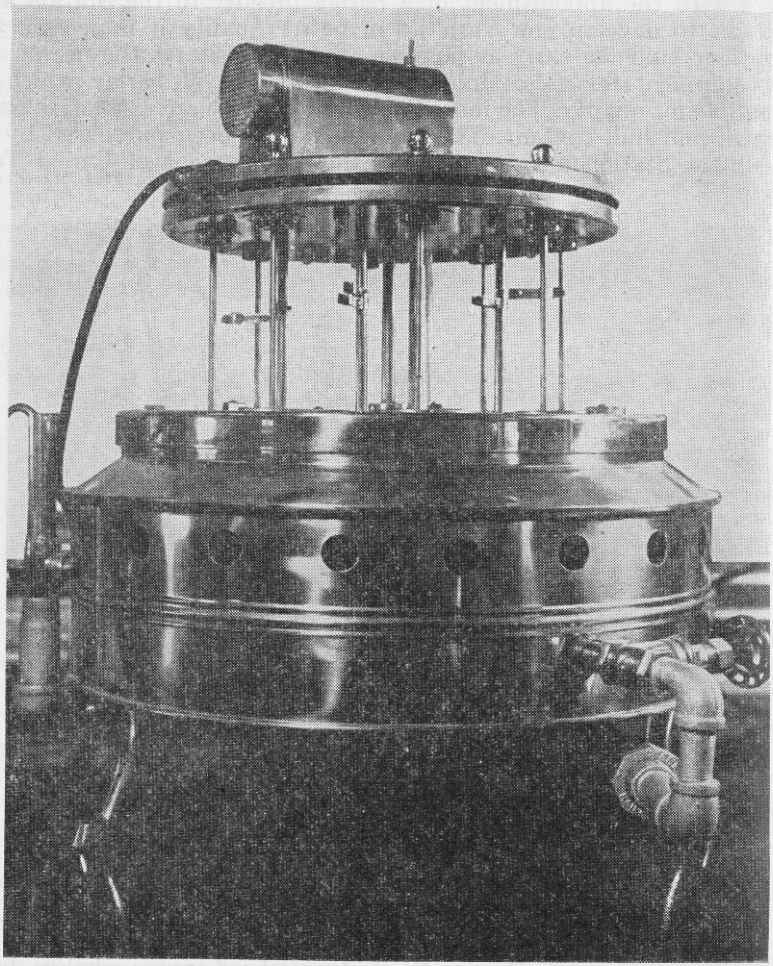

Fig. 2. Mashing equipment required for determining barley extract. This is constructed of brass, and consists of an inner water container or tank heated by gas burners, in which eight malting beakers can be placed simultaneously. These are held rigidly in position by suitable fastenings. Above the tank proper is an electric motor and chain belt for driving eight stirrers for the beakers at equal speed, one stirrer to each beaker. In addition, there are two large stirrers for the cooking tank. Thermometers are inserted in the cooking tank or bath, as well as in the beakers.

until 75° C. (167° F.) is attained, and the mash temperature is maintained at this point for 30 minutes. This temperature inactivates the enzymes; the extract is next cooled rapidly to room temperature, the barley meal is removed by filtration, and the amount of extracted material is found by determining the specific gravity of the liquid or extract. Larger values for malt extract are associated with ability of the sample of barley to yield high extract values during commercial malting. High yield of extract is practically always desirable from the economic viewpoint of the manufacturer (Ehrnst, 1947). Meredith (1943) has pointed out that barley extract is directly correlated with malt extract, and its determination serves to select varieties high in this property.

The determination of diastase is measured by the ability of barley extract to convert soluble starch to maltose. The starch is exposed for 30 minutes to the action of the barley enzymes which have been secured by extracting barley meal with distilled water containing a small quantity of proteolytic enzyme in the 20° C. bath (Fig. 1) for 18 hours. The action of the enzymes is stopped by the addition of sodium hydroxide, and the quantity of maltose produced determined by quantitative chemical procedure. Fig. 3 presents some of the apparatus required to determine these barley characteristics following the extraction and

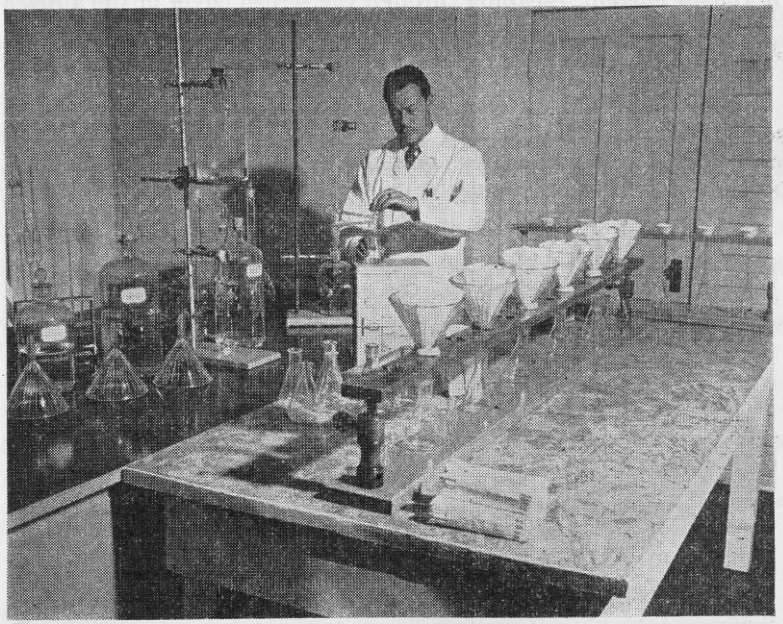

Fig. 3. Apparatus required in ascertaining the extract and diastatic power of barley after the enzymes extracted from the meal in the constant temperature bath have converted soluble starch to sugar. In center foreground are funnels with paper filters used for filtering the extract which is received in the flasks placed under the funnels. Necessary chemical solutions are shown on table at left. Mr. L. D. Sibbitt, Assistant Cereal Technologist, is shown making the final step in determining diastatic power.

cooking procedures. High diastase content is regarded with favor because it causes more ready conversion of starch to sugar during malting. It has been shown that barley varieties differ in their capacity to produce starch-converting enzymes when malted. High diastatic activity is more important in America than in England owing to the widespread use of cereal adjuncts, as corn grits, wheat flour, farina, rice, etc., in the United States. This practice results in economy of barley in malting, and is particularly important when malting barley is limited in supply. Meredith, Sallans and Rowland (1942) have shown that the determination of the activated barley diastatic power of hybrid varieties furnishes a reliable measure for the selection of new barleys high in malt diastatic power.

The nitrogen content and proportion of hull of the new barleys are also determined. These properties are especially important for assessing the feeding value of barley, since protein content is directly related to nutritive value as a source of protein, while low hull content is desirable because the hull contributes nothing to the food value. Nitrogen content is determined by standard apparatus and methods, while hull content is found by dehulling a weighed quantity of barley in a small dehulling device. In this the kernels are thrown violently against the wires of a cage lining a metal container by an air blast from a suitable nozzle. The force of the repeated blows loosens the hull, which is then carried off by the air current, escaping through the screen cover of the apparatus. The dehuller is shown in Fig. 4. A small amount of hull remains in the crease, but this is approximately the same for each sample dehulled. The loss in weight suffered by the barley during bombardment is the hull content. Varietal differences in hull content have been shown by Fraser (1944) and Harris and Scott (1947). The method compares favorably with removal of the hull by manual means except that the proportion of hull found tends to be slightly less.

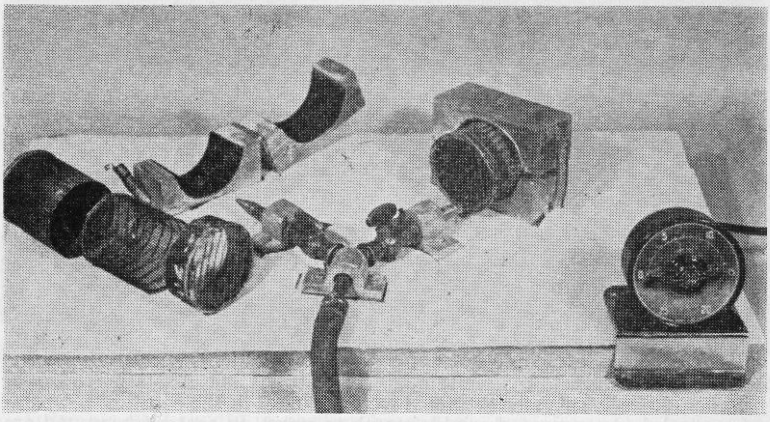

Fig. 4. Barley dehulling apparatus. The disassembled unit is shown at left, with metal container, wire cage and cover, while the dehuller ready for use is shown at the right. At lower right is the automatic timing device for regulating length of dehulling treatment.

In addition to testing the quality of new hybrids, varieties grown in the plots at six North Dakota stations will be examined, and the results analyzed statistically for environmental differences caused by growth, location, and season.

The installation of this barley testing laboratory marks an important forward step in the service rendered by the Experiment Station to the people of North Dakota. By testing of new hybrids developed in the barley breeding nursery, information regarding quality will be available much earlier than if the testing were delayed until laboratory malting trials could be made. In fact, many of the new hybrids would never be tested due to limitations necessarily placed on the number of samples which can be malted because of the more extensive equipment required, and the greatly reduced number of samples which can be malted in a given period. Hybrids exhibiting field characteristics which are more favorable than those in farm production and which in addition possess good malting quality will be increased for experimental malting tests, and possible release for general farm production.

The program for improving barley quality is very similar to that followed in wheat improvement work. Wheat hybrids are produced in the wheat nursery and tested for milling and baking quality employing micro or small sample methods. The more promising individuals are increased and larger experimental tests performed on samples from plots 1/60 to 1/40 of an acre in size. Commercial milling laboratories also collaborate in testing new varieties before release for farm growth is considered.

Acknowledgment

The author wishes to acknowledge the courtesy of **Cereal Chemistry** in granting permission for use of the illustration of the barley dehulling equipment shown in Fig. 4.

Literature Cited

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Bulletin 384 "Commercial Potato Production in Nebraska" by H. O. Werner is a comprehensive handbook on the subject. The bulletin is published by the Agricultural Experiment Station, College of Agriculture, University of Nebraska, Lincoln, Nebraska. The author, a well known authority on potato production, was Horticulturist in the North Dakota Agricultural Experiment Station from 1913 to 1918 when he resigned to go to the University of Nebraska.