NOTE ON A METHOD FOR TESTING GLUTEN STRENGTH[1]

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Gluten quality of durum wheat is an important factor for producing spaghetti of good quality in Europe. In the Canadian durum wheat breeding program, gluten quality has been important in selecting new varieties. Gluten strength has been taken as an indicator of gluten quality, because according to the Italian taste, durum varieties with short, inextensible gluten produce spaghetti with the

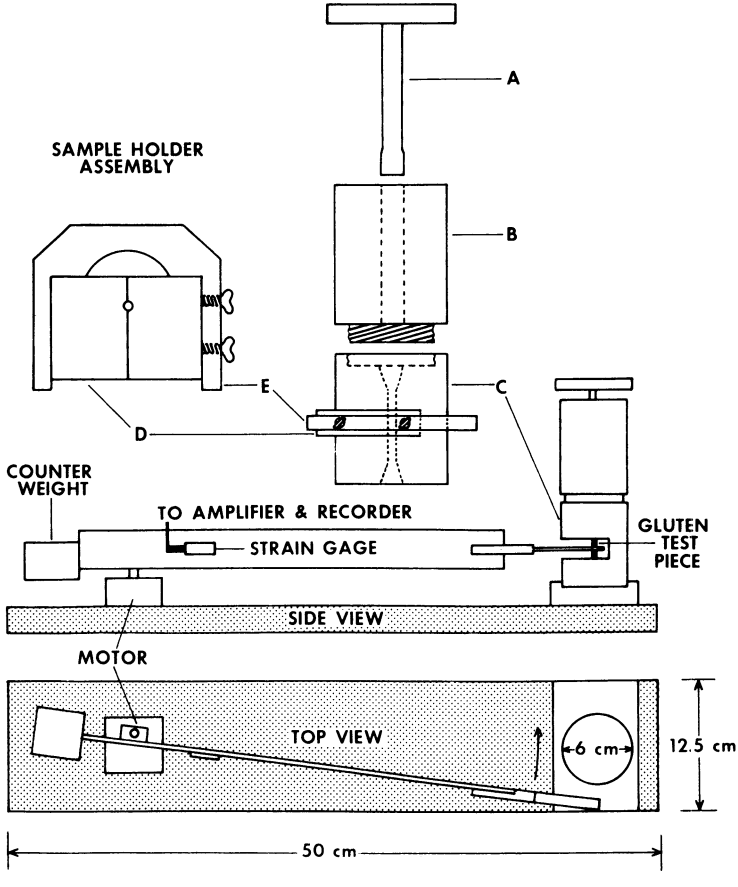

Fig. 1. Diagram of gluten-stretching apparatus.

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best cooking characteristics. In the durum wheat breeding program in North Dakota, greater emphasis has been given recently to gluten strength (1).

Mixing characteristics of semolina at low absorption as assessed on a farinograph (2) can give an indication of gluten strength. Protein content, semolina granulation, temperature, and absorption, however, influence the mixing curves. A farinogram does not always give a good indication of gluten strength. Another test for determining gluten strength is a stretching test, which Kosimina (3) originally devised and Matsuo *et al.* (4) modified. Extensibility tests have been useful in screening new varieties for gluten strength in the Canadian breeding program. The test, however, is time consuming and does not readily distinguish fairly strong glutens from very strong ones.

To refine the measurement for strength, a new method was developed. A sensitive strain gauge was used to measure the force required to break a strand of wet gluten.

MATERIALS AND METHODS

Apparatus

The apparatus is illustrated in Fig. 1. The sample holder (C) is made of brass, with tapering holes for the gluten test piece. Block D is a piece of Teflon with a hole aligned with the hole in the holder. The block is split across the hole for easy removal after the sample is installed in the holder to expose the gluten for stretching. Clamp E holds the Teflon pieces together temporarily in position in the holder. The cylinder (B) into which the sample is introduced is made of

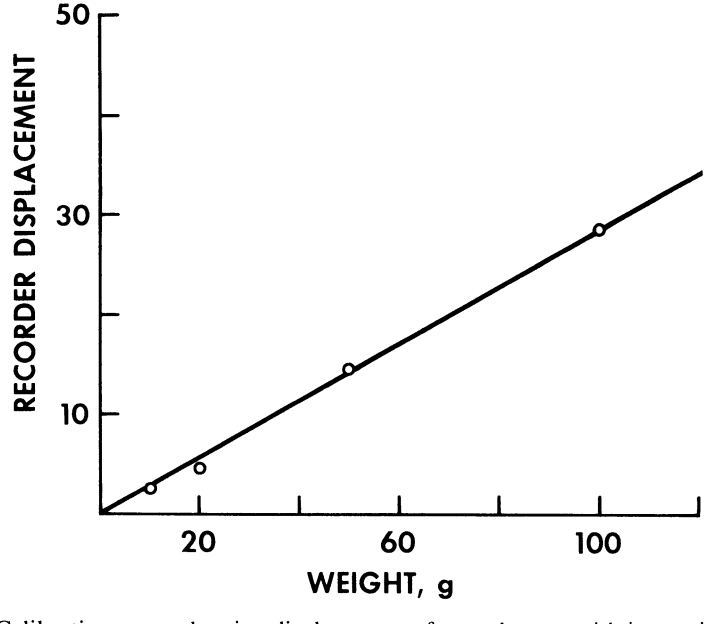

Fig. 2. Calibration curve showing displacement of recorder pen with increasing weight.

polyvinyl chloride. The plunger (A) forces the test piece into the holder.

The strain gauge is bonded to a stainless steel arm (2.5 × 30 × 0.3 cm). Rotated by a 3-rpm motor, the bar that stretches and breaks the gluten test piece is attached to one end of the arm. On the other end is a counterweight to balance the arm. As the motor rotates the arm, the strain gauge senses the force that the gluten generates in resisting stretching. A transducer amplifier-indicator (Model 300 D, Daytronic, Inc., Dayton, OH) amplifies and records the signal from the gauge on a strip chart.

Test Procedure

The Teflon block (D) is clamped and placed in the slot of the holder (C), and the holes are aligned. Approximately 3 g of freshly washed-out gluten is placed in the cylinder (B) and forced into the sample holder with plunger (A). A 2-kg weight is placed on top of the plunger and rested for 20 min with the sample holder in a bath maintained at 30° C. The Teflon pieces are then removed for the test. The motor is started and the exposed gluten strand is stretched and broken in a manner similar to an extensigraph test. The exposed gluten strand is 4 mm in diameter and 12.5 mm long. The time required for each test, including gluten washing and rest period, is about 35 min.

The strain gauge was calibrated by applying various weights with a pulley system to the stainless steel arm. Figure 2 shows the displacement of the recorder pen with increasing weights. From this calibration curve, the pen displacement is read off in grams and converted to dynes.

The apparatus was tested with glutens of durum varieties from the 1974 breeding program as well as gluten from other classes of wheat. All tests were

TABLE I
Gluten Strength of Durum Varieties and Some Other Classes of Wheat

Sample	Class of Wheat	Gluten Strength (dynes × 10^{-4})
Stewart 63	Durum, licensed, Canadian	4.21
Hercules	Durum, licensed, Canadian	7.65
Wascana	Durum, licensed, Canadian	6.66
Wakooma	Durum, licensed, Canadian	12.54
Macoun	Durum, licensed, Canadian	10.49
Coulter	Durum, licensed, Canadian	10.78
Botno	Durum, licensed, USA	3.72
Crosby	Durum, licensed, USA	4.70
DT 416	Durum, breeding, Canadian	5.19
DT 420	Durum, breeding, Canadian	11.17
DT 351	Durum, breeding, Canadian	8.04
DT 900	Durum, breeding, Canadian	9.22
Glenlea	Hard red spring, licensed, Canadian	10.00
1 CWRS[a]	Hard red spring	11.07
1 CWRW[b]	Hard red winter	4.70
1 CWSWS[c]	Soft white spring	5.88

[a]1 CWRS = grade No. 1 Canada Western red spring.
[b]CWRW = grade No. 1 Canada Western red winter.
[c]1 CWSWS = grade No. 1 Canada Western soft white spring.

done in triplicate. A sample of Wakooma was used to test the reproducibility of the apparatus.

RESULTS

The standard error observed in eight replicates with a mean breaking force of 12.49×10^{-4} dynes was $\pm 0.53 \times 10^{-4}$ dynes with gluten from Wakooma.

Gluten strengths of 12 durum wheat varieties, 1 hard red spring wheat variety, and 3 composite samples representing grades of other classes of wheat are given in Table I. Stewart 63, typical of varieties with weak, extensible glutens, shows a low breaking-strength value. The stronger gluten of Wakooma is reflected by a much higher value. Among other licensed and experimental varieties, the varieties from the breeding program, weak gluten varieties like Botno, Crosby, and DT 416 are readily distinguished. In the extensibility test reported previously (4), weaker gluten varieties were readily distinguishable; distinguishing among varieties like Wakooma, Coulter, and DT 900, however, was not possible.

Gluten strength of other classes of wheat are presented for comparison. Glenlea, a hard red spring wheat eligible only for the utility grades, and grade No. 1 Canadian Western red spring are not as strong as Wakooma. Both the Alberta red winter and soft white spring glutens are rather weak. Durum varieties now being selected in Canada have gluten strength comparable to that of hard red spring wheat.

In terms of the end product quality, gluten strength is only one of many contributing factors. Because the Canadian breeding program selects for strong gluten varieties, a test for gluten strength was necessary. The apparatus described has proved accurate and useful for this purpose.

Acknowledgment

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