TESTING MEAT COHESIVENESS USING THE INSTRON UNIVERSAL TESTING MACHINE AND THE COSU CELL

H.W. Ockerman, D.M. Greene and R.R. Hodges
The Ohio State University and OARDC, Columbus, Ohio, USA

SUMMARY

The results from this experiment indicate that the new cohesiveness test cell (COSU) can evaluate the cohesiveness of tumbled product and that the sample dimensions selected for use with the new test cell are appropriate. The new test cell used with the Instron universal testing machine will do a reasonable job in measuring cohesiveness particularly at higher cohesiveness levels. Comparisons between visual panel evaluations and peak Instron force measurements suggest that the machine satisfactorily measures cohesiveness traits similar to those evaluated by a sensory panel.

INTRODUCTION

The Instron Universal Testing Machine is normally used in meat research to measure tenderness or compression and a technique for testing cohesiveness or tensile strength is needed. Gillett et. al. (1978) developed a sample cell for the Instron to measure meat cohesiveness and consisted of one stationary and one moveable holding block. Each block had several offset holding pins, attached perpendicularly to the block's surface. The sample slice was impaled on the holding pins during testing. The moveable block was attached to the crosshead and load cell force sensors by a cable through a pulley. The blocks were then separated horizontally and the force required to pull the sample apart was transmitted to the load cell via the cable. This cell had two major problems - one was the elongation of the holes in the sample when tension was applied and the other was friction encountered by the cable-pulley transmission of force. It therefore appears that additional development is needed for a cell to measure cohesiveness of restructured meat in order to measure binding strength.

The objective of this research was to design, construct and test a cell (COSU) for the Instron that would measure the cohesiveness of a bond formed between adjacent muscle pieces that had been joined by restructuring.

DESCRIPTION OF METHODS

Sample Dimensions

A test cell was developed (See Fig.1), consisting of smooth edged clamping jaws adjustable by thumbscrews. This cell was fitted on a Model 1130 Instron Universal Testing Machine with the aid of the Warner Bratzler sheer housing turned 180 degrees. Commercially cured, sectioned and formed cooked boneless pork product was the initial source of samples in determining the optimum sample dimensions for testing with this cell. After testing the effects of various sample widths and thicknesses, additional hams were subjected to varying tumbling times and salt concentrations. These treatments were selected because of their anticipated effects on cohesiveness. Visual panel scores were evaluated to determine the viability of the new COSU test cell.

Each set of test cell jaws was opened to allow fitting of the sample. Prior to elongation, the lower set of jaws was positioned initially, 2.5 cm, on centre and below the upper set of jaws. Crosshead speed was adjusted to 10 cm/minute. As the crosshead descended the lower set of jaws descended stretching the sample until it broke. The recording chart was held stationary and recorded peak Instron force units required to break the sample. This procedure was repeated for each test. Samples which slipped from or broke near the jaws were discarded and the data rejected.

Tumbling Time

Treatment times of 0, 2, 4, 6, and 8 hrs (10 minutes on, 50 minutes off) were evaluated; and the hams were cooked to an internal temperature of 64°C. Samples were machine sliced 0.4 cm thick, cut 3.0 cm long, 2.5 cm wide (determined as optimal dimensions in previous test) and were tested. The seam between adjacent recombined muscles was positioned between the two sets of clamps to insure the probability that breaking would occur at the seam. Thirty peak Instron forces were recorded at each tumbling time (5 x 30 150 observations total). A ten member panel visually rated 30 different ham slices (12.5 ±0.5 cm diameter, 0.4 cm thick) from the same recombined ham on a nine point scale (1 = not cohesive, 9 = very cohesive). The 10 panel members' scores were averaged to obtain an average sample score and then the samples at each tumbling time were averaged to determine a tumbling time average.

Salt Concentration

Fresh ham pieces were stitch pumped with brines (10%) containing 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0 percent salt. The hams were tumbled for an 18 hr cycle and cooked as previously described. Thirty peak Instron forces to break the samples were recorded at each salt level (30 x 9 = 270 total) and the product was visually rated as previously described. The data was handled similarly resulting in an average for each salt level.

RESULTS AND DISCUSSION

As sample width increased Instron force units required to break the samples increased (Fig.2). Since the Instron force units appeared to have less change in force with additional width and slightly reduced variability with sample width between 2.0 and 3.O cm, the 2.5 cm width was selected as the optimum width to use with the new test cell.

Effects of sample thickness on Instron force units are shown in Fig.3. Because of the slope of the curve and the variability between 0.3 cm and 0.5 cm thickness, 0.4 cm was established as the standard thickness for all subsequent tests. The standard sample dimensions became 3.O cm long, 2.5 cm wide, and 0.4 cm thick.

Influence of tumbling time on Instron force units generally depict increased cohesiveness with increased

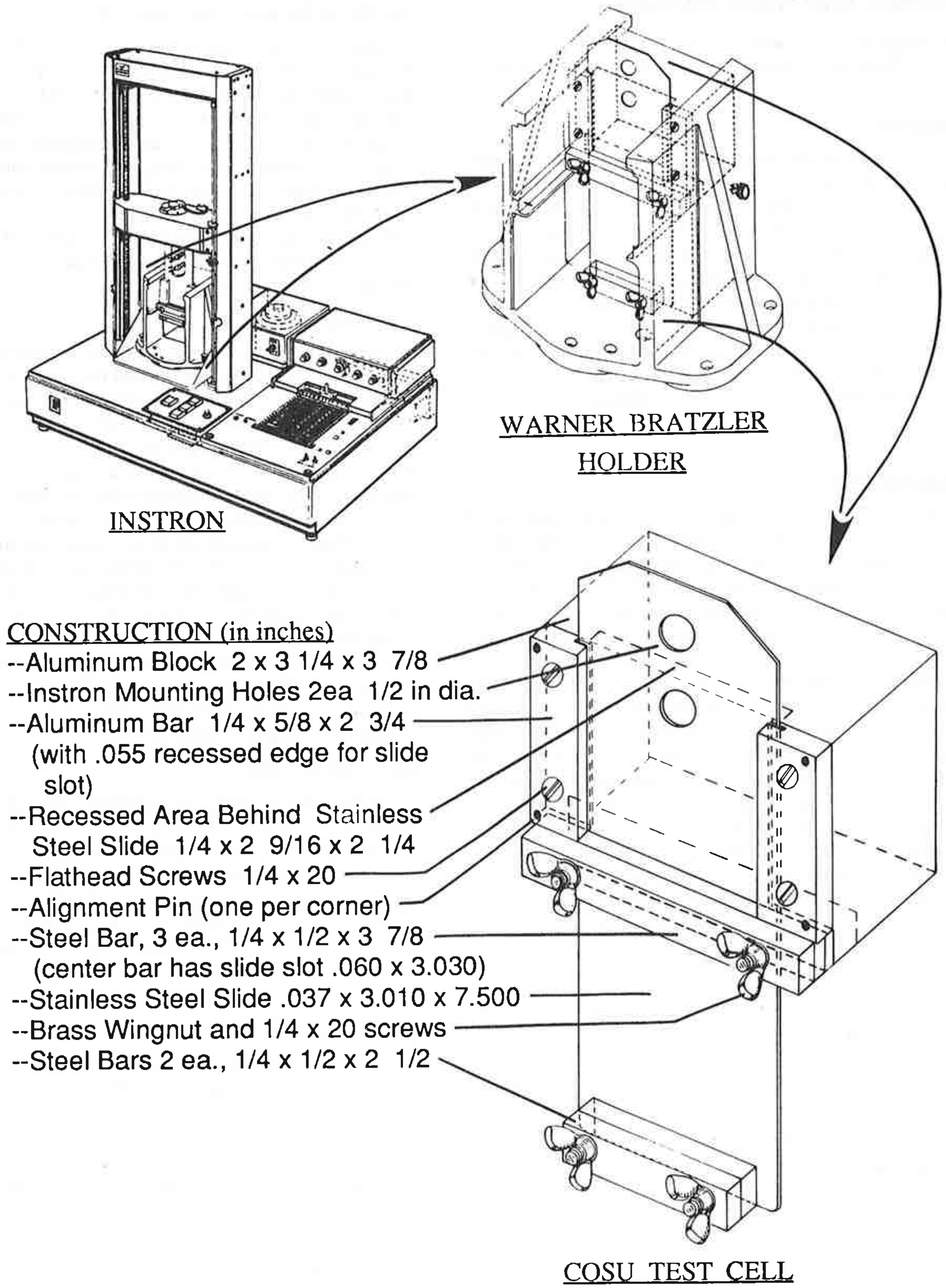

FIG. 1 Diagram of COSU Test Cell

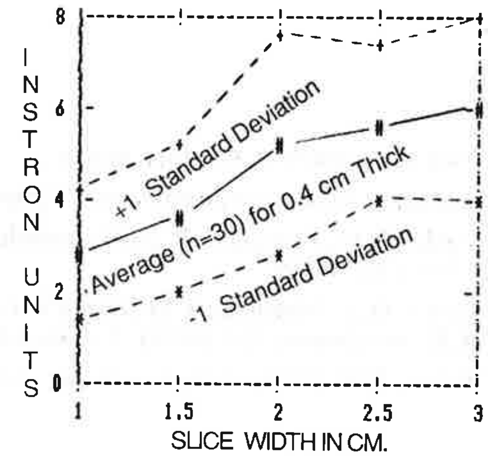

Fig. 2 Slice Width

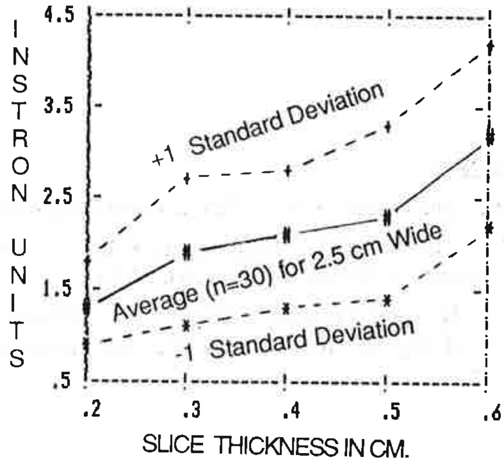

Fig. 3 Slice Thickness

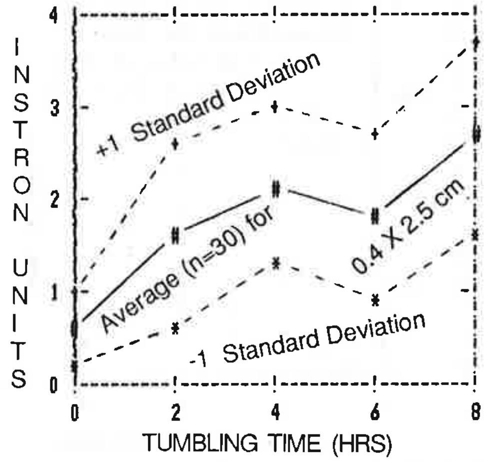

Fig. 4 Tumbling Time

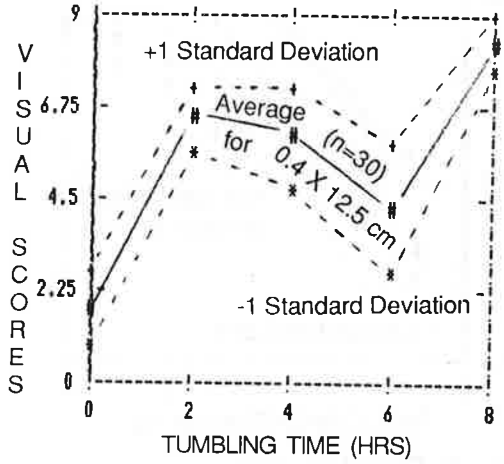

Fig. 5 Tumbling Time

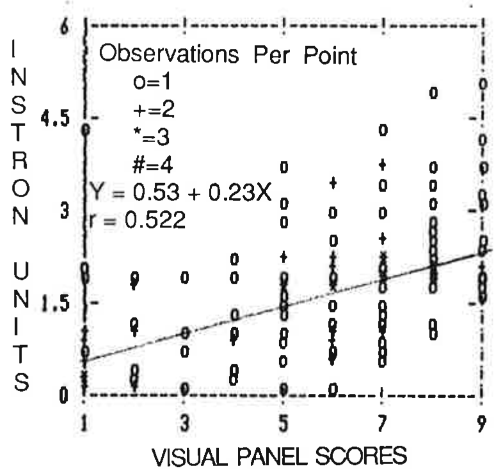

Fig. 6 Instron vs Panel

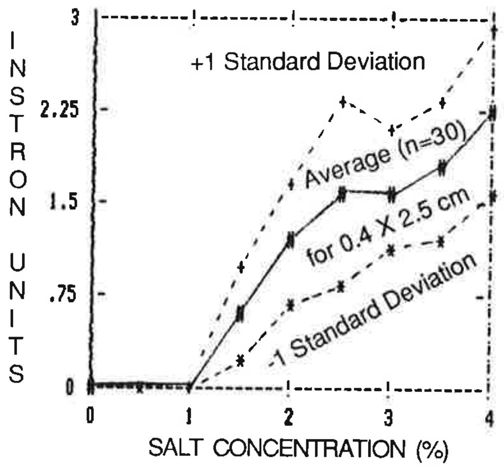

Fig. 7 Salt vs Instron

tumbling time (Fig.4). The relationship between tumbling time and panel appraisal is shown at Fig.5. The positive relationship between Instron force units to break the samples and visual panel scores for cohesiveness is plotted at Fig.6. The regression line slope is significantly different from 0 and the correlation value of 0.5 is highly significant. The effect of varying salt concentration on peak Instron force is shown at Fig.7. As might be expected, increased salt concentrations increased cohesiveness and Instron force to break the samples. Samples treated at the 0, 0.5, and 1.0 percent salt levels did not yield Instron readings because they lacked sufficient cohesiveness to be fitted into the clamps of the test cell. Beyond the 1.0 percent concentration level, Instron force showed a very positive relationship to salt concentration. Fig.8 clearly depicts the effect of increased salt concentration on panel cohesiveness evaluations. The positive correlation between panel scores and Instron force for ham pieces cured at different salt levels is shown at Fig.9.

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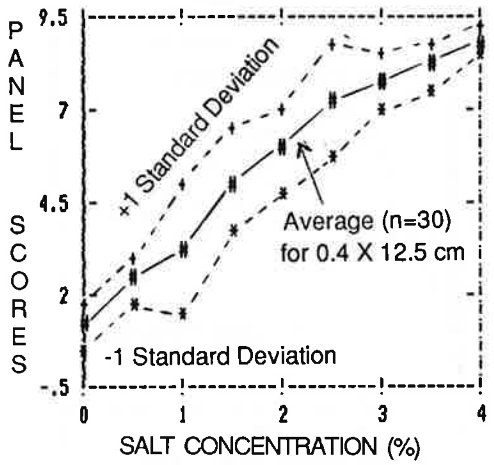

Fig. 8 Panel vs Salt

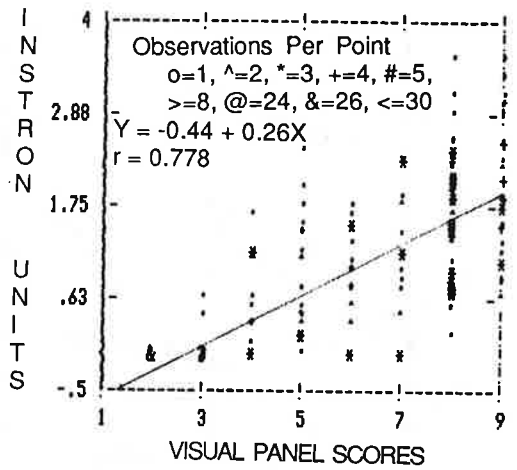

Fig. 9 Instron vs Panel