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Rapid Detection by RVA™ of Proteolytic Degradation Caused by Insects (*Aelia* and *Eurygaster*) in Soft Wheats Used for Bread Making

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In countries adjacent to the Mediterranean Sea, insects belonging to the genera *Aelia* and *Eurygaster* attack wheat in the field. This can result in large economic losses due to reduced flour quality, weak dough and breads of low volume and poor texture.

The damage produced in the grain of wheat is characterised by the destruction of its multifaceted structure due to the injection of a saliva inside the endosperm, often without externally visible damage. The saliva secretion includes principally protease enzymes (endopeptidases) that hydrolyse prolamins and glutenins, breaking peptide links. Also reported are alpha and beta amylases that degrade starch, and lipases that hydrolyse grain triglycerides causing rancidity.

Resultant dough with weakened gluten is not homogeneous but deforms while liberating water during the resting stage. During fermentation the dough weakens, increasing the porosity of the gluten. The lack of gas retention causes limited volume and a very deficient alveolar structure in the various final products.

According to the information of the quality survey of the Spanish wheats for the 2001 crop, run by the AETC (Spanish Association of Cereal Techniques), approximately 50% of the samples belonging to the main varieties cultivated in Spain (Marius and Astral) presented, in the Alveographic test average indexes, a degradation higher than 32% due to *Aelia* and *Eurygaster* attack.

It is very important to detect the batches attacked by insects *Aelia* and *Eurygaster* to avoid mixing them with sound wheats for processing. Currently the milling industry has two ways to test batches of wheat for insect damage, the first by meticulously studying the external surface of the grain and the second by rheological tests that allow the characterisation of the functional properties of wheat flours. The most common method in Spain is the Alveograph test, comparing the initial curves (W) with the ones obtained after a 2 hour rest of the dough (W2h). Proteolytic damage is indicated by a reduction in W after 2h rest by 15% or more with clear loss of L (extensibility).

In Spain the RVA is relatively new and could have many applications in the cereal industries due to its sensitivity, speed of heating and cooling, rapid test cycles, precision and repeatability.

MATERIALS AND METHODS

Wheat samples of vitreous, semivitreous and soft aspect categories, from the 2003 and 2004 Spanish harvests, were used. As a reference, Hard Red Spring wheat from Canada and USA, free of insect damage, was used. Wheat was milled in a laboratory mill equipped with sieve 0.8 mm, stored in sealed bags at 20–25°C, and the wholemeal used for all RVA tests. Moisture, protein, Falling Number and rheological properties from the flour dough were obtained following the official methods from AACC. Proteolytic activity from the attack

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of *Aelia* and *Eurygaster* was determined by procedure Nº 20 from the official methods of cereal and derivates analysis, ref: H-80277-A, 1977, using the Alveo-Consistograph Chopin NG.

Tests were performed using and RVA-4 using the lactic acid (LA) profile (1000 rpm 0–1 min. then 160 rpm, 25°C 0–5 min., ramp to 50°C at 7 min., hold to 10 min.), adding 2 mL of 0.5N lactic acid to 10 mL water and 10 g wholemeal (12% mb). The followiing measurements were made: Breakdown cP (visc @ 10 min. – visc. @ 3 min. as % of 3 min. value); viscosity cP at 30°C (V30), final viscosity cP at 50°C (VF) and the % of loss of viscosity (PV) according to the expression: [(V30 - VF)/V30] * 100.

RESULTS AND DISCUSSION

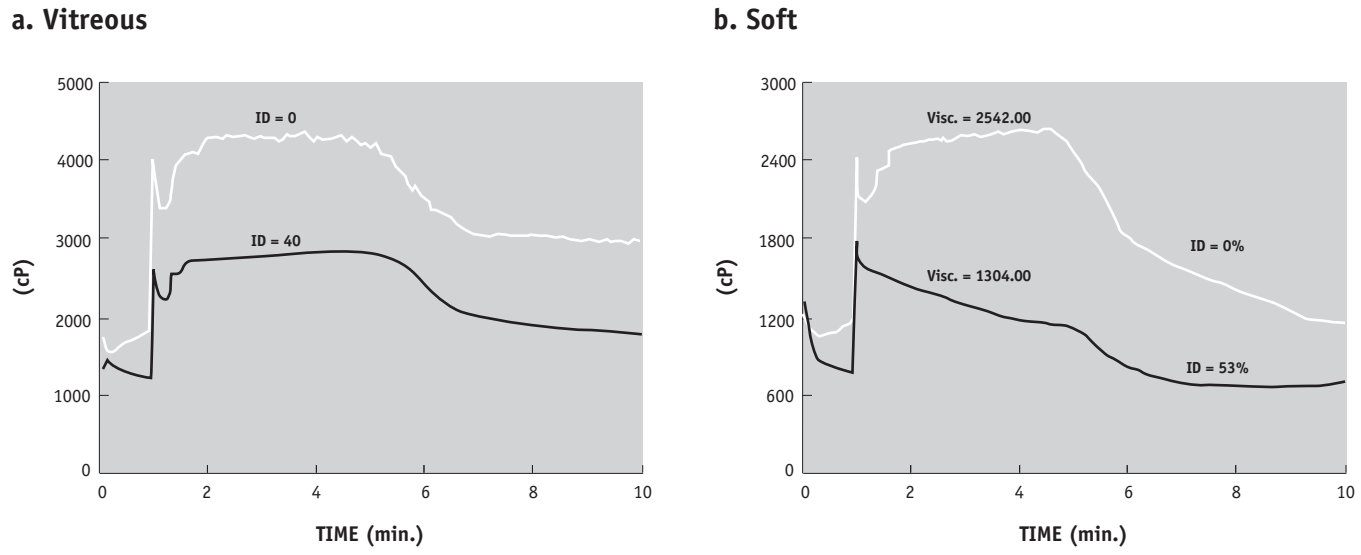
The black curves in Figures 1a and 1b are the wheats of vitreous structure attacked by *Aelia* and *Eurygaster*. They show a different behaviour in the RVA to the wheats that had not suffered any type of attack (white curves). A clear reduction in viscosity is visible in all the tested samples, with better definition for the wheat with evident signs of being attacked (Table 1). These results were confirmed by adding bacterial protease to wheat samples and running similar tests (results not shown).

Lactic acid (LA) facilitates separation starch–protein and limits swelling of starch molecules, producing suspensions of lower viscosity. Possibly this effect would be more evident in wheats attacked by *Aelia* and *Eurygaster*. Similarly gluten damaged by proteases would partially lose swelling capacity, accentuated at 50°C. All of this would explain the decrease in viscosity shown in the RVA graphs.

In general, the viscosity of vitreous wheat was greater than that of the soft ones, independently of *Aelia* and *Eurygaster* damage. Vitreous wheats develop more damaged starch than soft wheat due to the hardness and its effect during grinding. Therefore its swelling capacity is higher. This explains the higher loss of viscosity in the soft wheats.

The proposed method, using the Rapid Visco Analyser (RVA), allows rapid differentiation of wheat attacked by *Aelia* and *Eurygaster* from sound wheat.

Figure 1
Effect of proteolytic degradation in (a) vitreous and (b) soft wheat (white curves — no degradation, black curves — wheat degraded 40% & 53% insect damage (ID))



a. Vitreous

Variety	% ID	V30 (cP)	VF (cP)	% PV
HRS	0	3798	2970	22
HRS	0	3340	2744	18
HRS	0	4186	3150	24
Rinconada	0	3773	2691	28
Califa	0	4201	3115	26
Alcalá	0	3436	2466	28
Soissons	34	2696	1579	42
Soissons	41	1580	1057	33
Taylor	36	4268	2925	32
Isengrain	30	1583	920	42

b. Soft

Variety	% ID	V30 (cP)	VF (cP)	ref.
Marius	0	2059	1309	36
Marius	0	2151	1312	39
Marius	0	1806	1094	39
Astral	33	1625	816	50
Marius	35	1294	754	42
Astral	53	1747	676	61
Astral	41	1811	791	56
Marius	43	1961	1057	46

Table 1
Effect of the attack of Aelia *and* Eurygaster *on (a) vitreous and (b) soft wheats in the RVA*

Analysis of Soybean by the RVA™

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Hull free dry soybean has been ground into powder. 7g soybean powder (9% moisture) was added to a canister containing 25 mL distilled water. A 20-minute profile described by Turner et al. (1996) was used to analyse soybean samples in the RVA. This profile was started and held for 2 min. at 65°C, heated to 95°C at 4.5 min. and held at 95°C until 14.5 min. then cooled to 50°C at 17.75 min. and held until 20 min., the end of the test. The test was performed on RVA-4 using Thermocline for Windows version 2.0 control software.

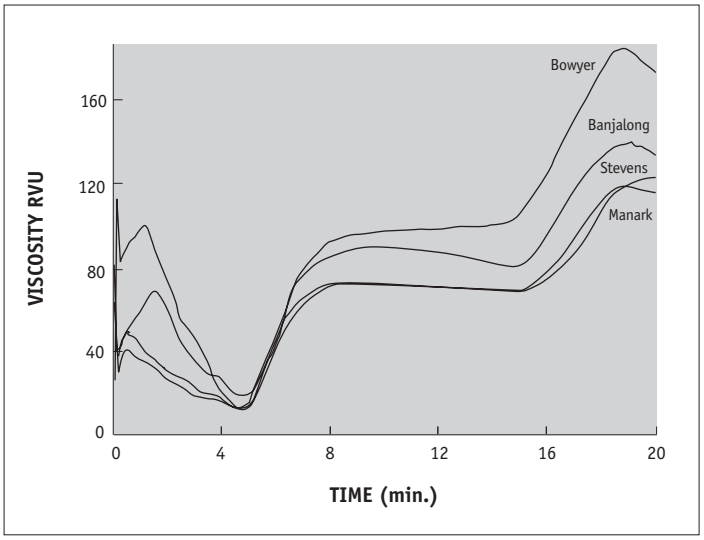

Figure 1
RVA™ multiple graph of four soybean varieties

The quality of soybean used for soy cheese or tofu making can be evaluated by RVA analysis. This study shows that RVA peak 1 viscosity (RVU) using the 20-minute profile had a significant correlation with the soy curd textural parameters, hardness ($R=0.98$, $P<0.01$), cohesiveness ($R=0.96$, $P<0.01$) and springiness ($R=0.99$, $P<0.01$). If soybean RVU value was high, a firm soybean curd was easily produced.

Reference:

Turner, N.E., Bason, M.L., Sleigh, R.W., and Fahmy, F. 1996. Assessing soybean quality for tofu production using the Rapid Visco Analyser, *9th Australian Soybean Conference 1996*. Pages: 124–128.

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