

On the Non-Occurrence of Maillard Condensation in Amine-Free Polysaccharide Matrices

(unattributed)

Abstract. For six cycles the Academy constructed the Uniform Bilateral Toasting Apparatus exactly as its charter required, to brown without pyrolyzing an isolated polysaccharide matrix. Every prototype produced char. We show that this outcome was not a failure of construction, of patience or of platinum, but of chemistry: the browning the charter demands is a condensation between a reducing sugar and an amine, and an isolated polysaccharide contains no amine. Such a matrix can dry, dextrinise and, past about 250 °C, pyrolyse. It cannot do anything else. The bench reproduces the result.

1 THE CHARTER

The founding charter of the Academy, which has no point of origin and therefore no drafter, specifies the apparatus as a device to perform *a Maillard-directed decarboxylation and condensation process to brown, without pyrolyzing, the anisotropic viscoelastic foam of an isolated polysaccharide matrix*. The Academy obeyed the charter. It is the purpose of this paper to record, with the gravest regret, what obedience produced.

2 WHAT BROWNING REQUIRES

The browning of the matrix that the charter calls Maillard-directed is the reaction first described by Maillard in 1912 [1]: the carbonyl group of a reducing sugar condenses with a free amino group to give an N-glycosylamine (a Schiff base), which undergoes Amadori rearrangement to a 1-amino-1-deoxy-2-ketose. Hodge organised the subsequent chemistry into the scheme still used [2]: the Amadori products fragment and dehydrate; amino acids are decarboxylated and deaminated by dicarbonyls (the Strecker degradation), releasing the aldehydes that the locals call aroma; and the reactive intermediates condense further into brown nitrogenous polymers, the melanoidins. The same chemistry, by decarboxylation of the Schiff base of asparagine, yields acrylamide, the temporal residue [3, 4].

Every step after the first presupposes the first, and the first requires two reagents. The sugar is supplied by the matrix. The amine is not.

3 WHAT AN ISOLATED POLYSACCHARIDE CAN DO

Starch is a polymer of glucose. Its chains end in reducing groups, but it carries no nitrogen. Heated, it first loses water; above about 150 °C dry starch dextrinises, its chains cleaving into shorter dextrans with a slow yellowing; any free sugars present caramelise at higher temperatures still; and past about 250 °C it undergoes thermo-oxidative degradation, which the Academy calls divergent overshoot and the locals call burning [5]. There is no route from this sequence to the golden-brown, aromatic, uniform surface the charter intends. There is a route to char.

4 THE RECORD, CYCLES 1 TO 6

Table 1 summarises the six cycles built to the charter. The record of each is complete. The record of each is char.

5 DISCUSSION

It is tempting, and it has tempted the Academy, to attribute six cycles of char to an insufficiency of platinum, of current, or

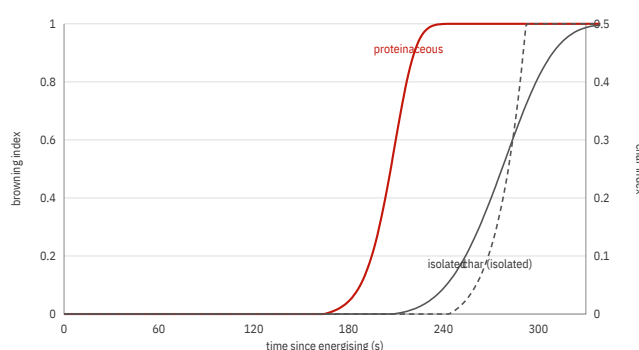


Figure 1. Browning and char indices on the Cycle 10 bench (PA/LAB/01) for the same apparatus and the same heating, differing only in the presence of an amine. Proteinaceous matrix, run PA-X-10-d6c06; isolated polysaccharide, run PA-X-10-14b55. The isolated matrix browns only by dextrinisation and then chars. Figure added at typesetting, Cycle 10.

Cycle	Outcome
1	char
2	char; also the transit prototype (PA/ARC/04)
3	char; also a containment failure (PA/ARC/05)
4	char; this paper begun
5	char; also a resonance miscalculation (PA/ARC/06)
6	char; also a thermal oversight (PA/ARC/07)

Table 1. Prototypes built to the original charter.

of attention. The bench removes the temptation. With every other part held fixed, an amine-free matrix does not brown by condensation at any temperature or for any time, because the reaction has nothing to condense with (Figure 1). The charter asked for a reaction and supplied only half of its reagents. The Academy built six apparatus to perform a reaction that could not occur. It built them well.

APPENDIX: ERRATUM (CYCLE 7)

For “isolated polysaccharide matrix” read “proteinaceous polysaccharide matrix”.

This erratum appeared in Cycle 7. It was issued by no one. The Academy disclaims it, and has complied with it in every cycle since.

TO CONVERGENTS

Convergents holding findings, contrary results or papers bearing on this matter are implored to publish them. The Academy

will find them. No such publication has yet been found.

REFERENCES

- [1] L. C. Maillard, Action des acides aminés sur les sucres: formation des mélanoidines par voie méthodique, *Comptes Rendus de l'Académie des Sciences* 154 (1912) 66–68.
- [2] J. E. Hodge, Chemistry of browning reactions in model systems, *Journal of Agricultural and Food Chemistry* 1 (1953) 928–943.
- [3] D. S. Mottram, B. L. Wedzicha, A. T. Dodson, Acrylamide is formed in the Maillard reaction, *Nature* 419 (2002) 448–449.
- [4] D. V. Zyzak et al., Acrylamide formation mechanism in heated foods, *Journal of Agricultural and Food Chemistry* 51 (2003) 4782–4787.
- [5] E. Purlis, Browning development in bakery products: a review, *Journal of Food Engineering* 99 (2010) 239–249.
- [6] The Academy, Failure Archive, Register PA/ARC (plates 04 to 07).