

Browning of potato vascular rings after frying

A new assessment scale to complement the current reference table for rating crisps

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1. Introduction

In recent years, the professional potato sector has been reporting recurrent incidences of **vascular browning**, particularly in varieties intended for **industrial processing**. When slices of tubers are fried into crisps, the **vascular rings** turn locally brown in a heterogeneous and irregular manner. Although the origin of the problem has not yet been clearly established, several **pathogens** are suspected of causing these browning symptoms. Typically, the presence of fungi or bacteria in the vascular vessels of the tuber can cause a non-enzymatic browning reaction during frying by converting starch into sugar. Particularly in dry, hot years, an increasing number of potato batches are rejected following the appearance of disparate stains in frying tests.

Several pathogens, such as *Fusarium* spp., *Colletotrichum coccodes*, or *Verticillium dahliae*, could cause browning symptoms. However, the non-cultivable bacterium *Candidatus Arsenophonus phytopathogenicus* is currently the most likely pathogen to cause plant damage and quality losses in many batches of potatoes.

To differentiate between the classic browning found in batches of potatoes that do not have the required starch levels, we propose a second **assessment scale**, specific to the location of the browning by identifying browning along the vascular rings of the tuber.

2. Vascular ring browning assessment scale

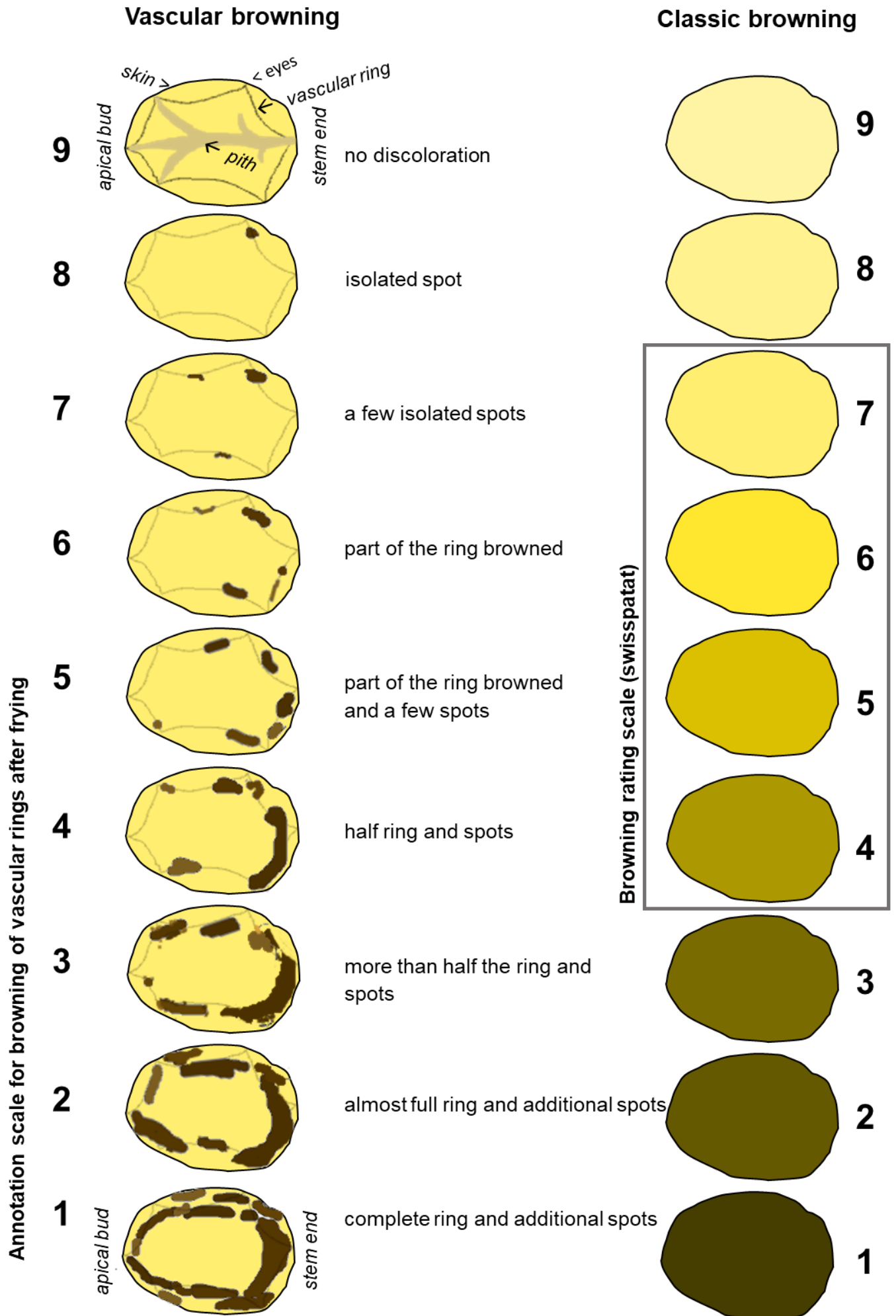
To best differentiate and annotate the two types of browning after frying, a new assessment scale, the “vascular browning” has been established to standardise the browning of vascular rings. The orientation from grade 9 (no symptoms) to grade 1 (maximum symptoms) was established in the same direction as the classic browning scale that has been used since 1987. The two scales are, in theory, independent of each other but will tend to converge at the lower end of the scale. Heavy infection of the vascular rings by a lambda pathogen produces large amounts of reducing sugars, which diffuse into the rest of the flesh, darkening the overall colour of the potato after frying. By contrast, tubers with a high starch deficiency turn completely brown, which may hide a specific browning of the vascular rings. A differentiated use of the assessment scales for the two types of browning makes it possible to determine which varieties are sensitive to this phenomenon during the study of potato varieties or during research projects.



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Photographic examples



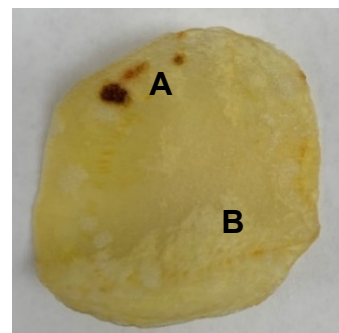
Examples of browning of potato crisps after a frying test. The browning of the vascular rings by local spots is apparent. Here, the following scores, from left to right, would be appropriate: 7 - 6 - 4 - 4.

3. Correct differentiation between the two scales

It is important to differentiate between the classic browning scale and the vascular browning scale. The existing classic browning scale, established in 1987, is based on the browning of potato flesh after frying. This is mainly due to the presence of large amounts of reducing sugars in the tuber. The browning is relatively evenly distributed across the flesh of the tuber. By contrast, browning of the vascular rings is localised in the conductive bundles of the tuber and, depending on the intensity of the symptoms, may extend into the parenchyma of the tuber.

Notably, during frying, slight colouration of the conductive bundles should be expected in slices from a healthy tuber with very low levels of reducing sugars, as conductive bundles are very often visible on crisp slices, even in healthy tubers. Correct annotation of potato browning using the new scale requires observing a dark, 'blurred' spot of discolouration on the vascular rings. The simple visual distinction of the rings should not be considered when scoring.

In the sample image of a potato crisp on the right, the stained area **A** is considered to be the discolouration of the rings. Area **B**, where the vascular rings are slightly visible but not stained, should not be considered browning, as it poses no problem.



4. Additional information

Swiss list of potato varieties, 2024. Schwaerzel R., Torche J.-M., de Werra P., Dupuis B. Agroscope Transfer, 511, 2023, 1-8.

Reference table for rating crisps, 1987 edition, Swiss Potato Commission, CH-3186 Guin.

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