AMD-HPTLC analysis of reaction products resulting from a thermal induced degradation of onion (*Allium cepa* L.) flavonols

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Introduction

Plant phenolic compounds are an important constituent of the human diet. In recent years they have gained much attraction due to their antioxidative, antibacterial, and even anticarcinogenic effects[1]. In this context onions are an interesting vegetable for research due to its high content of phenolic compounds and its widespread popularity[2]. In comparison to other vegetables onions contain high levels of quercetin glycosides (mainly quercetin-3,4'-diglucoside and quercetin-4'-glucoside)[3]. Only a few papers consider the impact of domestic processing (chopping, boiling, and frying) on the stability of the flavonoids[4].

It was concluded that such a degradation may partially result from oxidation[5], but the knowledge about the arising degradation products is still very limited.

The objective of the present study was to investigate the influence of a thermal treatment on the degradation of selected onion flavonoids.

Material and Methods

Onion samples and selected flavonoids were applied to thermal processes (cooking and roasting) under varying reaction parameters (temperature; oxidative conditions; pH-value). AMD-HPTLC was used to follow the changes during the thermal processing.

Sample preparation

1 a) Selected flavonoids (quercetin, quercetinglycosides)
b) Onions (Centurio, *Allium cepa* L.) were cut, freeze-dried and ground.

2 a) Flavonoids were cooked/roasted (180°C) up to 60 minutes
b) Onion samples were roasted at 180°C for 5 and 10 minutes.

3) The flavonol profile was analyzed using HPTLC-AMD following an extraction with 70% methanol and solid phase extraction as a clean-up step.

HPTLC parameters

development:	AMD II (CAMAG)
plate:	Silicalgel 60; HPTLC; 20x10cm (Merck)
application:	automatic TLC sampler III (CAMAG)
volume:	20 µL
solvents:	Solvent A: ethylacetic acid/water/formic acid (85:15:10) Solvent B: touluol/acetic acid (2:1)
gradient:	5 step gradient

step	solvent	time [Min]
1	A	5
2	B	10
3	B	15
4	B	20
5	B	25

detection:	TLC-Scanner III (CAMAG)
wavelength:	325 nm (plant phenolic compounds)

Results and Discussion

- Thermal treatment of flavonoids leads to a degradation to smaller substances or even to polymers (Figure 1-3).
- Cooking leads to a different result than roasting[7/8].
- Thermal treatments of the onion samples showed that the quercetin glycosides are degraded depending on roasting time and temperature, but especially depending on the flavonol profile (Figure 4).
- Roasting under model conditions showed that flavonoldiglycosides are degraded to their corresponding aglycones via with the respective monoglycosides as intermediates (Figure 5)[8].
- With regard to biovailability monoglucosides are highly bioavailable compared to the diglucosides and the aglykon[9/10].
- HPTLC is an exquisite technique to follow all the fractions formed, because Polymeric fractions might be discriminated during HPLC analysis.

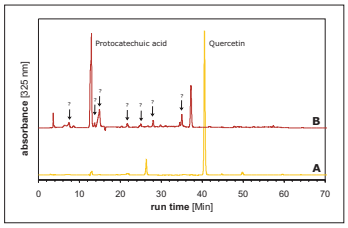

Figure 1. Cooking of Quercetin for (A) 0 and (B) 60 minutes.

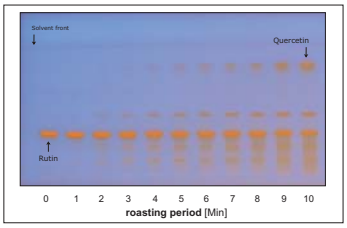

Figure 2. Roasting of rutin at 180°C (366nm).

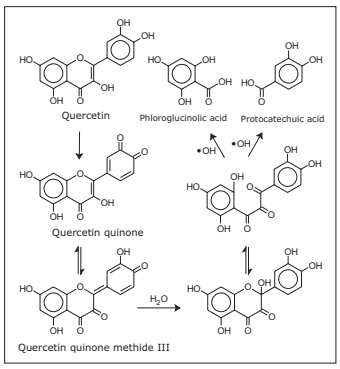

Figure 3. Hydroxyl radical mediated oxidative degradation of Quercetin[6].

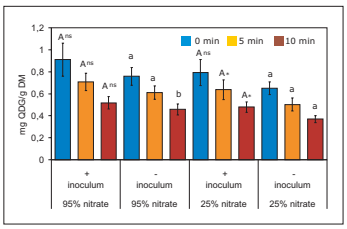

Figure 4. Thermal degradation of the quercetindiglucosides (QDG) of different fertilized onions.

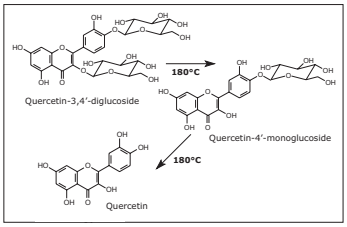

Figure 5. Reaction mechanism of the thermal degradation of (onion) quercetindiglucosides

Conclusions

It can be concluded that thermal processing leads to significant change of the flavonoid profile of flavonoid-rich food.

As the onion flavonol glycosides are degraded during thermal food processing, a flavonol profile consisting of a high amount of diglycosides seems to be advantageous during roasting.

The resulting intermediates and degradation products have a high bioavailability[9,10] and a comparatively high antioxidative activity.

Different fertilization techniques may support increased formation of quercetin glycosides in onion.

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