EFFECT OF ROSEMARY EXTRACT ON THE FORMATION OF HETEROCYCLIC AROMATIC AMINES IN FRIED BEEF PATTIES

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Background

Epidemiological studies have shown that the daily diet can be responsible for various types of cancer. Heterocyclic Aromatic Amines (HAA) are especially found in the crust of fried meat and fish. These substances are formed during the Maillard reaction from creatinine, carbohydrates and amino acids. Several HAA have been shown to be carcinogenic in long-term animal studies on rodents and non-human primates (Adamson et al., 1990). The International Agency for Research on Cancer has classified several HAA as possible human carcinogens and recommends the reduction of these compounds in exposure of humans (IARC, 1993). Besides the important physical parameters such as temperature and heating time, natural antioxidants should inhibit the formation of HAA, because free radicals are involved in the complex Maillard reaction and the formation of HAA.

Objectives

The objective of this study was to examine the possibility of reducing the formation of HAA in beef patties by using a commercial rosemary extract. Additionally, the beef patties were tested for sensory parameters such as taste, smell, juiciness and colour.

Materials and methods

Preparation of beef patties

Plain beef, roughly desinewed and defatted, was coarsely minced through a 3 mm plate. 1.2 % salt and the liquid extract of Rosmarinus officinalis (Tab.1) (Flavor Guard LO W/S, Chr. Hansen, Germany) in concentrations of 0.5, 0.75, 1.0 and 2.0 g/kg were added to the minced beef, respectively. The control batch was prepared without the extract. After mixing 80 g ± 1 g of the material, the beef patties (16 mm thick x 85 mm diameter; estimated fat content of 12 %) were formed with a special mould.

Heating devices

The patties were put between two pieces of tin foil, which were coated with sunflower oil. The two grill plates of a double contact grill (Nevada-grill, Neumärker, Hemer, Germany) produce a temperature of 230 °C. The patties were immediately fried on both sides simultaneously for 5 min to a core temperature of 72 °C and to a surface temperature < 190 °C at the end of the frying process.

Colour measurement of beef patties

One hour after heating, the L*(brightness)-, a*(redness)- and b*(yellowness)- values were determined by using a Chromameter CR 200 (Minolta, Ahrensburg, Germany).

Determination of HAA

The method of HPLC analysis with some modifications was based on the method described by Gross and Grüter (1992). The quantification was carried out with an external calibration (Norharman and Harman) or standard addition (MeIQx, 4,8-DiMeIQx, PhIP).

Sensory test

Sensory testers evaluated colour, juiciness, taste and smell of the fried samples with a scale from 0 (very unpleasant) to 6 (very pleasant). After frying, the samples were frozen for a week and reheated in a microwave for the sensory test.

Determination of weight loss during frying

The beef patties were weighed before and 1 hour after heating.

Results and discussion

There are different kinds of rosemary extracts in trade. Some of these extracts are in powder form and contain maltodextrin as carrier. These extracts were not suitable for our investigations because maltodextrins as carbohydrates can influence the Maillard reaction and the HAA formation consequently (Skog and Jägerstad, 1990). The different extracts also include strongly differing concentrations of carnosol, carnosolic acid and other antioxidant compounds such as phenolic diterpenes. These substances have a very high antioxidant potential and inhibit the warmed-over flavour in the patties, which were frozen and reheated in the microwave. The rosemary extract used was a water dispersible liquid, which contains lecithin and polyglycerides as emulgators. But the extract contains a lower content of carnosol and carnosolic acid (Tab. 1), while the products in powder form contain up to 17 %.

Figure 1 shows the effect of the used rosemary extract on the formation of HAA. PhIP was the only compound significantly reduced by adding the rosemary extract. The lowest concentration had approximately the same effect on the PhIP formation as the highest. The lowest used concentration was the recommendation of the extract producer for patties. Higher concentrations of the rosemary extract in the patties showed no further reduction effect on PhIP. The three highest concentrations of extract addition increased the amount of the MeIQx formation slightly. The PhIP content was reduced by 64 % in the average of all used extract amounts. Norharman and Harman were found in all beef patties but the contents increased with higher addition of rosemary extract.

The colour (Fig. 2) and the weight loss of the patties showed no significant differences between the batches with or without extract. Figure 3 shows the result of the sensory evaluation. All patties were evaluated equally pleasant as the controls without rosemary extract. The taste of the patties with extract was described pleasantly spicy. Even the higher amounts of extract addition did not result in over-spiced products.

Some authors have reported reductions in the content of HAA in fried ground beef patties as a result of adding oleoresin rosemary (Balogh et al., 2000). In this study, rosemary oil, when used in two concentrations (1 % and 10 % based on fat content), reduced PhIP formation by 44 % in fried meat. Contrary to these findings, some authors have reported that the formation of PhIP increases slightly with the addition of rosemary flavour. Additionally, no correlation could be found between the oxidative properties of the flavours and the formation of PhIP (Zöchling et al., 2002).

Conclusions

In the present study, only the content of PhIP decreased significantly with the addition of commercial rosemary extract. All other HAA, especially Norharman and Harman, increased slightly with the addition of rosemary extract. The PhIP content in the fried beef patties was reduced by 64 % in the average of all used extract amounts. The flavour and colour of the patties with rosemary extract were found pleasant.

References

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Abbreviations

HAA : Heterocyclic Aromatic Amines, MeIQx : 2-amino-3,8-dimethylimidazo [4,5-*f*]quinoxaline,
4,8-DiMeIQx: 2-amino-3,4,8-trimethylimidazo [4,5-*f*]quinoxaline,
PhIP: 2-amino-1-methyl-6-phenylimidazo [4,5-*b*] pyridine

Table 1. Specification of the rosemary extract

Ingredient	Concentration
Fat	> 97 %
Protein	< 0.2 %
Carbohydrate	< 1.0 %
Water	< 1.0 %
Carnosol	0.83 %
Carnosolic acid	0.78 %

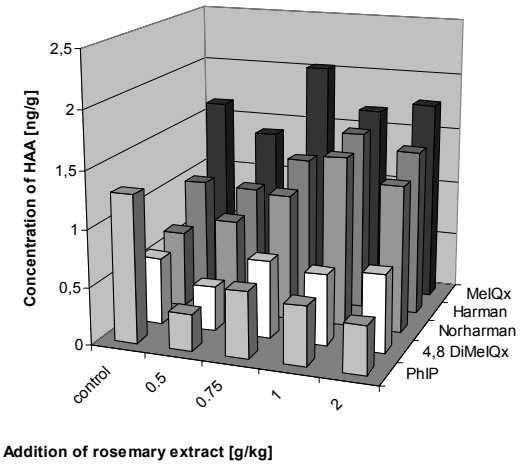

Figure 1. Concentration of HAA in fried beef patties for different additions of rosemary extract

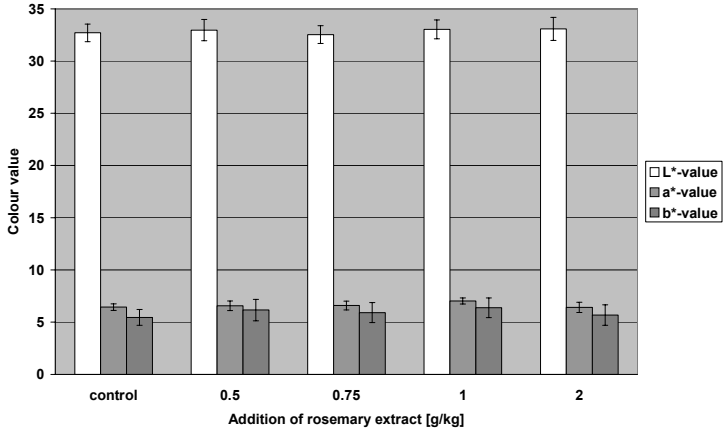

Figure 2. Colour measurement of fried beef patties for different addition of rosemary extract

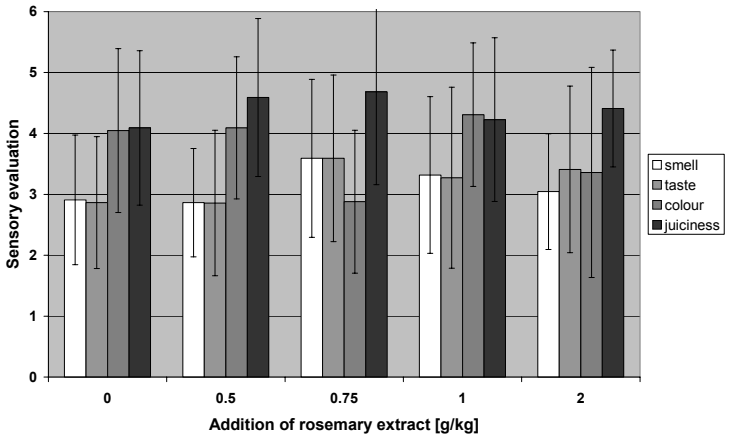

Figure 3. Sensory evaluation of fried beef patties for different addition of rosemary extract (scale from 0 (very unpleasant) to 6 (very pleasant))