EVALUATION OF AMINOACIDS FORMED IN THE (THERMO) SYNTHESIS OF ACRYLAMIDE DURING THE PROCESSING OF VEGETAL PRODUCTS

EVALUAREA UNOR AMINOACIZI IN PROCESUL DE (TERMO)SINTEZĂ A ACRILAMIDEI IN PROCESUL DE PRELUCRARE A PRODUSELOR VEGETALE

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Abstract. *Acrylic acid amide, known by its toxic effects exerted upon the biologic systems and by its high incidence in food, justifies its presence through the Maillard reaction, chemical cascade equations that take place during the thermal preparation of vegetals. The present researches are directed towards the gradual evaluation of concentration of certain amino acids in food in order to associate vegetal products that contain amino acids with those containing reducing sugars. In this direction, glutamine, asparagine and arginine were added to semi prepared potatoes before frying. The results can be corroborated with other data from literature that emphasize the role of ammonium carbonate in this synthesis, changing the research towards this aim. Is it possible that the presence of dicarboxylic amino acids favour the acrylamide production versus the basic amino acids?*
Key words: *acrylamide, asparagine, glutamic acid, arginine, olive oil, sunflower oil.*

Rezumat. *Amida acidului acrilic, cunoscută prin efectele sale toxice exercitate asupra sistemelor biologice şi prin incidența crescută în alimente, îşi justifică prezența ca produs al reacției Maillard, cascadă de ecuații chimice, derulate în procesul de prelucrare termică a vegetalelor. Cercetările redate în această lucrare sunt direcționate în sensul evaluării graduale a concentrațiilor anumitor aminoacizi în vederea asocierii potrivite a produselor vegetale ce conțin aminoacizi şi glucide reducătoare. În acest sens, pe şase eşantioane a 5 probe de cartofi semipreparați, s-a adăugat, înainte de prelucrarea termică, asparagină, acid glutamic şi arginină în concentrații constante (1 ppm). Determinarea concentrațiilor de acrilamidă pe probele de cartofi prăjiți au evidențiat concentrații ridicate pe eşantioanele cu adaos de asparagină şi glutamină. Aceste rezultate pot fi coroborate cu date din literatura de specialitate care scot în evidență rolul carbonatului de amoniu în aceasta sinteză, redirecționând cercetarea spre o altă cale de cercetare. Este posibil ca prezența aminoacizilor dicarboxilici să favorizeze producția de acrilamidă comparativ cu prezenta aminoacizilor bazici?*
Cuvinte cheie: *acrilamidă, asparagină, acid glutamic, arginină, ulei de măsline, ulei de floarea soarelui.*

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INTRODUCTION

Acrylamide (2-propamide) is the amide of an unsaturated acid, the acrylic acid, and it is used in the water potabilization process, the production of paper, cellulose, plastic, food packages, cosmetics etc. (Fig. 1).

Fig. 1 - Use of acrylamide (*according to Anca-Irina Burlacu 2009*)

Due to its toxic effects (neurotoxicity, carcinogenesis, genotoxicity, teratogenesis etc.) acrylamide becomes the main concern of toxicologists at the beginning of the 21st century when its adducts to haemoglobin are identified in the blood of some Italian workers (Erikson, 2005, 2006, Burlacu, 2009). The subsequent research conducted by Swedish researchers proved its presence in bread, biscuits, bakery products, snacks, fried potatoes etc. This represents an impulse for the study of its forming mechanism (Mustafa *et al.*, 2008). From the numerous studies conducted worldwide, it results that the thermal processing of food that includes amino acids and glucides is the main way acrylamide is formed (Tayemans, 2004, Vatemm and Shettz, 2003, Braten, 2005) (Fig. 2).

Because the analytical and toxicological studies on the assessment of acrylamide intake through food consumption in Romania are not so numerous, it results necessary to intensify the research on reducing the health risks subsequent to the consumption of qualitatively unsuitable products.

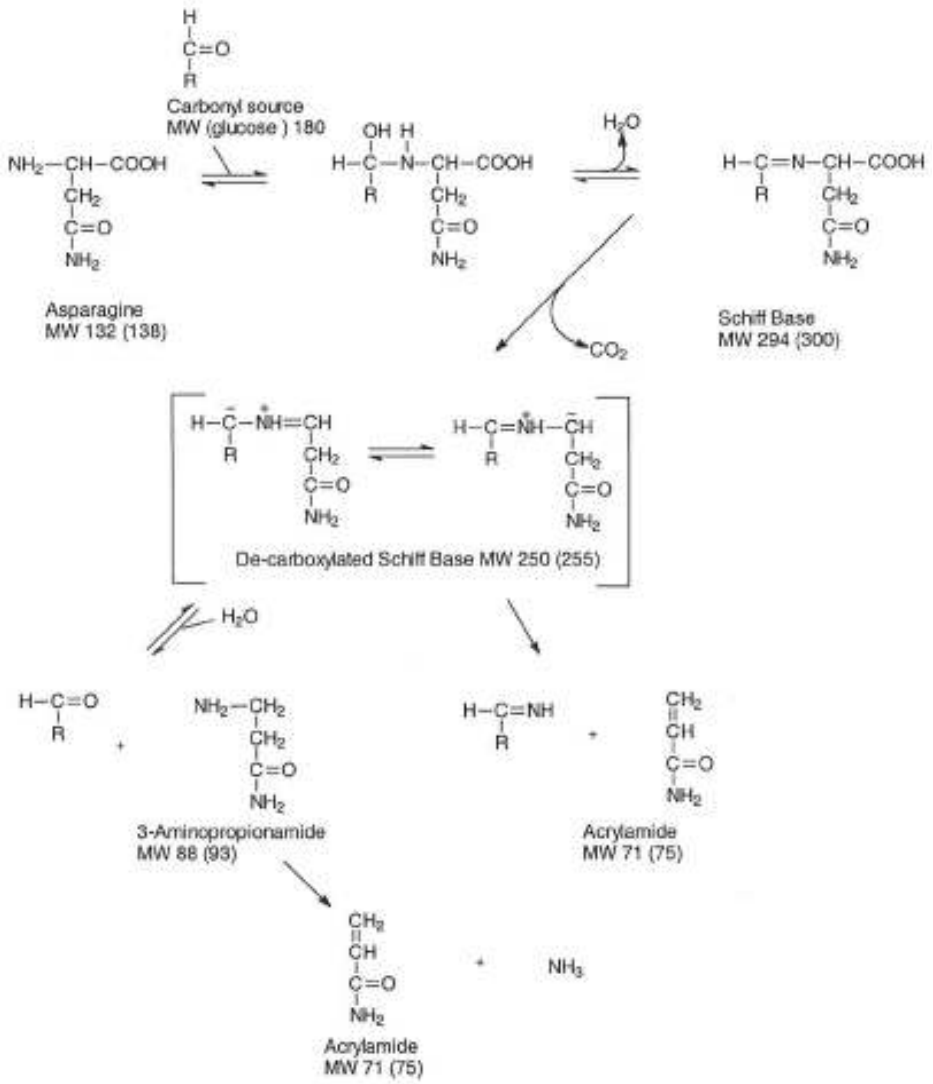

Fig. 2 - The formation mechanism of acrylamide in Maillard reaction (*according to Tayemans, 2004*)

MATERIAL AND METHOD

The experimental model was designed so to assess the influence of adding three amino acids on acrylamide thermal synthesis: asparagine (aspartic acid amide), glutamic acid (dicarboxylic amino acid) and arginine (basic amino acid). Simultaneously it was attempted to evaluate the influence of the oil used during the thermal processing process. For this there were considered six samples of semi processed frozen potatoes; each sample included three subsamples. The first sample was added asparagine (10 ppm), the second was added the same concentration of

glutamic acid while the third sample was added 10 ppm of arginine (Tab. 1). The first three samples were fried using olive oil and for the last three sunflower oil was used. In all cases the vegetal oil was fresh. At the end of the experiment, it was calculated the acrylamide concentration from each sample. The gas chromatography was used and the results were statistically processed.

Table 1

Experimental model

Sample	Olive oil			Sample	Sun flower oil		
	Asparagine	Glutamic acid	Arginine		Asparagine	Glutamic acid	Arginine
E1	10 ppm	-	-	E4	10 ppm	-	-
E2	-	10 ppm	-	E5	-	10 ppm	-
E3	-	-	10 ppm	E6	-	-	10 ppm
E0 (etalon)	-	-	-	E0	-	-	-

RESULTS AND DISCUSSIONS

The results were presented in Table 2 and Figures 3 and 4. Comparing the influence of amino acids to the samples studied, it is noticed the high level of acrylamide in all samples enriched by adding amino acids in comparison to the reference sample (2.1 μg).

Table 2

The resulting acrylamide concentrations

	ACRYLAMIDE CONCENTRATION (μg /10g sample)								
Samples / **Lipids**	**Asparagine [10 ppm]**			**Glutamic acid [10 ppm]**			**Arginine [10 ppm]**		
	min	**average**	**max**	**min**	**average**	**max**	**min**	**average**	**max**
E1 ; E2; E3 / olive oil	3,00	4,26	4,9	3,9	4,31	4,85	3,8	4,03	4,8
E4; E5; E6 / sun flower oil	3,80	4,70	5,5	4,1	4,93	5,6	3,9	4,6	4,85
E0 (reference)	2,10	2,93	3,00	2,1	2,9	3,5	2,2	2,73	3,3

The study of the results for the two lipids added during the thermal processing points out that for both olive and sunflower oil, the acrylamide concentration increased proportionally with the amino acids added. Comparing the acrylamide concentration from the two reference samples it is noticed that the

acrylamide value is higher for the sunflower oil (2.73 µg) compared to only 2.1 µg for the olive oil. The study on the evolution of acrylamide concentration in the samples processed with olive oil indicates that the highest acrylamide concentration was recorded at the sample where glutamic acid was added (4.31 µg). The study on acrylamide concentration for the samples processed with sunflower oil indicates the highest value at the sample where glutamic acid was added (4.93 µg) if compared to the concentration obtained when adding asparagine (4,7 µg) and arginine (4,6 µg).

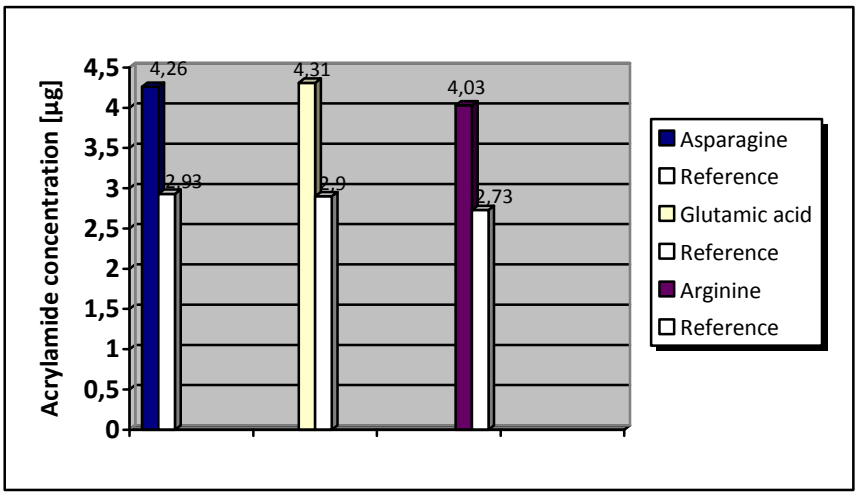

Fig. 3 - Variation of acrylamide concentration in samples E1, E2, E3 and reference sample (E0) with olive oil

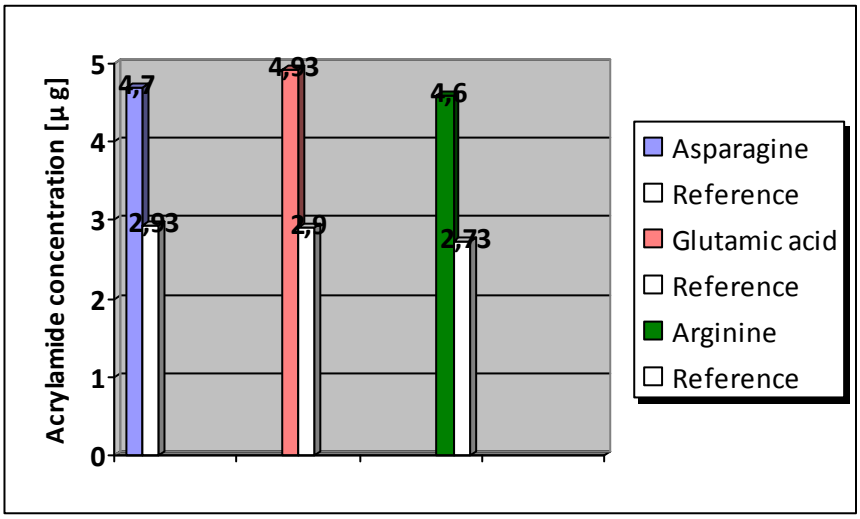

Fig. 4 - Variation of acrylamide concentration in samples E4, E5, E6 and reference sample (E0) with sunflower oil

CONCLUSIONS

1. Adding glutamic acid influenced greatly the acrylamide synthesis in the samples studied, its influence being higher than when adding asparagine and arginine.

2. Comparing the oils used for the thermal synthesis of acrylamide in the samples studies it is noticed that the sunflower oil has greater influence than olive oil.

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