

AF 04.07.2003 - 8 - Annex 2 - Paper from the UK

Review of current research activity on formation of acrylamide (AA) to identify areas with lack of data, areas where co-ordination is important and areas where absence of methods impair the research effort.

This table has been constructed using information from European stakeholders and is based on the matrix produced as an outcome of the 28 March 03 workshop on acrylamide.

Potatoes and other starch based snacks

Completed/ current research & available information	Agricultural	Laboratory trials	Processing	Catering: Food Service	Domestic cooking
	Chip industry has information on sugar amounts in potatoes in relation to storage conditions (temperature)	Preliminary work shows AA is reduced by reducing asparagine, but there is a greater effect through reduction of the carbonyl-source	Reduction of AA is not related to the quality/ sensory attributes of the product	British Potato Council has information on UK production methods and links into the food service sector	Effect of time/temperature and starting composition (sugars and amino acids) on AA levels is being investigated
	Study on changes to amino acids during potato storage (1990's at Nottingham Trent University) and reducing sugars	LC/MS and GC/MS methods being optimized for rapid determination of AA	Reduction of AA using rosemary is being investigated	French fries can be produced with less than 100 ppb provided potatoes are adequate and preparation follows certain rules	Variety testing of mostly agronomic aspects but also cooking and chipping, where appropriate, is being carried out
	Data on the impact of seasonal variation, agronomical aspects and cropping, including cultivars showing low levels of AA in processed foods	Creating model system to study effects of different amino acids and carbohydrates	An investigation of the effect of processing conditions on the formation of AA is being conducted		
	Amino acids and sugar content of selected cultivars has been determined	Research has been conducted on potato cold storage, sugar levels and preparation.	Study to define the parameters to minimise AA formation whilst maintaining desirable product changes is being conducted at the University of		

Reading

	Agricultural	Laboratory trials	Processing	Catering: Food Service Sugars produced during storage by different potato varieties and which of these varieties are used in food service	Domestic cooking
	The effect of food additives (citric or ascorbic acids) and low temperatures on the length of the browning process	Kinetic studies and the Maillard reaction	Impact of additives		Use market place information to collect data on the usage of varieties in different sectors
Proposed research & additional comments	Content of asparagine and other amino acids in different cultivars	Effect of reducing carbonyl-source on other beneficial compounds	Effect of different heat sources, direct/indirect oven etc	Effect of boiling followed by frying	Need for storage and cooking recommendations
	Development of new potato varieties to reduce AA formation		Effect of reusing, initial quality etc of cooking oil	Effect of starch gelatinization on AA formation	Determine varieties of potato used in domestic cooking
	Consider linking R&D from seasonal impact data and AA.B53 Effects of seasonal and cropping variations on AA levels.		Effect of using smashed potatoes, mixed with sugars, starches and other additives on browning	Effect of storage temperatures on AA levels both before and after cooking	

Cereals - bread, biscuit, breakfast cereal and snacks

	Agricultural	Laboratory trials	Processing	Catering: Food Service	Domestic cooking
Completed/ current research & available information	In a cereal mix, wheat has the main affect on AA formation, although non-wheat products may also contain AA Currently no link between free asparagine and AA in cereal products	In bread glucose oxidase has no impact on AA formation	Spices and additives have an effect on AA formation Some baking powders may reduce AA formation		

Proposed research & additional comments	Agricultural	Laboratory trials	Processing	Catering: Food Service AA content of batters and the affect of heating at high temperature for long periods	Domestic cooking
	Establish free amino acid profiles (e.g. wheat, rye, oats) and variability	Development of an elisa-based detection method	Variation of ingredients, type of preparation, baking and fermentation		Investigate domestic practices
	Seasonal variation, agronomical aspects (as listed above for potatoes)	Identify significant chemicals, besides asparagine, to establish framework Further research into the effects of time, temperature and moisture, on the formation and destruction of AA The use of fermentation and enzymatic methods for reduction in AA	Impact of cooking process and type of cereal/biscuit		Advice to consumers to follow instructions on labels
	Synergic effect of amino acids on enhancing AA formation		Study additives and also leguminosea products, due to occasional presence when AA is formed, and added ingredients eg enzymes, sugars		
	Further research into influence of storage on sugar content		Gelatinization of starch		
	Affect of sprouting grain on free amino acids and reactive carbohydrate levels		Breakfast cereal - manufacturers use combinations of cooking processes, need to carry out product specific in-house reseach		

Coffee

Completed/ current research & available	Agricultural	Laboratory trials	Processing	Catering: Food Service	Domestic cooking
	Studies on free asparagine content are ongoing	Optimisation of LC/MS and GC/MS detection	Preliminary work shows higher roasting temperatures		

information	methods is ongoing	produce lower concentrations of AA
Proposed research & additional comments	Investigate alternative formation pathways in coffee e.g. using free radicals	Further research into the affect of roasting temperatures on AA formation

Cocoa

	Agricultural	Laboratory trials	Processing	Catering: Food Service	Domestic cooking
Completed/ current research & available information	The determination of free amino acid profiles is ongoing	Optimisation of detection methods as laboratory variation is currently high	Amino acids present combine with sugar during roasting/browning, however, sugar in cocoa nuts is at minimum levels. Dutch alkali treatment process lowers AA levels. AA is unstable under alkaline conditions		
Proposed research & additional comments	Seasonal/agronomical impact Developing countries need an organised scheme for raw material acceptance and written specifications		Formation during different stages of processing Development of cocoa nut roasting equipment at present heat distribution is uneven (some carbonised/some raw)		

Nuts

	Agricultural	Laboratory trials	Processing	Catering: Food Service	Domestic cooking
Completed/ current research & available information	Raw almonds contain free asparagine at appreciable levels		In Brazil nuts processed under extreme heat condition, sugar levels are minimal		

Proposed research & additional comments	Developing countries need an organised scheme for raw material acceptance and written specifications	Development of Elisa-based detection method	Is AA formation in almonds linked to asparagine?
	Identification of almond varieties with low levels of asparagine and sugar		Development of nut roasting equipment to produce even heat distribution & look at browning process with amino acids Investigation of processing methods for products with high levels of AA following study of almonds

Other Foods

	Agricultural	Laboratory trials	Processing	Catering: Food Service	Domestic cooking
Completed/ current research & available information			Whisky - None found in new grain spirits and minimal trace in bottled malts.		
Proposed research & additional comments	Vegetables - investigate their composition and which vegetables are affected Composite foods - some are high in asparagine but low in AA, investigate possible inhibitory mechanisms		Meat/fish - investigate reason for low levels of AA, possible reaction with inherent nucleophiles	Vegetables - Influence of different cooking methods	Vegetables - Influence of different cooking methods
	General - Levels of polyacrylamide in uncooked foods	General - Need to develop a			General - UK FSA issued requirement for

resulting from the use of pesticides and herbicides.

fundamental understanding of the science, to help direct technology research

General -

Development of kinetic model to investigate effect of natural compounds eg chelating agents

General -

Identify molecular precursors to AA and study their stability and kinetics of formation. Determine the impact of the physical state on this

research in to the affect of domestic cooking