

Reduction of Acrylamide Formation in Fried Potato Chips

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ABSTRACT

Potato chips are very popular product especially among younger generations. This could be a potential source of acrylamide, a toxic compound which could develop during frying and baking processes. The main objective of this study to evaluate the acrylamide reduction potential of mint leaves solution, ginger and garlic paste solution and lemon juice in fried potato chips. Potatoes slices were fried at two different temperature and time combination such as 160° C for 7 mins and 180° C for 4 mins by using refined peanut oil. Prior to frying, the potato slices were treated in following ways i.e. rinsing in distilled water plus blanching in hot water at 100° C for 2 mins plus immersion in 0.5 and 1.0 per cent of mint leaves solution (T₁), ginger garlic paste solution (T₂) and lemon juice (T₃) for 1 h. The fried potato chips were analysed for acrylamide content. The result of the study showed, that the sample treated with 1.0 per cent of lemon juice (T₃) and fried at 160° C for 7 min had maximum acrylamide inhibitory effect. Frying time and temperature had the greatest influence on acrylamide formation.

Keywords: Acrylamide, Potato chips, Lemon juice, Ginger garlic paste, Mint leaves

INTRODUCTION

Potato (*Solanum tuberosum* L.) popularly known as 'The king of vegetables', has emerged as fourth most important food crop in India after rice, wheat and maize. Indian vegetable basket is incomplete without Potato. In India, potatoes have been utilized largely for consumption as fresh potatoes and the major part of potato harvest (approx. 68.5%) goes to domestic table consumption. Whereas,

in the developed countries, table potato utilization is merely 31%, rest being frozen french fries (30%), chips and shoestrings (12%) and dehydrated products (12%) (Singh et al., 2016).

Chips and snacks have become part of the daily diet for rural and urban in India. Acrylamide has been found to occur in many fried starchy foods especially potato chips and french fries.

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Acrylamide is a chemical compound that is formed from food components during high temperature heat treatment (frying, baking, roasting and grilling) as a result of the maillard reaction between reducing sugars (glucose and fructose) and amino acids (asparagine).

It is of great concern in recent days as it is known to be a possible carcinogen. It was discovered in foods during the year 2002 by Swedish National Food Agency (SNFA). Acrylamide formation in foods was influenced by several factors, including processing temperature, time, content and species of reducing sugars and amino acids, pH, moisture content and frying oils, etc (Pedreschi et al., 2005). Many of the studies have been conducted to develop possible mitigation strategies to limit acrylamide levels in various foods, especially fried potato products (Gokmen & Senyuva, 2007, Granda & Moreira, 2005). The mitigation strategies include lowering reducing sugars and free asparagine in the raw materials by changing processing technology. Therefore, the main purpose of this investigation was to confirm the Acrylamide lowering effect of mint leaves solution, ginger garlic paste solution and lemon juice on fried potato chips.

MATERIALS AND METHODS

Raw materials and Chemicals

Potatoes of Kufri Jyoti, a processed variety was purchased from Central Potato Research Station, Ooty, Tamil Nadu. Refined peanut oil, ginger, garlic, mint and lemon were purchased from the local market. Acrylamide (standard), HPLC-grade methanol, HPLC-grade acetonitrile and HPLC grade hexane and deionised Milli-Q water were purchased from M/s Sigma Aldrich, Bangalore.

Preparation of potato slices

The potatoes were washed with tap water and peeled manually. Further, it was cut into slices of approximately 1.0 mm thickness using vegetable slicer. Slices were washed with distilled water immediately after cutting to remove some starch found at surface of the

slices. Then the slices were subsequently blanched by heating potato slices in hot distilled water at 100°C for 1 min (potato slices-to-water ratio was 1:5 w/v).

Pre-treatments

Blanched slices were soaked for 1 h in distilled water containing mint leaves solution (T₁), ginger and garlic paste solution (T₂) and lemon juice (T₃) of 0.5 and 1.0 per cent. (potato slices-to-solution ratio was 1:10 w/v).

Frying conditions

Potato slices were deep-fried in hot refined peanut oil contained in electrical fryer (American Micronic Instruments, India) at two different temperature and time combination *i.e* 160°C for 7 mins and 180°C for 4 mins. Frying temperature was kept almost constant ($\pm 1^\circ\text{C}$). The potato slices and oil ratio was 1:10 (w/v)

Acrylamide analysis

Preparation of standard solutions

The acrylamide analysis was done by method given by Meghavarnam and Janakiraman (2018). Acrylamide standard stock solution (1 mg/ml) were prepared by dissolving 10 mg of the acrylamide in 10 mL of MilliQ water and it was protected from light and stored in a refrigerator at 4°C. All working solutions were prepared freshly by dilution of stock solution in MilliQ water.

Extraction of sample for high performance liquid chromatography (HPLC) analysis

One gram of potato chips were taken and finely ground in a pestle and mortar. The ground potato chips were transferred into a separating funnel and 10 mL of methanol was added. Then it was shaken vigorously for 15 mins. The homogenates was filtered and centrifuged at 10000 g for 10 mins; the centrifuged sample was filtered again through Whatman No.1 filter paper. The homogenate was defatted (twice) with 10 mL of hexane by allowing the homogenate to stand in water bath (30°C) for 30 mins. The obtained extracts were filtered through 0.2 μm a nylon syringe filter, which was used for analysis.

The quantification of acrylamide in potato chips was performed using HPLC

system (Shimadzu LC10ATVP series) equipped with a C18 column and diode array detector set at isocratic conditions with 97 per cent acetonitrile and 3 per cent 5mM trifluoroacetic acid as mobile phase at 1 mL/min flow rate and detection carried out at 210

nm at 28°C. Peak areas of the standards were used to interpolate acrylamide concentrations in the samples (Fig. 1). All analyses were performed in triplicates and the average results are expressed as micrograms per kilogram sample.

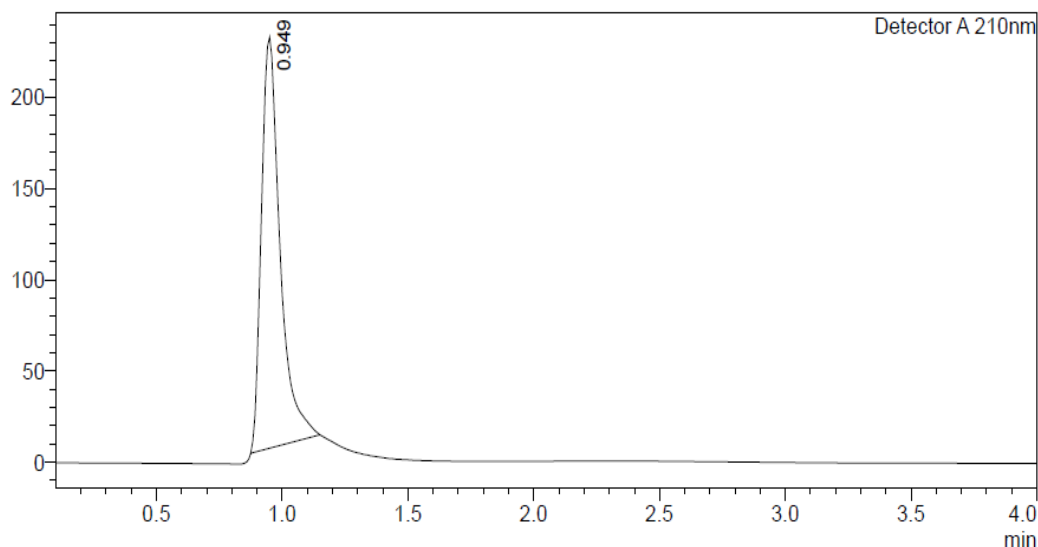


Fig. 1: HPLC Chromatogram of acrylamide standard (1ppm)

Statistical analysis

All the experiments were carried out in triplicate and statistical analysis was performed using AGRES for Window version 7.0. The statistical significance of data was tested applying analysis of variance (ANOVA) and the test of mean was compared by least significant difference (LSD); level of significance was 0.05.

RESULTS AND DISCUSSION

Acrylamide content

The acrylamide lowering effect of mint leaves solution, ginger garlic paste solution and lemon juice was shown in table 1. The potato slices treated with mint leaves solution did not found to have much effect on acrylamide reduction, which may be due to the less pronounced lowering effect of pH as compared to others treatment. The mitigation appeared to be higher in the chips treated with lemon juice followed by chips treated with ginger garlic paste solution and mint leaves solution. The acrylamide formation was less pronounced in the sample treated with 1.0 per cent of all the

three treatments (T_1 , T_2 , T_3) when compared with 0.5 per cent. Similarly the formation of acrylamide was lowered in the chips fried at 160°C for 7 mins when compared with the chips fried at 180°C for 4 mins. The potato slices treated with lemon juice of 1.0 per cent concentration and fried at 160°C for 7 min had low acrylamide content which is about $540 \pm 0.58 \mu\text{gKg}^{-1}$. Similar result was reported by Jung et al. (2003), who found that dipping potato strips in 10 and 20 g/l citric acid solutions induced 73.1 per cent and 79.7 per cent reduction of acrylamide formation in the French fries when fried at 190°C. Also, this result was coincident with that reported by Pedreschi et al. (2006), who reported potato strips immersion in citric acid solution of 10g/l reduced the acrylamide formation after frying. This may be due to lowering the pH with citric acid before frying was an efficient way to considerably diminish acrylamide formation in potato chips. These results suggest that there may be ways to reduce or prevent acrylamide formation by changing processing methods.

Table 1: Acrylamide content (μgKg^{-1}) of pre-treated potato chips

Treatment and concentration		Frying temperature and time	
		160°C (7 mins)	180°C (4 mins)
T ₁	0.5 %	930±0.44	995±0.79
	1%	770 ±0.33	836±0.58
T ₂	0.5%	910±1.00	997±0.29
	1%	720±0.43	840±0.56
T ₃	0.5%	724±0.29	956±0.17
	1%	540±0.58	715±0.40

Values represent means of three replicates± standard deviation

Source	SED	CD (0.05)
Treatments (T)	0.259	0.534**
Concentration (C)	0.211	0.436**
Temperature (D)	0.211	0.436**
Interaction (T×C)	0.366	0.756**
Interaction (C×D)	0.299	0.617**
Interaction (T×D)	0.366	0.756**
Interaction (T×C×D)	0.518	1.069**

T₁ Mint leaves solution
T₂ Ginger garlic paste solution
T₃ Lemon juice solution

*Significant level at 0.05%

CONCLUSION

The experimental findings revealed that, the potato chips treated with lemon juice (T₃) of 1.0 per cent and fried at 160°C had less acrylamide content. Hence the lemon juice is the best natural ingredient that had an excellent acrylamide mitigation effect in fried potato chips. It is also concluded from the result obtained that the acrylamide content can be reduced by frying the potato chips at low temperature (160°C).

REFERENCES

- Gokmen, V., & Senyuva, H.Z. (2007). Effects of some cations on the formation of acrylamide and furfurals in glucose–asparagine model system, *Eur. Food Res. Technol.* 225, 815–820.
- Granda, C., & Moreira, R.G. (2005). Kinetics of acrylamide formation during traditional and vacuum frying of potato chips, *J. Food Process Eng.* 28, 478–493.
- Jung, M.Y., Choi, D.S., & Ju, J.W. (2003). A novel technique for limitation of acrylamide formation in fried and baked corn chips and in French fries. *J. Food Sci.* 68, 1287–1290.
- Meghavarnam, A.K., & Janakiraman, S. (2018). Evaluation of acrylamide reduction potential of L-asparaginase from *Fusarium culmorum* (ASP-87) in starchy products, *LWT - Food Sci., & Tech.* 89, 32-37.
- Pedreschi, F., Kaack, K., & Granby, K. (2006). Acrylamide content and colour development in fried potato strips. *Food Res. Int.* 36, 40-46.
- Pedreschi, F., Moyano, P., Kaack, K., & Granby, K. (2005). Color changes and acrylamide formation in fried potato slices, *Food Res. Int.* 38, 1–9.
- Singh, B., Raigond, P., Joshi, A., Mehta, A., & Singh, B.P. (2016). A Manual on Potato Processing in India. CPRI Technical Bulletin No. 48 (Revised). ICAR- Central Potato Research Institute, Shimla, India 1-74.
- SSEC—Swedish Scientific Expert Committee Report. (2002). Acrylamide in Food—Mechanisms of formation and influencing factors during heating of foods.