INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH AND INNOVATIVE STUDIES
IJSRIS journal
ISSN: 2820-7157
Advancing Knowledge, Inspiring Innovation
www.ijsrisjournal.com
INDEXED JOURNAL
PEER REVIEWED Rigorous & Transparent
DOI: CROSSREF Member
OPEN ACCESS For Global Visibility
BI-MONTHLY Timely Publication
WIDE READERSHIP High Impact & Visibility
AUTHOR FRIENDLY Fast | Supportive | Reliable
RECEIVED 17 September
ACCEPTED 09 October
PUBLISHED 1 November 2026
September 2026
Volume 5
Number 6
Pages from 477 to 484

Experimental Preparation of French Fries and Potato Chips (Solanum tuberosum L.): Effect of Cooking Time and Temperature on Acrylamide Formation

DIALA BASUIKU Jonathan[1], MWANAMOKI MBOKOSO Paola[1], LUHUNU TAMUNDELE Gaston[1], BALOW'A KALONJI KAMUNA Ignace[1]

1 Higher Institute of Medical Techniques of Kinshasa, P.O. Box 774, Kinshasa XI, DRC

LICENSE
This article is licensed under the Creative Commons Attribution 4.0 International License (CC BY 4.0).
https://creativecommons.org/licenses/by/4.0/
Crossref doi
PREFIX : 10.63883
IJSRIS JOURNAL
OPEN ACCESS
This is an open access article distributed under the terms of open access.

ABSTRACT

Acrylamide is a newly identified contaminant, classified as a probable human carcinogen (IARC Group 2A), which forms in starchy foods subjected to dry cooking at temperatures above 120 °C, primarily through the Maillard reaction between asparagine and reducing sugars. In Kinshasa, the consumption of French fries and potato chips is growing rapidly, yet frying conditions are rarely standardized, and local data on this contaminant are lacking.

This study aims to evaluate the influence of cooking time and temperature on acrylamide formation during the experimental preparation of French fries and potato chips made from potatoes (Solanum tuberosum L.).

As part of this study, samples of French fries and potato chips were sourced from the provinces of North-North Kivu and Mbanza-Ngungu, as well as those sold in supermarkets and sourced from South Africa, were prepared and subjected to a comparative analysis to evaluate the influence of heat treatment parameters—specifically cooking temperature and duration—on acrylamide formation in these products. It should also be noted that acrylamide levels were estimated using UV-visible spectrophotometric methods (420 nm).

The results show that potato chips had higher average acrylamide levels, ranging from 436.1 to 471.9 µg/kg, while the average acrylamide level in French fries ranged from 356.0 to 429.2 µg/kg, with the highest values observed for products from North Kivu, regardless of their category, reflecting significant variability in acrylamide levels depending on frying conditions and the origin of the samples.

In conclusion, potato chips tend to accumulate higher levels of acrylamide than French fries, with products from North Kivu exhibiting the highest average levels, highlighting the potential influence of the product type, its origin, and frying conditions on the formation of this contaminant.

Keywords: Potatoes, French fries, potato chips, cooking time, cooking temperature, acrylamide.

1. INTRODUCTION

Acrylamide has been the subject of numerous risk assessments. The Joint FAO/WHO Expert Committee on Food Additives (JECFA, 2011) and the European Food Safety Authority (EFSA, 2015) have concluded that current levels of dietary exposure are of concern due to its carcinogenic and genotoxic effects. Fried potato products are among the main contributors to exposure in the general population (EFSA, 2015). In response, the European Union adopted Regulation (EU) 2017/2158, which imposes mitigation measures on food business operators and sets reference levels of 500 µg/kg for ready-to-eat French fries and 750 µg/kg for potato chips made from fresh potatoes (European Commission, 2017). Since 2009, the Codex Alimentarius has also had a code of practice for reducing acrylamide in foods (CAC, 2009).

Beyond microbiological hazards—which have long been the primary focus—health authorities and the scientific community are paying increasing attention to chemical hazards, particularly contaminants that are not present in the raw material but arise during its processing. These compounds, referred to as “newly formed” or “processing contaminants,” are generated by the heat treatments that foods undergo during domestic, artisanal, or industrial cooking (Lineback et al., 2012).

Among these contaminants, acrylamide (2-propenamide, C3H5NO) holds a unique position. Long known as an industrial monomer used in the manufacture of polyacrylamides, this molecule was classified as early as 1994 by the International Agency for Research on Cancer (IARC) in Group 2A, meaning “probably carcinogenic to humans” (IARC, 1994). However, its presence in food was not revealed until April 2002, when the Swedish National Food Agency and Stockholm University reported high levels in various starchy foods cooked at high temperatures, particularly French fries and potato chips (Tareke et al., 2002). A few months later, two independent research teams demonstrated that acrylamide is formed primarily through the Maillard reaction between free asparagine and reducing sugars (Mottram et al., 2002; Stadler et al., 2002).

In light of the above, we have chosen to focus our analysis on the following main research question: Do cooking time and frying temperature influence acrylamide formation in the samples of French fries and potato chips used in this study?

In anticipation of the question raised by this research, we believe that increasing the cooking temperature and extending the frying time significantly increase the acrylamide content of the French fries and potato chip samples used in this study.

2. OVERALL OBJECTIVE OF THE STUDY

The general objective of this study was to evaluate the influence of cooking time and temperature on acrylamide formation during the experimental preparation of French fries and potato chips made from potatoes (Solanum tuberosum L).

3. METHODOLOGY

This is an experimental study focused on the artisanal preparation of French fries and potato chips (Solanum tuberosum L) sourced from the provinces of North-North Kivu and Mbanza-Ngungu, as well as those sold in supermarkets, were prepared and subjected to a comparative analysis aimed at evaluating the influence of heat treatment parameters—specifically cooking temperature and duration—on acrylamide formation in these products. It should also be noted that acrylamide content was estimated using UV-visible spectrophotometric methods (420 nm). Three independent analytical tests were performed on each sample of French fries and potato chips. The results reported correspond to the average of these three tests.

4. RESULTS

4.1 Acrylamide Content in French Fries

Table 1: Acrylamide Content in Mbanza-Ngungu French Fries by Frying Temperature and Time (µg/kg)

Temperature (in °C)	3 min	5 min	7 min	10 min	Average acrylamide content ± standard deviation (µg/kg)
160	0.68	1.31	3.10	5.02	2.53 ± 1.98
170	44.52	59.45	263.22	621.40	247.15 ± 274.51
180	132.37	152.23	356.73	732.19	343.38 ± 274.54
190	532.72	681.44	873.13	1,237.28	831.14 ± 303.49

Table 1 shows that:

- At 160 °C, the levels remain very low (0.68 to 5.02 µg/kg) regardless of the duration.
- At 170 °C, the acrylamide content increases from 59.45 µg/kg after 5 minutes of frying to 621.40 µg/kg after 10 minutes of frying
- At 190 °C, the acrylamide content increases from 532.72 µg/kg after 3 minutes of frying to 1,237.28 µg/kg after 10 minutes

Table 2: Acrylamide levels in French fries from North Kivu, by frying temperature and duration (µg/kg)

Temperature (in °C)	3 min	5 min	7 min	10 min	Average acrylamide content ± standard deviation (µg/kg)
160	23	37	42	68	42.50 ± 18.66
170	73	103	439	732	336.75 ± 311.49
180	163	174	534	865	434.00 ± 311.09
190	631	686	943	1,354	903.50 ± 325.65

Table 2 shows that:

- At 160 °C, the acrylamide content increases from 23 µg/kg after 3 minutes of frying to 68 µg/kg after 10 minutes.
- At 170 °C, the acrylamide content rises from 103 µg/kg after 5 minutes of frying to 732 µg/kg after 10 minutes.
- At 180 °C, the acrylamide content increases from 174 µg/kg after 5 minutes of frying to 865 µg/kg after 10 minutes.
- At 190°C, the acrylamide content increases from 631 µg/kg after 3 minutes of frying to 1,354 µg/kg after 10 minutes.

Table 3: Acrylamide levels in South African french fries based on frying temperature and duration (µg/kg)

Temperature (in °C)	3 min	5 min	7 min	10 min	Average acrylamide content ± standard deviation (µg/kg)
160	21	28	35	52	34.00 ± 13.15
170	56	97	403	698	313.50 ± 300.39
180	153	168	497	823	410.25 ± 301.76
190	531	641	917	1,321	852.50 ± 343.30

Table 3 shows that:

- At 160 °C, the acrylamide content increases from 21 µg/kg after 3 minutes of frying to 52 µg/kg after 10 minutes.
- At 170 °C, the acrylamide content rises from 97 µg/kg after 5 minutes of frying to 698 µg/kg after 10 minutes.
- At 180 °C, the acrylamide content increases from 153 µg/kg after 3 minutes of frying to 823 µg/kg after 10 minutes.
- At 190°C, the acrylamide content increases from 531 µg/kg after 3 minutes of frying to 1,321 µg/kg after 10 minutes.

4.2 Acrylamide Content in Potato Chips

Table 4: Acrylamide levels in Mbanza-Ngungu potato chips by frying temperature and duration (µg/kg)

Temperature (in °C)	2 min	3 min	4 min	5 min	Average acrylamide content ± standard deviation (µg/kg)
150	0.032	0.087	55	132	46.78 ± 62.44
160	63	81	286	487	229.25 ± 199.39
170	343	453	608	834	559.50 ± 212.85
180	654	688	962	1,332	909.00 ± 313.90

Table 4 shows the changes in acrylamide levels in Mbanza-Ngungu potato chips as a function of frying temperature and time. The results show a gradual increase in acrylamide levels as the temperature rises and the frying time increases.

- At 150 °C, the acrylamide content rises from 0.032 µg/kg after 2 minutes of frying to 132 µg/kg after 5 minutes.
- At 160 °C, the acrylamide concentration increases from 63 µg/kg after 2 minutes to 487 µg/kg after 5 minutes of frying.
- At 170 °C, a more pronounced increase is observed, with levels rising from 343 µg/kg after 2 minutes to 834 µg/kg after 5 minutes.

Finally, at 180 °C, acrylamide levels are the highest for all frying times considered. They range from 654 µg/kg after 2 minutes to 1,332 µg/kg after 5 minutes.

Table 5: Acrylamide levels in potato chips from North Kivu, by frying temperature and duration (µg/kg)

Temperature (in °C)	2 min	3 min	4 min	5 min	Average acrylamide content ± standard deviation (µg/kg)
150	23	31	168	238	115.00 ± 105.61
160	63	87	401	733	321.00 ± 314.89
170	218	352	652	854	519.00 ± 287.75
180	612	697	982	1,439	932.50 ± 372.90

Table 5 shows the changes in acrylamide levels in potato chips from North Kivu, as a function of frying temperature and duration. The results show a gradual increase in acrylamide concentration as both the temperature rises and the frying time increases.

- At 150 °C, the acrylamide content rises from 23 µg/kg after 2 minutes of frying to 238 µg/kg after 5 minutes.
- At 160 °C, the acrylamide concentration rises from 63 µg/kg after 2 minutes to 87 µg/kg after 3 minutes. It then increases significantly, reaching 401 µg/kg after 4 minutes and 733 µg/kg after 5 minutes of frying.
- At 170 °C, acrylamide levels range from 218 µg/kg after 2 minutes, 352 µg/kg after 3 minutes, 652 µg/kg after 4 minutes, and 854 µg/kg after 5 minutes.

Finally, at 180 °C, acrylamide concentrations are the highest for all frying times considered. They range from 612 µg/kg after 2 minutes to 697 µg/kg after 3 minutes, then reach 982 µg/kg after 4 minutes and 1,439 µg/kg after 5 minutes.

Table 6: Acrylamide levels in potato chips sold in supermarkets (from South Africa) by frying temperature and duration (µg/kg)

Temperature (in °C)	2 min	3 min	4 min	5 min	Average acrylamide content ± standard deviation (µg/kg)
150	19	28	157	231	108.75 ± 103.04
160	56	83	413	719	317.75 ± 312.89
170	220	342	662	849	518.25 ± 288.72
180	528	653	923	1,445	887.25 ± 406.73

Table 6 presents the acrylamide levels in potato chips from South Africa, as a function of frying temperature and time. The results show a gradual increase in acrylamide concentration as the temperature rises and the frying time increases.

- At 150 °C, the acrylamide content rises from 19 µg/kg after 2 minutes of frying to 231 µg/kg after 5 minutes.
- At 160 °C, the acrylamide concentration rises from 56 µg/kg after 2 minutes to 83 µg/kg after 3 minutes. It then increases to 413 µg/kg after 4 minutes and 719 µg/kg after 5 minutes of frying.
- At 170 °C, the acrylamide levels recorded range from 220 µg/kg after 2 minutes, 342 µg/kg after 3 minutes, 662 µg/kg after 4 minutes, and 849 µg/kg after 5 minutes.

Finally, at 180 °C, acrylamide levels increased for all frying durations studied. They rose from 528 µg/kg after 2 minutes to 653 µg/kg after 3 minutes, then increased to 923 µg/kg after 4 minutes and 1,445 µg/kg after 5 minutes.

Table 7 below summarizes the descriptive statistics for acrylamide levels for each product and origin, calculated across the 16 time–temperature combinations.

Table 7: Average acrylamide levels in French fries and potato chips by source (µg/kg).

Parameters	Source	Minimum	Maximum	Mean ± SD
French fries	Mbanza-Ngungu	0.68	1,237.28	356.0 ± 381.1
French fries	North-North Kivu	23	1,354	429.2 ± 407.2
French fries	South Africa	21	1,321	402.6 ± 394.1
Potato chips	Mbanza-Ngungu	0.032	1,332	436.1 ± 391.2
Potato chips	North-North Kivu	23	1,439	471.9 ± 404.5
Potato chips	South Africa	19	1,445	458.0 ± 399.2

The results in Table 7 show variation in acrylamide levels in French fries and potato chips depending on their place of origin.

- For French fries, the highest average level was observed in those from North-North Kivu (429.2 ± 407.2 µg/kg), followed by those from South Africa (402.6 ± 394.1 µg/kg).
- For potato chips, the average levels were generally higher than those observed in French fries. The highest average value was recorded in potato chips from North-North Kivu (471.9 ± 404.5 µg/kg), followed by those from South Africa (458.0 ± 399.2 µg/kg).

5. DISCUSSION OF THE RESULTS

The discussion of the results is organized around three main themes: the influence of frying temperature and duration on acrylamide formation, a comparison of acrylamide levels between French fries and potato chips based on their origin, and the health and technological implications of the observed concentrations.

5.1 Influence of frying temperature and duration on acrylamide levels in French fries and potato chips

The results in Tables 1 through 6 show a significant increase in acrylamide levels as frying temperature rises and frying time increases, for both French fries and potato chips, regardless of their origin.

For French fries from Mbanza-Ngungu, the average acrylamide concentration rises from 2.53 ± 1.98 µg/kg at 160 °C to 831.14 ± 303.49 µg/kg at 190 °C. A similar trend is observed for French fries from North-North Kivu, whose average acrylamide content increases from 42.50 ± 18.66 µg/kg at 160 °C to 903.50 ± 325.65 µg/kg at 190 °C. French fries from South Africa also exhibit this trend, with an increase from 34.00 ± 13.15 µg/kg at 160 °C to 852.50 ± 343.30 µg/kg at 190 °C.

This particularly marked increase at high temperatures can be explained by the chemical mechanisms of acrylamide formation during the Maillard reaction. Indeed, Mottram et al. (2002) and Stadler et al. (2002) have shown that acrylamide forms primarily when carbohydrate-rich foods containing free asparagine—particularly potatoes—are heated. This reaction becomes particularly significant when temperatures exceed approximately 120 °C and conditions favor food browning.

Similarly, Zyzak et al. (2003) highlighted the central role of free asparagine and reducing sugars in acrylamide formation. Thus, the increase in concentrations observed in our study could be attributed to the intensification of thermal reactions between these precursors as frying temperature and time increase.

The same trend was observed for potato chips. In Mbanza-Ngungu, the average content rose from 46.78 ± 62.44 µg/kg at 150 °C to 909.00 ± 313.90 µg/kg at 180 °C. In North-North Kivu, it increases from 115.00 ± 105.61 to 932.50 ± 372.90 µg/kg, while potato chips from South Africa show an increase from 108.75 ± 103.04 to 887.25 ± 406.73 µg/kg.

These observations confirm that temperature is a key technological parameter in acrylamide formation. The simultaneous increase in frying time also enhances this formation, as evidenced by the maximum concentrations recorded after the longest frying times. This trend is consistent with the findings of Tareke et al. (2002), who demonstrated the formation of acrylamide in starch-rich foods subjected to high temperatures.

It should also be noted that potato chips exhibit high concentrations even after relatively short frying times. This could be explained in particular by their thinness, large surface area, and dry matter content, which promote rapid heat transfer and accelerated dehydration. The reduction in

moisture during frying can thus promote the browning reactions responsible for acrylamide formation.

Ultimately, the results show that controlling the frying temperature and duration is an essential way to limit acrylamide formation in potato-based products.

5.2 Comparison of Acrylamide Levels by Product Type and Place of Origin

A comparative analysis of the results in Table 7 reveals that potato chips have slightly higher average acrylamide levels than French fries, regardless of their origin. For French fries, the highest average concentration was recorded in North-North Kivu (429.2 ± 407.2 µg/kg), followed by South Africa (402.6 ± 394.1 µg/kg) and Mbanza-Ngungu (356.0 ± 381.1 µg/kg). For potato chips, the average concentrations were 471.9 ± 404.5 µg/kg in North-North Kivu, 458.0 ± 399.2 µg/kg in South Africa, and 436.1 ± 391.2 µg/kg in Mbanza-Ngungu.

This difference between the two product categories may be related to their physical and technological characteristics. Indeed, potato chips are generally cut into thin slices, which increases their surface area in contact with hot oil and promotes rapid dehydration during frying. This situation can create conditions conducive to the formation of acrylamide in the product's surface layers. French fries, which are generally thicker, exhibit a different distribution of heat and moisture between their surface and interior.

This explanation is consistent with the work of Gökmen et al. (2006), who showed that acrylamide formation in French fries depends on the thermal history of different parts of the product, particularly the temperatures reached at the surface and at the core. The authors notably highlighted significant differences in concentration between these two zones.

Furthermore, the differences observed depending on the origin of the potatoes could also be related to the initial composition of the potatoes, particularly the concentrations of free asparagine and reducing sugars. These constituents are essential precursors for acrylamide formation. Thus, growing conditions, potato variety, tuber maturity, and storage conditions can influence the final concentrations obtained after frying. EFSA (2015) emphasizes in particular that the composition of raw materials and storage conditions are important factors in the variability of acrylamide levels in potato-based products.

It should be noted, however, that the differences observed between Mbanza-Ngungu, North-North Kivu, and South Africa do not, on their own, allow for the establishment of a specific effect related to origin. Indeed, this could be associated with several confounding factors, including the varieties used, storage practices, and processing methods. In the absence of a comparative statistical analysis, these differences should therefore be considered descriptive trends rather than statistically significant differences.

Another important factor concerns the dispersion of the results. The standard deviations are particularly high across the six groups studied, reflecting significant variability in acrylamide concentrations depending on the combinations of frying temperature and duration. This variability confirms that preparation conditions likely play a more decisive role than the origin of the products alone.

5.3 Technological and Health Implications of the Observed Acrylamide Levels

The concentrations obtained in this study are of particular interest from a food safety perspective, given the toxicological properties of acrylamide. Indeed, the EFSA (2015) considers that acrylamide in food constitutes a public health concern due to its genotoxic and carcinogenic potential, as demonstrated primarily by experimental studies in animals. However, epidemiological data from humans remain limited and do not allow for a conclusive establishment of a causal relationship between dietary exposure and cancer.

An examination of individual concentrations shows that certain experimental conditions lead to particularly high levels. For French fries, maximum concentrations reached 1,237.28 µg/kg in Mbanza-Ngungu, 1,354 µg/kg in North-North Kivu, and 1,321 µg/kg in South Africa. For potato chips, they reach 1,332, 1,439, and 1,445 µg/kg, respectively. These values are primarily recorded at the highest temperatures and after the longest frying times.

By way of comparison, European Commission Regulation 2017/2158 sets reference levels of 500 µg/kg for ready-to-eat french fries and 750 µg/kg for potato chips. These values are reference levels intended to guide measures to reduce acrylamide in food and should not be interpreted as toxicological limits guaranteeing the absence of risk.

In our study, the maximum concentrations recorded exceed both of these reference levels. The overall average concentrations by source, however, remain below these values. This comparison must nevertheless be interpreted with caution, as the calculated averages combine several experimental conditions, whereas the regulatory limits apply

to finished, ready-to-eat products. Individual values and actual market conditions must therefore be considered separately.

These results highlight the need to adopt technological measures aimed at limiting acrylamide formation. These include controlling frying temperature and time, selecting potatoes with low concentrations of reducing sugars, adhering to appropriate storage conditions, and applying suitable pre-treatment methods, such as soaking cut potatoes.

The work of Tareke et al. (2002), Mottram et al. (2002), and Zyzak et al. (2003) provide fundamental insights into these mechanisms and justify the importance of minimizing conditions that promote Maillard reactions. Similarly, the EFSA (2015) recommends considering interventions that address both raw materials and processing methods to reduce dietary exposure to acrylamide.

Ultimately, the results of this study show that acrylamide formation in French fries and potato chips is strongly influenced by frying conditions, particularly by higher temperatures and longer heat treatment times. Potato chips have slightly higher average concentrations than French fries, while differences between production sites remain relatively modest. Reducing exposure to acrylamide therefore requires better control of processing parameters, as well as raising awareness among producers, retailers, and consumers about best practices for preparing fried foods.

CONCLUSION

The objective of the study was to evaluate the influence of cooking time and temperature on acrylamide formation during the experimental preparation of French fries and potato chips (Solanum tuberosum L.)

The results of this study show that acrylamide formation in French fries and potato chips is strongly influenced by frying conditions, particularly temperature and cooking time. A gradual increase in these two parameters leads to a significant rise in acrylamide concentrations, regardless of the products' origin.

The highest concentrations were recorded at 190°C after 10 minutes of frying for French fries (1,354 µg/kg from North-North Kivu) and at 180°C after 5 minutes for potato chips (1,445 µg/kg from South Africa). Furthermore, potato chips generally have slightly higher average acrylamide levels than French fries, while the differences between sources remain relatively modest.

It is also evident that several maximum concentrations exceed the European reference levels established for French fries (500 µg/kg) and potato chips (750 µg/kg), underscoring the importance of this issue for food safety.

Ultimately, frying temperature and duration are the key technological parameters that must be controlled to limit acrylamide formation. It therefore appears necessary to promote appropriate frying practices—in particular, reducing excessive temperatures and prolonged frying times—in order to help reduce consumer exposure to this food contaminant.

REFERENCES

Codex Alimentarius Commission. (2009). Code of Practice for the Reduction of Acrylamide in Foods (CAC/RCP 67-2009). Food and Agriculture Organization of the United Nations & World Health Organization. View the official document.

European Commission. (2017). Commission Regulation (EU) 2017/2158 of November 20, 2017, establishing mitigation measures and reference levels for the reduction of acrylamide in food. Official Journal of the European Union, L 304, 24–44. View the regulation.

EFSA Panel on Contaminants in the Food Chain (CONTAM). (2015). Scientific opinion on acrylamide in food. EFSA Journal, 13(6), Article 4104. https://doi.org/10.2903/j.efsa.2015.4104

European Commission. (2017). Commission Regulation (EU) 2017/2158 of November 20, 2017, establishing mitigation measures and benchmark levels for the reduction of the presence of acrylamide in food. Official Journal of the European Union, L 304, 24–44. View the European regulation.

European Food Safety Authority (EFSA) Panel on Contaminants in the Food Chain (CONTAM). (2015). Scientific opinion on acrylamide in food. EFSA Journal, 13(6), Article 4104. https://doi.org/10.2903/j.efsa.2015.4104

Gökmen, V., Palazoğlu, T. K., & Şenyuva, H. Z. (2006). Relationship between acrylamide formation and the time–temperature history of the surface and core regions of French fries. Journal of Food Engineering, 77(4), 972–976. https://doi.org/10.1016/j.jfoodeng.2005.08.030

International Agency for Research on Cancer. (1994). Acrylamide. In Some industrial chemicals (IARC

Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 60, pp. 389–433). View the official monograph.

Joint FAO/WHO Expert Committee on Food Additives. (2011). Evaluation of certain contaminants in food: Seventy-second report of the Joint FAO/WHO Expert Committee on Food Additives (WHO Technical Report Series No. 959). World Health Organization. View the official report.

Lineback, D. R., Coughlin, J. R., & Stadler, R. H. (2012). Acrylamide in foods: A review of science and future considerations. Annual Review of Food Science and Technology, 3, 15–35. https://doi.org/10.1146/annurev-food-022811-101114

Mottram, D. S., Wedzicha, B. L., & Dodson, A. T. (2002). Acrylamide is formed in the Maillard reaction. Nature, 419, 448–449. https://doi.org/10.1038/419448a

Mottram, D. S., Wedzicha, B. L., & Dodson, A. T. (2002). Acrylamide is formed in the Maillard reaction. Nature, 419, 448–449. https://doi.org/10.1038/419448a

Stadler, R. H., Blank, I., Varga, N., Robert, F., Hau, J., Guy, P. A., Robert, M.-C., & Riediker, S. (2002). Acrylamide from Maillard reaction products. Nature, 419, 449–450. https://doi.org/10.1038/419449a

Stadler, R. H., Blank, I., Varga, N., Robert, F., Hau, J., Guy, P. A., Robert, M.-C., & Riediker, S. (2002). Acrylamide from Maillard reaction products. Nature, 419, 449–450. https://doi.org/10.1038/419449a

Tareke, E., Rydberg, P., Karlsson, P., Eriksson, S., & Törnqvist, M. (2002). Analysis of acrylamide, a carcinogen formed in heated foodstuffs. Journal of Agricultural and Food Chemistry, 50(17), 4998–5006. https://doi.org/10.1021/jf020302f

Tareke, E., Rydberg, P., Karlsson, P., Eriksson, S., & Törnqvist, M. (2002). Analysis of acrylamide, a carcinogen formed in heated foodstuffs. Journal of Agricultural and Food Chemistry, 50(17), 4998–5006. https://doi.org/10.1021/jf020302f

Zyzak, D. V., Sanders, R. A., Stojanovic, M., Tallmadge, D. H., Eberhart, B. L., Ewald, D. K., Gruber, D. C., Morsch, T. R., Strothers, M. A., Rizzi, G. P., & Villagran, M. D. (2003). Acrylamide formation mechanism in heated foods. Journal of Agricultural and Food Chemistry, 51(16), 4782–4787. https://doi.org/10.1021/jf034180i