

**PENGARUH PERKECAMBAHAN DAN IRADIASI UV-C TERHADAP
PENURUNAN OKRATOKSIN A PADA KACANG TANAH**

SKRIPSI

diajukan untuk memenuhi sebagian syarat memperoleh gelar Sarjana Sains
Program Studi Kimia



oleh

Widya Prasetyawati Septiani

NIM 1900177

PROGRAM STUDI KIMIA

FAKULTAS PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM

UNIVERSITAS PENDIDIKAN INDONESIA

BANDUNG

2023

**PENGARUH PERKECAMBAHAN DAN IRADIASI UV-C TERHADAP
PENURUNAN OKRATOKSIN A PADA KACANG TANAH**

Oleh

Widya Prasetyawati Septiani

Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

© Widya Prasetyawati Septiani

Universitas Pendidikan Indonesia

2023

Hak Cipta dilindungi undang-undang.

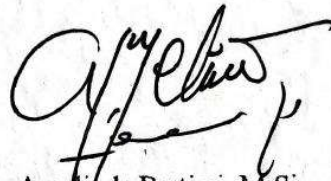
Skripsi ini tidak boleh diperbanyak seluruhnya atau sebagian, dengan dicetak ulang, difotokopi, atau cara lainnya tanpa ijin dari penulis.

WIDYA PRASETYAWATI SEPTIANI

**PENGARUH PERKECAMBAHAN DAN IRADIASI UV-C TERHADAP
PENURUNAN OKRATOKSIN A PADA KACANG TANAH**

disetujui dan disahkan oleh:

Pembimbing I,



Amelinda Pratiwi, M.Si.

NIP. 920200419910505201

Pembimbing II,



Dr. Siti Aisyah, M.Si.

NIP. 197509302001122001

Mengetahui,

Ketua Program Studi Kimia



Prof. Fitri Khoerunnisa, Ph.D.

NIP. 197806282001122001

PERNYATAAN

Dengan ini saya menyatakan bahwa skripsi dengan judul “**Pengaruh Perkecambahan dan Iradiasi UV-C Terhadap Penurunan Okratoksin A Pada Kacang Tanah**” beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung risiko atau sanksi apabila di kemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya.

Bandung, 28 Agustus 2023

Yang membuat pernyataan,



Widya Prasetyawati Septiani

NIM. 1900177

KATA PENGANTAR

Segala puji penulis panjatkan kehadirat Allah SWT yang telah memberikan rahmat dan karunia-Nya sehingga penulis dapat menyelesaikan penelitian dan skripsi ini. Shalawat serta salam semoga tetap tercurahlimpahkan kepada junjungan kita Nabi Muhammad SAW beserta keluarga, para sahabat, dan umatnya hingga akhir zaman.

Penulisan skripsi ini diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Sarjana Sains Program Studi Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Pendidikan Indonesia. Judul skripsi ini yaitu **“Pengaruh Perkecambahan dan Iradiasi UV-C Terhadap Penurunan Okratoksin A Pada Kacang Tanah”**. Penelitian ini diharapkan dapat memberikan manfaat secara umum bagi perkembangan ilmu pengetahuan dan secara khusus bagi penulis.

Penulis menyadari masih banyak kekurangan dalam penulisan skripsi ini. Oleh karena itu, penulis memohon maaf atas segala kekurangan dan kesalahan yang terjadi. Demi perbaikan ke depannya, penulis mengharapkan kritik dan saran yang membangun dari pembaca. Semoga pada kesempatan berikutnya penulis dapat menghasilkan karya yang lebih baik lagi.

Bandung, 28 Agustus 2023

Penulis

UCAPAN TERIMA KASIH

Dalam penyusunan skripsi ini tidak terlepas dari bantuan, bimbingan, dan dukungan dari berbagai pihak. Oleh karena itu, penulis ingin menyampaikan rasa syukur kepada Allah SWT atas segala rahmat dan karunia-Nya, juga ucapan terima kasih kepada berbagai pihak yang terlibat dalam penyusunan skripsi ini baik secara langsung maupun tidak langsung, yaitu:

1. Bapak Hilman Sastra Hadhie Prawira dan Ibu Yoyoh Rohmayati selaku orang tua yang senantiasa memberikan kasih sayang, bimbingan, motivasi, dan dukungan kepada penulis hingga saat ini. Juga Yulia Pratiwi Ramadhani dan Nunik Pramanik Pebriani selaku kakak yang selalu memberikan dukungan kepada penulis.
2. Ibu Amelinda Pratiwi, M.Si., selaku pembimbing I yang telah meluangkan waktu, tenaga, dan pikiran serta dengan sabar senantiasa memberikan saran, kritik, motivasi, dan membimbing penulis dalam menyelesaikan penelitian dan skripsi ini.
3. Ibu Dr. Siti Aisyah, M.Si., selaku pembimbing II yang senantiasa membimbing serta memberikan ide, kritik, dan saran selama proses penelitian dan penyusunan skripsi ini.
4. Ibu Prof. Fitri Khoerunnisa Ph.D., selaku ketua Program Studi Kimia dan Ibu Prof. Dr. F.M. Titin Supriyanti, M.Si, selaku ketua KBK Kimia Makanan.
5. Laboran dan Teknisi Departemen Pendidikan Kimia FPMIPA UPI yang telah membantu penulis dalam melaksanakan penelitian.
6. Ibu Heli Siti Halimatul Munawaroh, M.Si., selaku dosen pembimbing akademik yang senantiasa memberikan motivasi dan dukungan kepada penulis.
7. Azizah Nurdiana dan Alifa Listina Dewi, selaku rekan kerja yang senantiasa bertukar pikiran dan bekerja sama dengan penulis serta memberikan ide dan motivasi selama penelitian dan penyusunan skripsi ini.
8. Salsabila Yaafi Saniyyah, Zahrah Rufaida, Kinanti Aulia Putri, Maya Lianawati, Alifia Vidiastari Nabilla, Hufaidatul Azfa, Dewi Yulina Nur Soleha, Adzra Zahra Ziva, dan teman-teman Kimia 2019 yang selalu menyemangati, mendukung, dan membantu penulis selama penelitian dan penyusunan skripsi.

9. Febri Dwicki Maulana, yang selalu memberikan dukungan kepada penulis.
10. Semua pihak yang tidak dapat disebutkan satu per satu yang telah membantu penulis dalam melaksanakan penelitian dan penyusunan skripsi ini.

Semoga Allah SWT selalu melindungi, melimpahkan rahmat dan karunia-Nya, serta memberikan balasan terbaik kepada semua pihak yang telah membantu penulis.

ABSTRAK

Indonesia merupakan salah satu produsen kacang tanah terbesar di dunia dengan jumlah produksi 970 juta ton per tahun. Namun, kondisi Indonesia yang memiliki iklim tropis dengan karakteristik suhu dan kelembaban tinggi dapat memicu pertumbuhan jamur penghasil okratoksin A (OTA), yaitu cemaran toksik yang dapat terakumulasi dalam tubuh dan mengakibatkan berbagai penyakit berbahaya. OTA dapat didegradasi dengan perlakuan perkecambahan dan iradiasi UV-C. Penelitian ini bertujuan untuk mengetahui persentase penurunan dan modifikasi OTA pada kacang tanah akibat perkecambahan tanpa dan dengan adanya iradiasi UV-C yang dianalisis menggunakan UHPLC-ESI-QQQ. Kacang tanah steril direndam dalam 100 ppb OTA, kemudian diberi perlakuan perkecambahan pada suhu 25°C dan kelembaban 100% selama 3 hari dengan kondisi sebagai berikut: (1) tanpa iradiasi UV-C (gelap); (2) iradiasi UV-C 30 menit/hari; dan (3) iradiasi UV-C 60 menit/hari. Selanjutnya, sampel dianalisis menggunakan instrumen UHPLC-ESI-QQQ dengan metode *Multiple Reaction Monitoring* (MRM) untuk kuantifikasi OTA dan *Product Ion Scan* (PIS) untuk mengidentifikasi senyawa modifikasi OTA. Berdasarkan hasil penelitian, perkecambahan gelap menghasilkan penurunan OTA yang lebih tinggi (89,25%) daripada perkecambahan dengan iradiasi UV-C (63,11-65,80%). Waktu paparan radiasi UV-C yang semakin bertambah meningkatkan persentase penurunan OTA pada kacang tanah tetapi tidak signifikan. Penurunan OTA tersebut berkaitan dengan terjadinya modifikasi struktur OTA melalui reaksi deklorinasi, hidrolisis, esterifikasi, dan konjugasi akibat pekecambahan dan iradiasi UV-C. Perlakuan iradiasi UV-C diduga menghambat aktivitas protease dan *phenylalanine ammonia-lyse* (PAL) dalam biosintesis metabolit sekunder yang diduga berperan terhadap penurunan OTA. Dengan demikian, perlakuan perkecambahan dengan adanya iradiasi UV-C selama 30 menit/hari dan 60 menit/hari kurang efektif dalam menurunkan kandungan OTA pada kacang tanah jika dibandingkan dengan perkecambahan dalam kondisi gelap.

Kata kunci: Kacang tanah, OTA, perkecambahan, iradiasi UV-C.

ABSTRACT

Indonesia is one of the largest peanut producers in the world with a total production of 970 million tons per year. However, the condition of Indonesia which has a tropical climate with high temperature and humidity characteristics can trigger the growth of fungi that produce ochratoxin A (OTA), which are toxic contaminants that can accumulate in the body and cause various dangerous diseases. OTA can be degraded by germination treatment and UV-C irradiation. This study aims to determine the percentage of reduction and modification of OTA in peanuts due to germination without and with UV-C irradiation which were analyzed using UHPLC-ESI-QQQ. Sterilized peanuts were soaked in 100 ppb OTA, then germinated at 25°C and 100% humidity for 3 days under the following conditions: (1) without UV-C irradiation (dark); (2) UV-C irradiation 30 minutes/day; and (3) UV-C irradiation 60 minutes/day. Next, the samples were analyzed using the UHPLC-ESI-QQQ instrument with the Multiple Reaction Monitoring (MRM) method for OTA quantification and Product Ion Scan (PIS) to identify OTA modified compounds. Based on the results, dark germination resulted in a higher reduction of OTA (89.25%) than germination with UV-C irradiation (63.11-65.80%). The increasing exposure time to UV-C radiation increased the percentage of OTA reduction in peanuts but not significantly. The decrease in OTA is related to the modification of the OTA structure through dechlorination, hydrolysis, esterification and conjugation reactions due to germination and UV-C irradiation. UV-C irradiation treatment is thought to inhibit protease and phenylalanine ammonia-lyase (PAL) activity in the biosynthesis of secondary metabolites which are thought to play a role in reducing OTA. Thus, germination treatment with UV-C irradiation for 30 minutes/day and 60 minutes/day is less effective in reducing the OTA content in peanuts when compared with germination in dark conditions.

Keywords: Peanut, OTA, germination, UV-C irradiation.

DAFTAR ISI

KATA PENGANTAR.....	i
UCAPAN TERIMA KASIH	ii
ABSTRAK	iv
ABSTRACT	v
DAFTAR ISI	vi
DAFTAR TABEL.....	ix
DAFTAR GAMBAR	x
DAFTAR LAMPIRAN	xi
BAB I PENDAHULUAN	1
1.1 Latar Belakang	1
1.2 Rumusan Masalah	3
1.3 Tujuan Penelitian.....	3
1.4 Manfaat Penelitian.....	3
1.5 Struktur Organisasi Skripsi.....	4
BAB II TINJAUAN PUSTAKA	5
2.1 Kacang Tanah	5
2.2 Okratoksin A	6
2.3 Perlakuan Penurunan Okratoksin A	9
2.3.1 Perkecambahan.....	10
2.3.2 Iradiasi UV-C	11
2.4 Analisis Okratoksin A	12
2.4.1 Kromatografi Cair/ <i>Liquid Chromatography</i> (LC)	12
2.4.2 Spektrometri Massa.....	15
2.4.2.1 Prinsip Dasar Spektrometri Massa	15
2.4.2.2 Instrumentasi Spektrometri Massa	16

2.4.2.2.1 Pengenalan sampel (<i>sample introduction</i>)	16
2.4.2.2.2 Sumber ion	16
2.4.2.2.3 Penganalisa massa.....	18
2.4.2.2.4 Detektor	18
2.4.2.3 Spektrometri Massa Tandem: Disosiasi yang Diinduksi Tumbukan (<i>Collision Induced Dissociation/CID</i>)	18
2.4.3 <i>Ultra-High Liquid Chromatography-Mass Spectrometry/Mass Spectrometry</i> (UHPLC-MS/MS).....	21
BAB III METODE PENELITIAN.....	23
3.1 Waktu dan Lokasi Penelitian	23
3.2 Alat dan Bahan	23
3.2.1 Alat.....	23
3.2.2 Bahan.....	24
3.3 Bagan Alir Penelitian	24
3.4 Tahapan Penelitian	26
3.4.1 Penyimpanan Kacang Tanah	26
3.4.2 Optimasi Perkecambahan.....	26
3.4.2.1 Optimasi Sterilisasi Kacang Tanah.....	26
3.4.2.2 Optimasi <i>Spiking</i> OTA	26
3.4.3 Perkecambahan Kacang Tanah.....	27
3.4.3.1 Sterilisasi	27
3.4.3.2 <i>Spiking</i> Okratoksin A	27
3.4.3.3 Kondisi Perkecambahan Kacang Tanah	27
3.4.3.3.1 Alat Perkecambahan (<i>Germinator</i>).....	27
3.4.3.3.2 Kondisi Perkecambahan	28
3.4.3.4 Pengeringan dan Penepungan.....	29

3.4.4	Preparasi Standar.....	29
3.4.5	Preparasi Sampel.....	29
3.4.6	Analisis OTA Menggunakan UHPLC-ESI-QQQ.....	30
3.4.7	Analisis Statistik.....	30
BAB IV HASIL DAN PEMBAHASAN.....		32
4.1	Optimasi Perkecambahan.....	32
4.1.1	Optimasi Sterilisasi Kacang Tanah.....	32
4.1.2	Optimasi <i>Spiking</i> OTA.....	34
4.2	Perkecambahan Kacang Tanah <i>Spiked</i> OTA.....	35
4.3	Kuantifikasi OTA.....	38
4.3.1	Pengaruh Perkecambahan dan Iradiasi UV-C Terhadap Penurunan OTA	40
4.4	Modifikasi Senyawa OTA.....	42
4.4.1	Identifikasi Senyawa Modifikasi OTA.....	42
4.4.2	Toksisitas Senyawa Modifikasi OTA.....	45
BAB V KESIMPULAN DAN SARAN.....		47
5.1	Kesimpulan.....	47
5.2	Saran.....	47
DAFTAR PUSTAKA.....		48
LAMPIRAN.....		63

DAFTAR TABEL

Tabel 3.1 Ringkasan perbedaan perlakuan pada kacang tanah	29
Tabel 4.1 Persentase perkecambahan hari ke-3 pada berbagai konsentrasi pelarut dan cara <i>spiking</i>	34

DAFTAR GAMBAR

Gambar 2.1 Kacang tanah	5
Gambar 2.2 Kacang tanah terkontaminasi <i>Aspergillus</i>	7
Gambar 2.3 Struktur okratoksin A, B, dan C	7
Gambar 2.4 Proses metabolisme yang terjadi selama perkecambahan biji	10
Gambar 2.5 Diagram skematik kromatografi fase normal (NPC) dan kromatografi fase terbalik (RPC).....	13
Gambar 2.6 Skema sistem UHPLC.....	14
Gambar 2.7 Komponen spektrometer massa	16
Gambar 2.8 Skema representatif sumber ionisasi ESI.....	17
Gambar 2.9 Diagram sistem spektrometri massa dan spektrometri massa tandem.	19
Gambar 2.10 Percobaan spektrometri massa tandem	20
Gambar 2.11 Skema sistem UHPLC-MS/MS.....	22
Gambar 3.1 Tahapan sterilisasi, <i>spiking</i> OTA, dan perkecambahan tanpa dan dengan iradiasi UV-C.....	24
Gambar 3.2 Tahapan ekstraksi dan analisis OTA.....	25
Gambar 3.3 Skema alat <i>germinator</i>	28
Gambar 4.1 Perkecambahan kacang tanah yang disterilisasi NaOCl 1%, 3% dan 5%	33
Gambar 4.2 Persentase perkecambahan kacang tanah <i>spiked</i> OTA pada kondisi tanpa cahaya (GG), dengan iradiasi UV-C 30 menit/hari (GUV30) dan 60 menit/hari (GUV60).....	37
Gambar 4.3 Hasil identifikasi OTA dalam larutan standar OTA.....	38
Gambar 4.4 Pola fragmentasi OTA.....	39
Gambar 4.5 Kurva Standar OTA	40
Gambar 4.6 Konsentrasi OTA pada kacang tanah tanpa perlakuan (UG), perkecambahan gelap (GG), perkecambahan UV-C 30 menit/hari (GUV30), dan perkecambahan 60 menit/hari (GUV60).....	40
Gambar 4.7 Senyawa modifikasi OTA	43

DAFTAR LAMPIRAN

Lampiran 1 Optimasi perkecambahan kacang tanah <i>spiked</i> OTA	63
Lampiran 2 Data perkecambahan kacang tanah <i>spiked</i> OTA	66
Lampiran 3 Data penimbangan	67
Lampiran 4 Data perhitungan.....	68
Lampiran 5 Analisis OTA menggunakan UHPLC-ESI-QQQ	71
Lampiran 6 Kromatogram hasil analisis OTA standar dan sampel	72
Lampiran 7 Konsentrasi dan penurunan OTA pada sampel kacang tanah	74
Lampiran 8 Parameter <i>Product Ion Scan</i>	75
Lampiran 9 Hasil analisis <i>Product Ion Scan</i>	78
Lampiran 10 Dokumentasi.....	82

DAFTAR PUSTAKA

- Abayechaw, D., & Wolchafo, K. (2020). The concept and process of seed germination – a review. *International Journal of Current Research and Academic Review*, 8(5), 100–112. <https://doi.org/10.20546/ijcrar.2020.805.011>
- Abbasi, B. H., Tian, C. L., Murch, S. J., Saxena, P. K., & Liu, C. Z. (2007). Light-enhanced caffeic acid derivatives biosynthesis in hairy root cultures of *Echinacea purpurea*. *Plant Cell Reports*, 26(8), 1367–1372. <https://doi.org/10.1007/s00299-007-0344-5>
- Abrunhosa, L., Paterson, R. R. M., & Venâncio, A. (2010). Biodegradation of ochratoxin a for food and feed decontamination. In *Toxins* (Vol. 2, Issue 5). <https://doi.org/10.3390/toxins2051078>
- Aisyah, S., Gruppen, H., Madzora, B., & Vincken, J. P. (2013). Modulation of isoflavonoid composition of *Rhizopus oryzae* elicited soybean (*Glycine max*) seedlings by light and wounding. *Journal of Agricultural and Food Chemistry*, 61(36), 8657–8667. <https://doi.org/10.1021/jf4020203>
- Akkamma, M. B., & Lobo, B. (2023). Optical properties of UV-C irradiated polyvinylidene chloride films. *Radiation Physics and Chemistry*, 212, 111182. <https://doi.org/10.1016/j.radphyschem.2023.111182>
- Aldred, D., Cairns-fuller, V., & Ñ, N. M. (2008). *Environmental factors affect efficacy of some essential oils and resveratrol to control growth and ochratoxin A production by Penicillium verrucosum and Aspergillus westerdijkiae on wheat grain.* 44, 341–346. <https://doi.org/10.1016/j.jspr.2008.03.004>
- Al-Khayri, J. M., Shri, , Jain, M., & Johnson, D. V. (2019). *Advances in Plant Breeding Strategies: Nut and Beverage Crops Volume 4.*
- Ameer Sumbal, G., Hussain Shar, Z., Hussain Sherazi, S. T., Sirajuddin, Nizamani, S. M., & Mahesar, S. A. (2016). Decontamination of poultry feed from

- ochratoxin A by UV and sunlight radiations. *Journal of the Science of Food and Agriculture*, 96(8). <https://doi.org/10.1002/jsfa.7384>
- Annissa, S., Musfiroh, I., & Indriati, L. (2019). Perbandingan Metode Analisis Instrumen HPLC dan UHPLC : Article Review. *Farmaka*, 17(3), 189–197.
- Ardiantika, A. (2019). *PENGARUH PERKECAMBAHAN DAN KOMBINASI PERKECAMBAHAN-ELISITASI MENGGUNAKAN JAMUR TEMPE TERHADAP PROFIL ASAM AMINO NON PROTEIN PADA KORO PEDANG (Canavalia ensiformis L.)* (Skripsi Sarjana, Universitas Pendidikan Indonesia).
- Asra, R. (2014). Pengaruh hormon giberelin (GA3) terhadap daya kecambah dan vigoritas *Calopogonium caeruleum*. *Biospecies*, 7(1).
- Banchuen, J., Thammarutwasik, P., Oraikul, B., Wuttijumnong, P., & Sirivongpaisal, P. (2009). Effect of Germinating Processes on Bioactive Component of Sangyod Muang Phatthalung Rice. In *www.thaiagj.org Thai Journal of Agricultural Science* (Vol. 42, Issue 4). www.thaiagj.org
- Banerjee, S., & Mazumdar, S. (2012). Electrospray Ionization Mass Spectrometry: A Technique to Access the Information beyond the Molecular Weight of the Analyte. *International Journal of Analytical Chemistry*, 2012, 1–40. <https://doi.org/10.1155/2012/282574>
- Bonku, R., & Yu, J. (2020). Health aspects of peanuts as an outcome of its chemical composition. In *Food Science and Human Wellness* (Vol. 9, Issue 1). <https://doi.org/10.1016/j.fshw.2019.12.005>
- Boudra, H., Le Bars, P., & Le Bars, J. (1995). Thermostability of ochratoxin A in wheat under two moisture conditions. *Applied and Environmental Microbiology*, 61(3). <https://doi.org/10.1128/aem.61.3.1156-1158.1995>
- BPOM. (2009). Penetapan batas maksimum cemaran mikroba dan kimia dalam makanan. Jakarta.
- Brapeau, R. (1978). *The primary structure of staphylococcal protease I*.

- Changjan, D., Toyen, D., & Umroong, P. (2022). Effect of UV-C Radiation on Seed Germination and Some Ultrastructure in Water Convolvulus (*Ipomoea aquatica* Forssk. 'Reptan'). *Microscopy and Microanalysis Research—The Journal of The Microscopy Society of Thailand*, 35(1), 33-37.
- Chen, Y., & Chang, S. K. C. (2015). Macronutrients, Phytochemicals, and Antioxidant Activity of Soybean Sprout Germinated with or without Light Exposure. *Journal of Food Science*, 80(6). <https://doi.org/10.1111/1750-3841.12868>
- Choudhury, A., Chandra, B., Viswavidyalaya, K., & Karmakar, S. (2020). *Germination: The Way of Entering into a New Life*. www.agricosemagazine.com
- Christensen, A. B., Gregersen, P. L., Schröder, J., & Collinge, D. B. (1998). A chalcone synthase with an unusual substrate preference is expressed in barley leaves in response to UV light and pathogen attack. *Plant Molecular Biology*, 37(5), 849–857. <https://doi.org/10.1023/A:1006031822141>
- Csapó, J., Prokisch, J., Albert, C., & Sipos, P. (2019). Effect of UV light on food quality and safety. *Acta Universitatis Sapientiae, Alimentaria*, 12(1). <https://doi.org/10.2478/ausal-2019-0002>
- Delorme, M. M., Guimarães, J. T., Coutinho, N. M., Balthazar, C. F., Rocha, R. S., Silva, R., Margalho, L. P., Pimentel, T. C., Silva, M. C., Freitas, M. Q., Granato, D., Sant'Ana, A. S., Duart, M. C. K. H., & Cruz, A. G. (2020). Ultraviolet radiation: An interesting technology to preserve quality and safety of milk and dairy foods. In *Trends in Food Science and Technology* (Vol. 102, pp. 146–154). Elsevier Ltd. <https://doi.org/10.1016/j.tifs.2020.06.001>
- Deng, L. Z., Tao, Y., Mujumdar, A. S., Pan, Z., Chen, C., Yang, X. H., Liu, Z. L., Wang, H., & Xiao, H. W. (2020). Recent advances in non-thermal decontamination technologies for microorganisms and mycotoxins in low-moisture foods. In *Trends in Food Science and Technology* (Vol. 106, pp. 104–112). Elsevier Ltd. <https://doi.org/10.1016/j.tifs.2020.10.012>

- Do, T. H., Tran, S. C., Le, C. D., Thi, B., Nguyen, H., Thi, T., Le, P., Thi, H., Le, H., Le, T. D., & Thai-nguyen, T. H. (2020). Dietary exposure and health risk characterization of aflatoxin B1, ochratoxin A, fumonisin B1, and zearalenone in food from different provinces in Northern Vietnam. *Food Control*, 107108. <https://doi.org/10.1016/j.foodcont.2020.107108>
- Dong, M. W. (2019). *HPLC AND UHPLC FOR PRACTICING SCIENTISTS Second Edition*. www.wiley.com.
- Duarte, S. C., Pena, A., & Lino, C. M. (2011). *Human ochratoxin A biomarkers — From exposure to effect*. 41(3), 187–212. <https://doi.org/10.3109/10408444.2010.529103>
- Durner, J., & Watts, D. C. (2014). Principles of analytical chemistry for toxicology. In *Regulatory Toxicology* (pp. 321–357). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-35374-1_91
- Ediage, E. N., Di Mavungu, J. D., Monbaliu, S., Van Peteghem, C., & De Saeger, S. (2011). A validated multianalyte LC-MS/MS method for quantification of 25 mycotoxins in cassava flour, peanut cake and maize samples. *Journal of Agricultural and Food Chemistry*, 59(10), 5173–5180. <https://doi.org/10.1021/jf2009364>
- Eshelli, M., Qader, M. M., Jambi, E. J., Hursthouse, A. S., & Rateb, M. E. (2018). Current status and future opportunities of omics tools in mycotoxin research. In *Toxins* (Vol. 10, Issue 11). MDPI AG. <https://doi.org/10.3390/toxins10110433>
- European Commission. (2006). Commission Regulation (EC) No 401/2006 of 23 February 2006 laying down the methods of sampling and analysis for the official control of the levels of mycotoxins in foodstuffs. *Off J Eur Union L*, 70, 12-34.
- European Food Safety Authority (EFSA). (2006). Opinion of the scientific panel on contaminants in the food chain related to ochratoxin A in food. *EFSA journal*, 4(6), 365. <https://doi.org/10.2903/j.efsa.2006.365>

- Fang, Y., Franke, C., Manthei, A., McMullen, L., Temelli, F., & Gänzle, M. G. (2021). Effects of high-pressure carbon dioxide on microbial quality and germination of cereal grains and beans. *Journal of Supercritical Fluids*, 175. <https://doi.org/10.1016/j.supflu.2021.105272>
- Ferreira, C. D., Lang, G. H., Lindemann, I. da S., Timm, N. da S., Hoffmann, J. F., Ziegler, V., & de Oliveira, M. (2021). Postharvest UV-C irradiation for fungal control and reduction of mycotoxins in brown, black, and red rice during long-term storage. *Food Chemistry*, 339. <https://doi.org/10.1016/j.foodchem.2020.127810>
- Gan, R. Y., Lui, W. Y., Wu, K., Chan, C. L., Dai, S. H., Sui, Z. Q., & Corke, H. (2017). Bioactive compounds and bioactivities of germinated edible seeds and sprouts: An updated review. In *Trends in Food Science and Technology* (Vol. 59). <https://doi.org/10.1016/j.tifs.2016.11.010>
- García-Cela, E., Marin, S., Sanchis, V., Crespo-Sempere, A., & Ramos, A. J. (2015). Effect of ultraviolet radiation A and B on growth and mycotoxin production by *Aspergillus carbonarius* and *Aspergillus parasiticus* in grape and pistachio media. *Fungal Biology*, 119(1), 67–78. <https://doi.org/10.1016/j.funbio.2014.11.004>
- Garg, N., Aggarwal, M., Javed, S., & Khandal, R. K. (2013). Studies for optimization of conditions for reducing Aflatoxin contamination in peanuts using ultraviolet radiations. *International Journal of Drug Development and Research*, 5(3).
- Gianinetti, A., Finocchiaro, F., Maisenti, F., Satsap, D. K., Morcia, C., Ghizzoni, R., & Terzi, V. (2018). The caryopsis of red-grained rice has enhanced resistance to fungal attack. *Journal of Fungi*, 4(2). <https://doi.org/10.3390/jof4020071>
- Grebe, S. K. G., & Singh, R. J. (2011). LC-MS/MS in the clinical laboratory - Where to from here? *Clinical Biochemist Reviews*, 32(1).
- Groot, S. P. C., van Litsenburg, M. J., Kodde, J., Hall, R. D., de Vos, R. C. H., &

- Mumm, R. (2022). Analyses of metabolic activity in peanuts under hermetic storage at different relative humidity levels. *Food Chemistry*, 373. <https://doi.org/10.1016/j.foodchem.2021.131020>
- Gupta, R. C., Lasher, M. A., Miller Mukherjee, I. R., Srivastava, A., & Lall, R. (2017). Aflatoxins, ochratoxins, and citrinin. In *Reproductive and Developmental Toxicology* (pp. 945–962). Elsevier. <https://doi.org/10.1016/B978-0-12-804239-7.00048-2>
- Gupta, R. C., Srivastava, A., & Lall, R. (2018). Ochratoxins and Citrinin. In *Veterinary Toxicology: Basic and Clinical Principles: Third Edition* (pp. 1019–1027). Elsevier. <https://doi.org/10.1016/B978-0-12-811410-0.00072-6>
- Han, C., Zhen, W., Chen, Q., & Fu, M. (2021). UV-C irradiation inhibits surface discoloration and delays quality degradation of fresh-cut stem lettuce. *LWT*, 147(January), 111533. <https://doi.org/10.1016/j.lwt.2021.111533>
- Han, Z., Zhao, Z., Shi, J., Liao, Y., Zhao, Z., Zhang, D., Wu, Y., De Saeger, S., & Wu, A. (2013). Combinatorial approach of LC-MS/MS and LC-TOF-MS for uncovering in vivo kinetics and biotransformation of ochratoxin A in rat. *Journal of Chromatography B: Analytical Technologies in the Biomedical and Life Sciences*, 925, 46–53. <https://doi.org/10.1016/j.jchromb.2013.02.028>
- He, J., Evans, N. M., Liu, H., Zhu, Y., Zhou, T., & Shao, S. (2021). UV treatment for degradation of chemical contaminants in food: A review. *Comprehensive Reviews in Food Science and Food Safety*, 20(2). <https://doi.org/10.1111/1541-4337.12698>
- Hesami, M., Naderi, R., & Yoosefzadeh-Najafabadi, M. (2018). Optimizing sterilization conditions and growth regulator effects on in vitro shoot regeneration through direct organogenesis in *Chenopodium quinoa*. *BioTechnologia. Journal of Biotechnology Computational Biology and Bionanotechnology*, 99(1).
- IARC. (1993). Some naturally occurring substances: food items and constituents, heterocyclic aromatic amines and mycotoxins. *IARC Monographs on the*

Evaluation of Carcinogenic Risks to Humans; International Agency for Research on Cancer: Lyon, France, 56, 489-521.

- Ibarz, R., Garvín, A., Azuara, E., & Ibarz, A. (2015). Modelling of ochratoxin A photo-degradation by a UV multi-wavelength emitting lamp. *LWT*, *61*(2), 385–392. <https://doi.org/10.1016/j.lwt.2014.12.017>
- Indiarto, R., & Rezaharsanto, B. (2020). The Physical, Chemical, And Microbiological Properties Of Peanuts During Storage: A Review. *Article in International Journal of Scientific & Technology Research*. www.ijstr.org
- Jalili, M., Jinap, S., & Noranizan, A. (2010). Effect of gamma radiation on reduction of mycotoxins in black pepper. *Food Control*, *21*(10), 1388–1393. <https://doi.org/10.1016/j.foodcont.2010.04.012>
- JECFA. (2007). Safety Evaluations of Specific Mycotoxins: Ochratoxin A. Prepared by the 56th Meeting of the Joint FAO/WHO Expert Committee on Food Additives, 6–15 February, Geneva.
- Jhade, R.K. (2019). Plant propagation and nursery management. JNKVV, College of Horticulture, Chhindwara.
- Jordan, D., Brandenburg, R., Payne, G., Hoisington, D., Mangan, N., Rhoads, J., Abudulai, M., Adhikari, K., Chen, J., Akromah, R., Appaw, W., Ellis, W., Balota, M., Mallikarjunan, K., Boote, K., MacDonald, G., Bowen, K., Bravo-Ureta, B., Jelliffe, J., ... Opoku, N. (2018). *Preventing mycotoxin contamination in groundnut cultivation* (pp. 181–212). <https://doi.org/10.19103/as.2017.0023.28>
- Jubeen, F., Bhatti, I. A., Zargham Khan, M., And, Z.-U.-H., & Shahid, M. (2012). Effect of UVC Irradiation on Aflatoxins in Ground Nut (*Arachis hypogea*) and Tree Nuts (*Juglans regia*, *Prunus dulcis* and *Pistachio vera*). In *J.Chem.Soc.Pak* (Vol. 34, Issue 6).
- Kang, J. S. (2012). Principles and applications of LC-MS/MS for the quantitative bioanalysis of analytes in various biological samples. *Tandem Mass Spectrometry—Applications and Principles*, *29*, 441-92.

- Kassa, M. T., Yeboah, S. O., & Bezabih, M. (2009). Profiling peanut (*Arachis hypogea* L.) accessions and cultivars for oleic acid and yield in Botswana. *Euphytica*, *167*(3). <https://doi.org/10.1007/s10681-008-9852-9>
- Khalil, O. A. A., Hammad, A. A., & Sebaei, A. S. (2021). *Aspergillus flavus* and *Aspergillus ochraceus* inhibition and reduction of aflatoxins and ochratoxin A in maize by irradiation. *Toxicon*, *198*. <https://doi.org/10.1016/j.toxicon.2021.04.029>
- Kondrateva, N. P., Krasnolutszkaya, M. G., Dukhtanova, N. V., & Obolensky, N. V. (2019). Effect of ultraviolet radiation the germination rate of tree seeds. *IOP Conference Series: Earth and Environmental Science*, *226*(1). <https://doi.org/10.1088/1755-1315/226/1/012049>
- Kőszegi, T., & Poór, M. (2016). Ochratoxin a: Molecular interactions, mechanisms of toxicity and prevention at the molecular level. In *Toxins* (Vol. 8, Issue 4). MDPI AG. <https://doi.org/10.3390/toxins8040111>
- Li, Y. C., Qian, H., Sun, X. L., Cui, Y., Wang, H. Y., Du, C., & Xia, X. H. (2014). The effects of germination on chemical composition of peanut seed. *Food Science and Technology Research*, *20*(4), 883–889. <https://doi.org/10.3136/fstr.20.883>
- Li, Y., Sun, X., Ma, Z., Cui, Y., Du, C., Xia, X., & Qian, H. (2016). Beneficial Influence of Short-Term Germination on Decreasing Allergenicity of Peanut Proteins. *Journal of Food Science*, *81*(1). <https://doi.org/10.1111/1750-3841.13161>
- Liao, C. D., Wong, J. W., Zhang, K., Yang, P., Wittenberg, J. B., Trucksess, M. W., Hayward, D. G., Lee, N. S., & Chang, J. S. (2015). Multi-mycotoxin Analysis of Finished Grain and Nut Products Using Ultrahigh-Performance Liquid Chromatography and Positive Electrospray Ionization-Quadrupole Orbital Ion Trap High-Resolution Mass Spectrometry. *Journal of Agricultural and Food Chemistry*, *63*(37), 8314–8332. <https://doi.org/10.1021/jf505049a>
- Liew, W. P. P., & Mohd-Redzwan, S. (2018). Mycotoxin: Its impact on gut health

- and microbiota. In *Frontiers in Cellular and Infection Microbiology* (Vol. 8, Issue FEB). Frontiers Media S.A. <https://doi.org/10.3389/fcimb.2018.00060>
- Liu, Y., Galani Yamdeu, J. H., Gong, Y. Y., & Orfila, C. (2020). A review of postharvest approaches to reduce fungal and mycotoxin contamination of foods. *Comprehensive Reviews in Food Science and Food Safety*, 19(4), 1521–1560. <https://doi.org/10.1111/1541-4337.12562>
- Lu, Q., Guo, M. Y., Tian, J., Luo, J. Y., & Yang, M. H. (2022). A comprehensive study on multi-mycotoxin screening, changes of mycotoxin residues and fungal community analysis from barley germination to malt. *International Journal of Food Microbiology*, 372. <https://doi.org/10.1016/j.ijfoodmicro.2022.109678>
- Ma, Z., Bykova, N. V., & Igamberdiev, A. U. (2017). Cell signaling mechanisms and metabolic regulation of germination and dormancy in barley seeds. In *Crop Journal* (Vol. 5, Issue 6, pp. 459–477). Crop Science Society of China/Institute of Crop Sciences. <https://doi.org/10.1016/j.cj.2017.08.007>
- Magnoli, C., Astoreca, A., Ponsone, L., Fernández-Juri, M. G., Chiacchiera, S., & Dalcerro, A. (2006). Ochratoxin A and the occurrence of ochratoxin A-producing black aspergilli in stored peanut seeds from Córdoba, Argentina. *Journal of the Science of Food and Agriculture*, 86(14). <https://doi.org/10.1002/jsfa.2625>
- Magnoli, C., Astoreca, A., Ponsone, M. L., Fernández-Juri, M. G., Barberis, C., & Dalcerro, A. M. (2007). Ochratoxin A and *Aspergillus* section *Nigri* in peanut seeds at different months of storage in Córdoba, Argentina. *International Journal of Food Microbiology*, 119(3). <https://doi.org/10.1016/j.ijfoodmicro.2007.07.056>
- Malir, F., Ostry, V., & Novotna, E. (2013). Toxicity of the mycotoxin ochratoxin A in the light of recent data. In *Toxin Reviews* (Vol. 32, Issue 2, pp. 19–33). <https://doi.org/10.3109/15569543.2013.782504>
- Maul, R., Müller, C., Rieß, S., Koch, M., Methner, F. J., & Irene, N. (2012).

- Germination induces the glucosylation of the Fusarium mycotoxin deoxynivalenol in various grains. *Food Chemistry*, 131(1), 274–279. <https://doi.org/10.1016/j.foodchem.2011.08.077>
- Mehrafarin, A., Naghdi Badi, H., Noormohammadi, G., Zand, E., Rezazadeh, S., & Qaderi, A. (2011). Effects of environmental factors and methanol on germination and emergence of Persian Fenugreek (*Trigonella foenum-graecum* L.). *African Journal of Agricultural Research*, 6(19), 4631–4641. <https://doi.org/10.5897/AJAR11.348>
- Miao, Y., Hong-zhi, L., Ying, Y., Ai-min, S., Li, L., Hui, H., Qiang, W., Hong-wei, Y., & Xiao-he, W. (2016). Optimising germinated conditions to enhance yield of resveratrol content in peanut sprout using response surface methodology. *International Journal of Food Science and Technology*, 51(8). <https://doi.org/10.1111/ijfs.13099>
- Müller, G., Burkert, B., Möller, U., Diller, R., Rohrmann, B., Rosner, H., & Köhler, H. (2004). Ochratoxin A and some of its derivatives modulate radical formation of porcine blood monocytes and granulocytes. *Toxicology*, 199(2–3), 251–259. <https://doi.org/10.1016/j.tox.2004.01.040>
- Neme, K., & Mohammed, A. (2017). Mycotoxin occurrence in grains and the role of postharvest management as a mitigation strategies. A review. In *Food Control* (Vol. 78, pp. 412–425). Elsevier Ltd. <https://doi.org/10.1016/j.foodcont.2017.03.012>
- Niessen, W. M. A. (2019). Liquid chromatography | Mass spectrometry. In *Encyclopedia of Analytical Science* (pp. 127–132). Elsevier. <https://doi.org/10.1016/B978-0-12-409547-2.14213-1>
- Noble, R. E. (2002). Effects of UV-irradiation on seed germination. *Science of the Total Environment*, 299(1–3). [https://doi.org/10.1016/S0048-9697\(02\)00232-2](https://doi.org/10.1016/S0048-9697(02)00232-2)
- Oğuz, Z. G., & Bozoğlu, H. (2022). The Effect of Acetic Acid Priming on Germination and Sprout Ability of Faba Bean (*Vicia faba* L.) Seeds.

International Journal of Innovative Approaches in Agricultural Research, 6(4), 410–416. <https://doi.org/10.29329/ijjaar.2022.506.11>

Ouakhssase, A., Fatini, N., & Addi, E. A. (2021). Validation and Application of Ultra-Performance Liquid Chromatography-Tandem Mass Spectrometry Method for Aflatoxins and Ochratoxin A Evaluation in Argan Kernels and Edible Argan Oil from Morocco. *ACS Food Science and Technology*, 1(5), 762–769. <https://doi.org/10.1021/acsfoodscitech.1c00031>

Pakfetrat, S., Amiri, S., Radi, M., Abedi, E., & Torri, L. (2019). Reduction of phytic acid, aflatoxins and other mycotoxins in wheat during germination. *Journal of the Science of Food and Agriculture*, 99(10), 4695–4701. <https://doi.org/10.1002/jsfa.9710>

Pakpahan, J. S. (2019). *Uji Pupuk Petroganik dan Grand K Terhadap Pertumbuhan serta Produksi Tanaman Kacang Tanah (Arachis hypogaea L.)*. Doctoral dissertation, Universitas Islam Riau.

Palencia, E. R., Mitchell, T. R., Snook, M. E., Glenn, A. E., Gold, S., Hinton, D. M., Riley, R. T., & Bacon, C. W. (2014). Analyses of Black Aspergillus Species of Peanut and Maize for Ochratoxins and Fumonisin. *Journal of Food Protection*, 77(5), 805–813. <https://doi.org/10.4315/0362-028X>

Parasuraman, S., Rao, A., Balamurugan, S., Muralidharan, S., Jayaraj Kumar, K., & Vijayan, V. (n.d.). An Overview of Liquid Chromatography-Mass Spectroscopy Instrumentation. *Pharmaceutical Methods*, 5(2), 47–55. <https://doi.org/10.5530/phm.2014.2.2>

Pascari, X., Marin, S., Ramos, A. J., & Sanchis, V. (2022). Relevant Fusarium Mycotoxins in Malt and Beer. In *Foods* (Vol. 11, Issue 2). MDPI. <https://doi.org/10.3390/foods11020246>

Payne, G. A. (2016). Mycotoxins and Product Safety. In *Peanuts: Genetics, Processing, and Utilization*. <https://doi.org/10.1016/B978-1-63067-038-2.00012-5>

Pazderů, K., Vepřiková, Z., Capouchová, I., Konvalina, P., Prokinová, E.,

- Janovská, D., Škeříková, A., & Honsová, H. (2016). Changes in the content of various Fusarium mycotoxins forms in germinating winter wheat and spring barley kernels. *Plant, Soil and Environment*, 62(1), 42–46. <https://doi.org/10.17221/708/2015-PSE>
- Peykarestan, B., & Seify, M. R. (2012). UV Irradiation Effects on Seed Germination and Growth, Protein Content, Peroxidase and Protease Activity in Red Bean. *International Journal of Science and Engineering Investigations*, 1. www.IJSEI.com
- Pfohl-Leszkowicz, A., Petkova-Bocharova, T., Chernozemsky, I. N., & Castegnaro, M. (2002). Balkan endemic nephropathy and associated urinary tract tumours: A review on aetiological causes and the potential role of mycotoxins. *Food Additives and Contaminants*, 19(3). <https://doi.org/10.1080/02652030110079815>
- Pramai, P., Abdul Hamid, N. A., Mediani, A., Maulidiani, M., Abas, F., & Jiamyangyuen, S. (2018). Metabolite profiling, antioxidant, and α -glucosidase inhibitory activities of germinated rice: nuclear-magnetic-resonance-based metabolomics study. *Journal of Food and Drug Analysis*, 26(1), 47–57. <https://doi.org/10.1016/j.jfda.2016.11.023>
- Prusova, N., Dzuman, Z., Jelinek, L., Karabin, M., Hajslova, J., Rychlik, M., & Stranska, M. (2022). Free and conjugated Alternaria and Fusarium mycotoxins during Pilsner malt production and double-mash brewing. *Food Chemistry*, 369. <https://doi.org/10.1016/j.foodchem.2021.130926>
- Puntarić, D., Bošnjir, J., Šmit, Z., Škes, I., & Baklaić, Z. (2001). Ochratoxin A in corn and wheat: geographical association with endemic nephropathy. *Croat Med J*, 42(2), 175-80.
- Rabotyagova, O. S., Cebe, P., & Kaplan, D. L. (2008). Collagen structural hierarchy and susceptibility to degradation by ultraviolet radiation. *Materials Science & Engineering C*, 28(8), 1420–1429. <https://doi.org/10.1016/j.msec.2008.03.012>
- Riley, R. T., & Norred, P. (1999). Mycotoxin prevention and decontamination - a

case of study on maize. *Food, Nutrition and Agriculture*, 23.

Sadeghianfar, P., Nazari, M., & Backes, G. (2019). Exposure to ultraviolet (UV-C) radiation increases germination rate of maize (*zea maize L*) and sugar beet (*beta vulgaris*) seeds. In *Plants* (Vol. 8, Issue 2). <https://doi.org/10.3390/plants8020049>

Sánchez-Maldonado, A. F., Lee, A., & Farber, J. M. (2018). Methods for the Control of Foodborne Pathogens in Low-Moisture Foods. In *Annual Review of Food Science and Technology* (Vol. 9). <https://doi.org/10.1146/annurev-food-030117-012304>

Sangare-Tigori, B., Moukha, S., Kouadio, H. J., Betbeder, A.-M., Dano, D. S., & Creppy, E. E. (2006). Co-occurrence of aflatoxin B₁, fumonisin B₁, ochratoxin A and zearalenone in cereals and peanuts from Côte d'Ivoire. *Food Additives and Contaminants*, 23(10), 1000–1007. <https://doi.org/10.1080/02652030500415686>

Shanakhat, H., Sorrentino, A., Raiola, A., Reverberi, M., Salustri, M., Masi, P., & Cavella, S. (2019). Technological properties of durum wheat semolina treated by heating and UV irradiation for reduction of mycotoxin content. *Journal of Food Process Engineering*, 42(3). <https://doi.org/10.1111/jfpe.13006>

Soleimany, F., Jinap, S., & Abas, F. (2012). Determination of mycotoxins in cereals by liquid chromatography tandem mass spectrometry. *Food Chemistry*, 130(4), 1055–1060. <https://doi.org/10.1016/j.foodchem.2011.07.131>

Songsermsakul, P., & Razzazi-Fazeli, E. (2008). A review of recent trends in applications of liquid chromatography-mass spectrometry for determination of mycotoxins. In *Journal of Liquid Chromatography and Related Technologies* (Vol. 31, Issues 11–12, pp. 1641–1686). <https://doi.org/10.1080/10826070802126395>

Subantoro, R., & Prabowo, R. (2013). Pengaruh Berbagai Metode Pengujian Vigorterhadap Pertumbuhan Benih Kedelai. *Mediagro*, 9(1).

Sun, L., Li, R., Tai, B., Hussain, S., Wang, G., Liu, X., & Xing, F. (2023). Current

- Status of Major Mycotoxins Contamination in Food and Feed in Asia—A Review. In *ACS Food Science and Technology* (Vol. 3, Issue 2, pp. 231–244). American Chemical Society. <https://doi.org/10.1021/acsfoodscitech.2c00331>
- Sutradhar, M., Singh, B. K., Ali, M. N., Samanta, S., & Mandal, N. (2021). A Comparative Analysis among Different Surface Sterilisation Methods for Rice Invitro Culture. *International Journal of Plant & Soil Science*, 148–154. <https://doi.org/10.9734/ijpss/2021/v33i1730559>
- Todd, J. F. J. (1991). Recommendations for nomenclature and symbolism for mass spectroscopy (including an appendix of terms used in vacuum technology). *Pure and Applied Chemistry*, 63(10). <https://doi.org/10.1351/pac199163101541>
- Toffa, D. D., Mahnine, N., Ouaffak, L., El Abidi, A., El Alaoui Faris, F. Z., & Zinedine, A. (2013). First survey on the presence of ochratoxin A and fungi in raw cereals and peanut available in the Republic of Niger. *Food Control*, 32(2), 558–562. <https://doi.org/10.1016/j.foodcont.2013.01.028>
- Toomer, O. T. (2018). Nutritional chemistry of the peanut (*Arachis hypogaea*). In *Critical Reviews in Food Science and Nutrition* (Vol. 58, Issue 17). <https://doi.org/10.1080/10408398.2017.1339015>
- Trianto, M., Budiarsa, I. M., & Kundera, I. N. (2019). Kadar protein berbagai jenis kacang (leguminoceae) dan pemanfaatannya sebagai media pembelajaran. *Journal of Biology Science and Education*, 7(2), 533-538.
- Trivedi, A. B., Doi, E., & Kitabatake, N. (1992). Detoxification of Ochratoxin A on Heating under Acidic and Alkaline Conditions. *Bioscience, Biotechnology, and Biochemistry*, 56(5). <https://doi.org/10.1271/bbb.56.741>
- USDA. 2022. Peanut Explorer. Foreign Agricultural Service. URL:https://ipad.fas.usda.gov/cropeplorer/cropview/commodityView.aspx?cropid=2221000&sel_year=2022&rankby=Production. Diakses tanggal 29 Januari 2023.
- Vidal, A., Morales, H., Sanchis, V., Ramos, A. J., & Marín, S. (2014). Stability of

- DON and OTA during the breadmaking process and determination of process and performance criteria. *Food Control*, 40, 234–242.
- Vita, D. S., Rosa, P., & Giuseppe, A. (2014). Effect of Gamma Irradiation on Aflatoxins and Ochratoxin A Reduction in Almond Samples. *Journal of Food Research*, 3(4), 113. <https://doi.org/10.5539/jfr.v3n4p113>
- Xiao, Y., Liu, H., Li, H., Liu, Q., Lu, Q., Varshney, R. K., Chen, X., & Hong, Y. (2021). Widely targeted metabolomics characterizes the dynamic changes of chemical profile in postharvest peanut sprouts grown under the dark and light conditions. *LWT*, 152. <https://doi.org/10.1016/j.lwt.2021.112283>
- Xiong, K., Wang, X. L., Zhi, H. W., Sun, B. G., & Li, X. T. (2017). Identification and safety evaluation of a product from the biodegradation of ochratoxin A by an *Aspergillus* strain. *Journal of the Science of Food and Agriculture*, 97(2), 434–443. <https://doi.org/10.1002/jsfa.7742>
- Yildiz, M., Fatih Ozcan, S., T. Kahramanogullari, C., & Tuna, E. (2013). The Effect of Sodium Hypochlorite Solutions on the Viability and In Vitro Regeneration Capacity of the Tissue. *The Natural Products Journale*, 2(4). <https://doi.org/10.2174/2210315511202040328>
- Yulianti, R. (2019). E-modul biologi Kelas XII: pertumbuhan dan perkembangan pada tumbuhan.
- Zhao, X., Liu, D., Zhang, L., Zhou, Y., & Yang, M. (2021). Development and optimization of a method based on QuEChERS-dSPE followed by UPLC-MS/MS for the simultaneous determination of 21 mycotoxins in nutmeg and related products. *Microchemical Journal*, 168. <https://doi.org/10.1016/j.microc.2021.106499>
- Zhu, T., Yang, J., Zhang, D., Cai, Q., Shen, Y., Tu, S., & Tu, K. (2021). of the reestablishment of oxidant-antioxidant homeostasis Light radiation promoted stilbene accumulation in peanut sprouts : a response of the reestablishment of oxidant - antioxidant homeostasis. *Acta Physiologiae Plantarum*, October. <https://doi.org/10.1007/s11738-021-03305-2>