ISSUE 02/2024

FEBRUARY 2024

PRESCRIPTION

Latest news and updates from the Faculty of Pharmacy

IN THIS ISSUE

BJOUXZ AND NATTO

The girls were almost singing the tune 'ABCDEFG, HIJKLMN, OPQRSTU, VWXYZ' in the standard Sesame Street melody. The teaching-enhanced classroom (TEC) was comfortable with appropriate lighting, air conditioning, and a projector, though the outside temperature in the afternoon of mid-May 2023 might reach 35'C. The pharmaceutical chemistry lecturer wrote the alphabet on the board in good order and reminded the students about 'BJOUXZ'.

These six letters do not represent the one-letter acronym for the twenty natural amino acids. When the class reached the letter 'E', they were reminded of alpha (α)-glutamic acid (Glu). Subsequent questions on the tutorial sheet tested the students' knowledge of glutamic acid's structure, as well as their understanding of the amide functional group and dipeptide linkage. This chemical bonding is involved in the construction of the amino acid polymer, called poly-gamma (γ)-glutamic acid (γ-PGA).

The pharmacy undergraduates were asked to illustrate this polypeptide γ-PGA, starting with Glu, or 2-aminopentanedioic acid, as the monomer unit (Figure 1). In the γ-PGA molecule, peptide bonds are formed between the amino (-NH2) group at carbon-2 (C2 or C-α) of Glu and the carboxylic (-COOH) group at carbon-5 (C5 or next to C-γ) of another Glu unit at the end of its side chain (Ho et al. 2006).

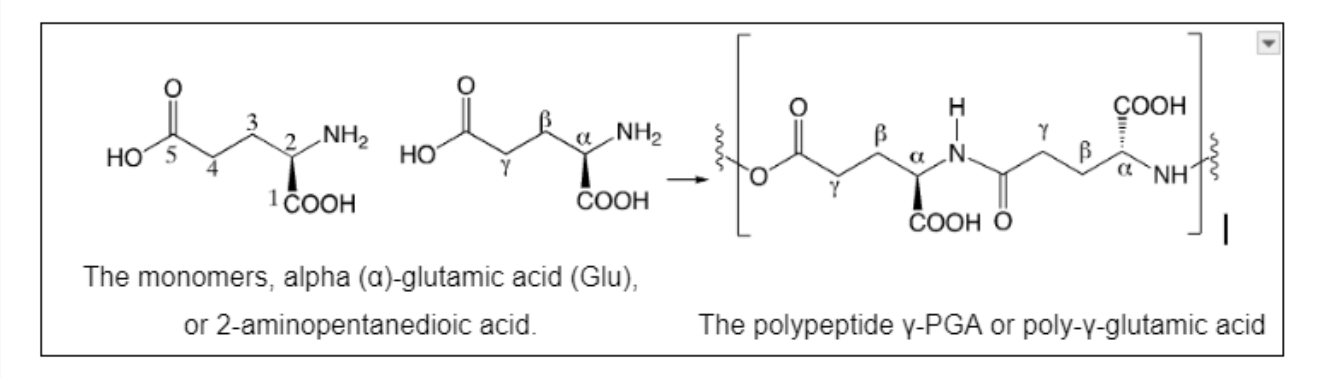


Figure 1: The chemical build-up of poly-gamma (γ)-glutamic acid (γ-PGA) could be illustrated from its monomer, alpha (α)-glutamic acid (Glu or "E").

Poly-γ-glutamic acid (γ-PGA) is produced by microbial fermentation of various Bacillus species (Johnson et al. 2022). The soybeans are typically fermented by *Bacillus subtilis (B. subtilis)* to give natto, a popular, traditional Japanese food (Li et al. 2021). Natto is served with soy sauce and rice, as sushi (Figure 2). It is a widely known source of γ-PGA. It has a sticky, slimy texture, a pungent odour, and a nutty flavour. It also contains protein, fibre, vitamins, and nattokinase, an enzyme that has been shown to lower blood pressure and reduce the risk of heart disease (Chen et al., 2018). High probiotic potential and other health benefits of natto have been reported (Afzaal et al., 2022).

The nattokinase consists of a single polypeptide chain, it is composed of a linear chain of 275 amino acid molecules (Yanagisawa et al., 2010) with spatial folding and without any disulphide bond. This is unlike the structure of the nonapeptide oxytocin hormone, that was presented in the online lecture on the organic chemistry subject (please see below, a book review of Lessons in Chemistry by Bonnie Garmus, 2023). While in the pharmaceutical biochemistry lessons, the amino acids are introduced to enhance the students' knowledge on the detection of those acids and the purification of proteins. The information on peptide degradation is also valuable. These pharmacists-to-be will then get more input on the smart probiotics once they are involved in their community pharmacy attachment.

Figure 2: Natto is served as sushi (left) at a Japanese dine-in. It is also an appetiser, with a nutty flavour and a sticky, slimy texture (right).

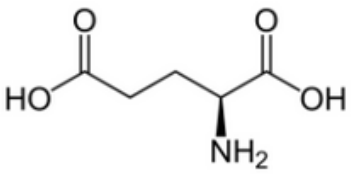
REFERENCES

- Afzaal, M., Saeed, F., Islam, F., Ateeq, H., Asghar, A., Abbas Shah, Y., Ofoedu, C. E. & Chacha, J. S. (2022). Nutritional Health Perspective of Natto: A Critical Review, Biochemistry Research International, vol. 2022, Article ID 5863887, https://doi.org/10.1155/2022/5863887
- Chen, H., McGowan, E. M., Ren, N., Lal, S., Nassif, N., Shad-Kaneez, F., Qu, X. & Lin, Y. (2018). Nattokinase: A Promising Alternative in Prevention and Treatment of Cardiovascular Diseases. Biomark Insights., 13, 1177271918785130. doi: 10.1177/1177271918785130.
- Ho, G.-H., Ho, T.-I., Hsieh, K.-H., Su, Y.-C., Lin, P.-Y., Yang, J., Yang, K.-H. & Yang, S.-C. (2006). γ-Polyglutamic Acid Produced by Bacillus Subtilis (Natto): Structural Characteristics, Chemical Properties and Biological Functionalities. Journal of the Chinese Chemical Society, 53, 1363-1384.
- Johnson, L. C., Akinmola, A. T. & Scholz, C. (2022). Poly(glutamic acid): From natto to drug delivery systems, Biocatalysis and Agricultural Biotechnology, 40,102292.
- Li, M., Zhang, Z., Li, S., Tian, Z. & Ma, X. (2021). Study on the mechanism of production of γ-PGA and nattokinase in Bacillus subtilis natto based on RNA-seq analysis. Microb Cell Fact, 20, 83. https://doi.org/10.1186/s12934-021-01570-x.
- Yanagisawa, Y., Chatake, T., Chiba-Kamoshida, K., Naito, S., Ohsugi, T., Sumi, H., Yasuda, I. & Morimoto, Y. (2010). Purification, crystallization and preliminary X-ray diffraction experiment of nattokinase from Bacillus subtilis natto. Acta Crystallographica. Section F, Structural Biology and Crystallization Communications., 66, 1670–3. doi:10.1107/S1744309110043137.

GRAPHICAL ABSTRACT

Poly-γ-glutamic acid (γ-PGA) and nattokinase are the main substances in natto, which are produced via solid-state microbial fermentation by *Bacillus subtilis* in soybeans. Both have wide application prospects.

Natto, a Japanese appetiser

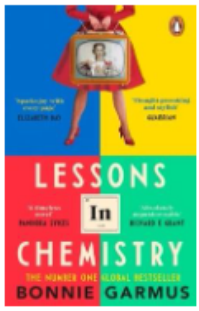


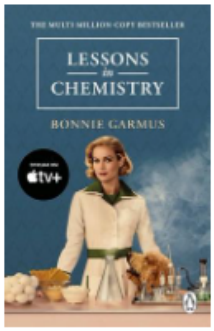
The chemical structure of glutamic acid

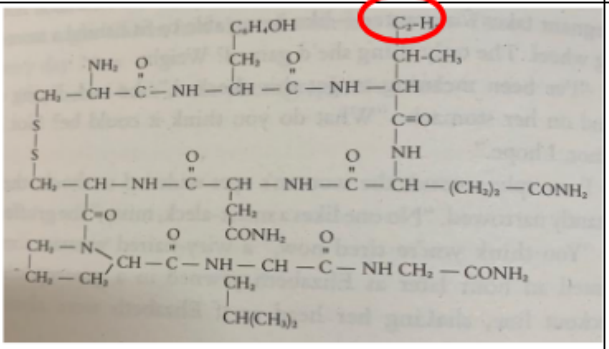
The fermented soybean or natto was garnished with seaweed and served as the Japanese appetiser. It contains a natural D- and/or L-glutamic acid biopolymer, called γ-PGA.

BOOK CLUB / BOOK REVIEW

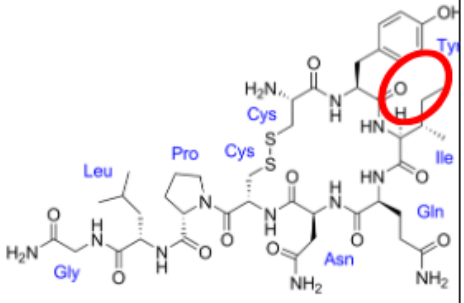
Lessons in Chemistry by Bonnie Garmus
Published: 2nd March 2023
ISBN: 978-1804990926
Lessons in Chemistry: Apple TV+
Published: 12th Oct 2023
ISBN: 978-1804993477
Imprint: Penguin
Format: Paperback, Page 126: oxytocin



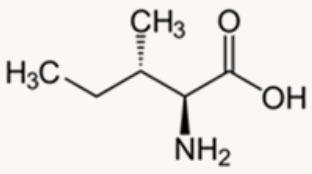




The ethyl group as a substituent in the polypeptide, might be unintentionally written as C_2-H_5 (Source: Garmus, 2023).



The ethyl group in isoleucine (Ile) can be shown in the line drawing of the oxytocin. The terminal methyl group is not drawn.



Isoleucine (Ile)

A simple write-up of oxytocin is as follows: H-Cys-Tyr-Ile-Gln-Asn-Cys-Pro-Leu-Gly-NH2. Ile is the three-letter abbreviation for an amino acid, isoleucine. The hydrocarbon side chain of Ile includes an ethyl as the functional group (written as -C2H5 or -CH2CH3). However, the chemical structure of oxytocin (Garmus, 2023, Lessons in Chemistry, page 126) is not accurately presented (Garson, 2023). In writing the formula, there should be a true expression for linking the carbon and hydrogen atoms in the ethyl group, i.e., -C2H5, instead of C2-H5. It is noticeable and gives alert to the chemists, since there should only be three protons connecting to the terminal methyl (-CH3) of the ethyl group (-CH2CH3). The writing of C2-H5 gives the impression that all five hydrogens are directly linked to one of the carbon-carbon bonds, which is untrue. A similar illustration of oxytocin appears on the same page number of the paperback version, which was adapted for the Apple TV+ series, having Brie Larson as the main character. This review hopes that the printing of an ethyl group as C2-H5, might not be on purpose.

REFERENCE

Emeritus Professor Mary Garson AM [@MMaryGarsonae]. (2023, April 10). The chemical structure of oxytocin is incorrectly drawn! A small detail. [Tweet / Post]. X. https://twitter.com/MMaryGarsonae/status/1645373719987240966

About The Author

Assoc. Prof. Dr. Ibtisam Abdul Wahab teaches chemistry to pharmacy students. Her research interests include studies on traditional herbal medicines and analysis of natural products from plants.

Questions

Let's dive deeper into the article and evaluate your comprehension. We have 5 questions for you here.

ISSUE 02/2024 FEBRUARY 2024

PRESCRIPTION

Latest news and updates from the Faculty of Pharmacy

Editorial Advisor:
Prof. Dato' Dr. Abu Bakar Abdul Majeed

Authors:
Assoc. Prof. Dr. Ibtisam Abdul Wahab, Assoc. Prof. Dr. Lim Siong Meng, Prof. Dr. Kalavathy Ramasamy, Prof. Dato' Dr. Abu Bakar Abdul Majeed, Dr. Faezah Sabirin, Dr. Aisyah Hasyila Jahidin, Mdm. Nik Ateerah Rasheeda Mohd Rocky, Mdm. Nurul Ashikin Jamludin, Ms. Nik Aisyah Najwa Nik Mustaffa Shapri, Dr. Zafirah Liyana Abdullah, Dr. Hisyam Abdul Hamid, Dr. Noreen Husain, Dr. Nadia Jalaludin, Mdm. Massita Nordin, Dr. Siti Nooraishah Hussin, Ms. Zakiah Mohd Noordin, Assoc. Prof Dr. Mahmathi Karuppanan, Mdm. Farhana Fakhira Ismail, Ms. Izzati Abdul Halim Zaki, Dr. Nor Khaizan Anuar, Mr. Ahmad Assakir Ahmad Shukri and Mdm. Nurniza Misbar

Illustrator:
Mdm. Nurul Izzati Ismail

PRESCRIPTION

Faculty of Pharmacy,
Universiti Teknologi MARA,
Kampus Puncak Alam,
42300 Bandar Puncak Alam, Selangor.

@pharmacyuitm

@pharmacy_uitm

Faculty of Pharmacy UiTM

https://pharmacy.uitm.edu.my/

+603-3258 4645

korporatff@uitm.edu.my