Technological University Dublin
ARROW@TU Dublin

Articles | School of Culinary Arts and Food Technology

2023-06-08

The examination of potato starch granules under the microscope

Roisin Burke
Technological University Dublin, roisin.burke@tudublin.ie

Follow this and additional works at: https://arrow.tudublin.ie/tfschafart

 Part of the Other Food Science Commons

Recommended Citation

Burke R. 2023. The examination of potato starch granules under the microscope, International Journal of Molecular Gastronomy, 6, 1-3, DOI: 10.21427/4BJP-EA32

This Article is brought to you for free and open access by the School of Culinary Arts and Food Technology at ARROW@TU Dublin. It has been accepted for inclusion in Articles by an authorized administrator of ARROW@TU Dublin. For more information, please contact arrow.admin@tudublin.ie, aisling.coyne@tudublin.ie, vera.kilshaw@tudublin.ie.

This work is licensed under a Creative Commons Attribution-NonCommercial-Share Alike 4.0 International License.

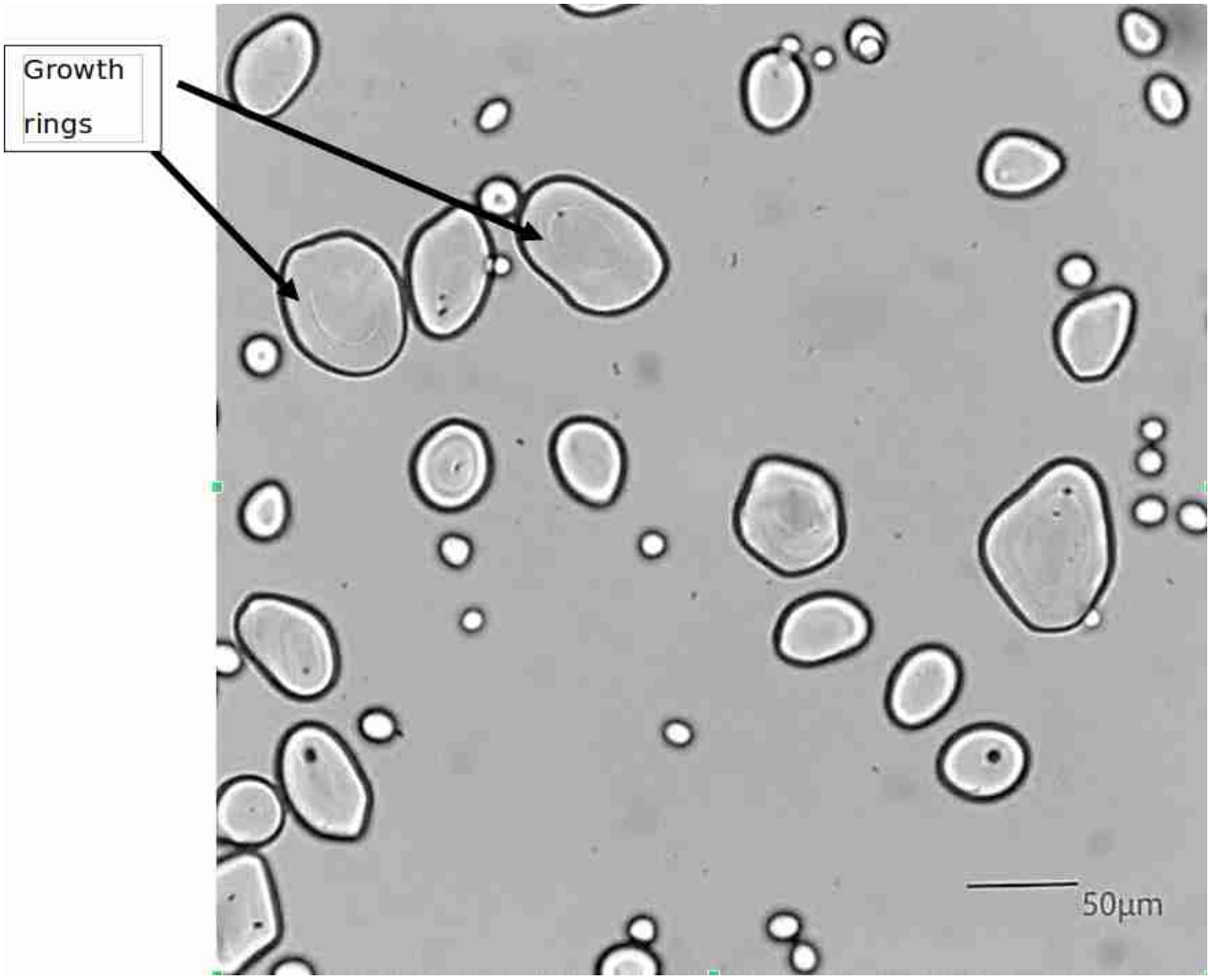
International Journal of Molecular and Physical Gastronomy (IJMPG)
Image for thought

The examination of potato starch granules under the microscope

Roisin Burke[1]

1. Technological University Dublin.

**Correspondence: roisin.burke@TUDublin.ie*



Potato starch granules magnified 200 times using an Olympus BH-2 microscope and Pixelink M1 camera.

Starch, which is a mixture of the polysaccharides amylose and amylopectin, is the most abundant storage reserve system in plants and is an important raw material for food and industrial applications (Röper, 2002). The suitability of starch for specific applications is determined by granule size, physicochemical properties and the presence of non-starch components, such as proteins and lipids (Ellis *et al.*, 1998).

The shape and size of starch granules differ according to the botanical source and the environmental condition under which a crop was grown (Jackson, 2003). Starch from all plant sources are made up of granules in a range of sizes and shapes exhibiting a size and a shape distribution (Gao *et al.*, 2021)

A study by Wang *et al.* (2016) revealed that the morphology, shape, relative crystallinity, and crystal form of starch granules from the tubers of *Solanum tuberosum* L ("potato") vary significantly among cultivars. Potato starch consists of mixed populations of large, medium and small granules, with a wide size distribution (1–100 μm). In general, the shape of potato starch granules is oval, round, and irregular, which is greatly related with crystal form. In detail, potato starch granules which are larger than 30 μm show ellipsoidal shape, whereas granules that are smaller than 15 μm show spherical shape. When viewed under a microscope, the starch granules of potato differ in size and shape from those of cereal starches.

For potato starch, the average granule size ranges from 1 to 20 μm for small, and from 20 to 110 μm for large granules. For maize, the size of individual starch granules ranges from 1 to 7 μm for small granules, and from 15 to 20 μm for large granules (Singh *et al.*, 2016). Variations in the structure of amylose and amylopectin and in their relative amounts in a granule play an important role in controlling starch granule size and shape. Most starch granules are made up of alternating regions of amorphous and semicrystalline materials, which are between 100 and 400 nm thick. These structures are termed "growth rings." The factors regulating growth ring formation are not understood, but a complex interplay of circadian rhythms, physical mechanisms (the structure of starch polymers) and diurnal rhythms could contribute (Pilling and Smith, 2003). The factors regulating growth ring formation are not understood (Pilling and Smith, 2003). All starch grains have a hilum, which is the point around which layers of protein are deposited. The hilum is often off-centre, with growth rings emanating outward (Mozdy, 2016).

The slide from which Figure 1 was obtained was prepared by adding a minute amount of potato starch (purchased from a health food store) to a slide and then adding a glycerol aqueous solution (50:50) mixture which suspended the starch sample. The dispersed granules were gently covered with a cover slip (Rui *et al.*, 2020). The slide was viewed under a magnification of 200, using an Olympus BH-2 microscope and photographed with a Pixelink M1 camera.

Acknowledgement

Thank you to Tony Hutchinson, School of Food Science and Environmental Health, TU Dublin, for technical assistance with the imaging.

References

Ellis RP, Cochrane MP, Dale MFB, Duffus CM, Lynn A, Morrison IM, Prentice RDM, Swanston JS, Tiller SA. 1998. Starch production and industrial use, *J. Sci. Food Agric.,* 77, 289–311.

Gao M, Moussavi M, Myers D. 2021. Analysis and Specification of Starch Granule Size Distributions, *J. Vis Exp.,* 4(169). doi: 10.3791/61586. PMID: 33749669.

Jackson DS. 2003. Starch: Structure, Properties, and Determination. In *Encyclopedia of Food Sciences and Nutrition* (Second Edition), Academic Press, Cambridge MA.

Mozdy (2016). *In the Tiny World of Starch Grains Bigger is Better*, National History Museum in Utah.

https://nhmu.utah.edu/BLOG/2016/08/08/TINY-WORLD-STARCH-GRAINS-BIGGER-BETTER

Pilling M, Smith AM. 2003. Growth Ring Formation in the Starch Granules of Potato Tubers, *Plant Physiology*, 132, 365-371.

Röper H. 2002. Renewable raw materials in Europe – industrial utilisation of starch and sugar, *Starch/Stärke*, 54, 89–99.

He R, Fu NF, Chen HM, Ye JQ, Chen LZ, Pu YF, Zhang WM. 2020. Comparison of the structural characterizatics and physicochemical properties of starches from sixteen cassava germplasms cultivated in China, *International Journal of Food Properties*, 23, 1, 693-707, DOI:10.1080/10942912.2020.1752714.

Singh J, Colussi R, McCarthy OJ, Kaur I. 2016. Potato Starch and Its Modification. In Singh J and Kaur L (eds) *Advances in Potato Chemistry and Technology* (Second Edition), Academic Press, 195-247. https://doi.org/10.1016/B978-0-12-800002-1.00008-X.

Wang C, Tang CH, Fu X, Huang Q, Zhang B. 2016. Granular size of potato starch affects structural properties, octenylsuccinic anhydride modification and flowability, *Food Chemistry*, 212, 453–459. https://doi.org/10.1016/j.foodchem.2016.06.006

Received :
18 March 2023

Accepted :
13 May 2023

Published :
8 June 2023

Reviewers :
1. Paul Menut, Université Paris Saclay, INRAE, AgroParisTech, UMR SayFood, 91120 Palaiseau, France

2. Hervé This, Université Paris Saclay, INRAE, AgroParisTech, UMR SayFood, 91120 Palaiseau, France

Cite as:
Burke R. 2023. The examination of potato starch granules under the microscope, *International Journal of Molecular Gastronomy*, 6, 1-3.