

Nature's forgotten emulsifier: revisiting the chemistry, application and use of *Gum acacia*

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ABSTRACT

Gum Acacia also known as Gum Acacia a (GA), a naturally exudate from wild acacia tress, is a complex mixture of polysaccharides and glycoprotein. Gum Acacia (GA) possess unique properties and has gained significant interest across different science disciplines. Gum Acacia has become a multipurpose agent not only used in food and pharmaceutical and cosmetics industry but possess a variety of therapeutic benefits. Due to its versatile qualities such as non-toxicity, high solubility and pH stability, GA has gained popularity among researchers. The present review cover the literature review regarding the GA to gather all scientific information and draw the attention of researcher to initiate further extensive research.

Keywords: Gum Acacia, medicinal uses, food industry, pharmaceutical industry, cosmetics industry, toxicity and safety.

INTRODUCTION

Plants have been used for medicinal purposes and to control epidemic for thousands of years across cultures worldwide, also to flavor and conserve food, decoration¹. The use of plants for treating diseases is as old as the human species². Many common plants possess natural compounds that help to treat various health conditions (Aloe aramatissima³, Amomum subulatum⁴, Plectranthus lanuginosus⁵). Similarly, Gum Acacia (GA) is a tree gum exuded by two species of *Acacia* genus (*sensu lato*) especially from *Senegalia senega* L, and *Vachellia seyal*⁶ not only used as a house hold remedy for the treatment of various diseases in Sub-Saharan Africa region⁷ also

in modern medicine to control various medical conditions⁷. Apart from Africa, *Acacia senegal* is also found in Pakistan (Sindh and Baluchistan)⁸. Gum Acacia extracted from *Acacia senegal* is a deciduous shrub growing to 15 m tall⁹.

Chemistry and structure:

Gum Acacia is a complex mixture of branched polysaccharides and glycoproteins¹⁰. Polysaccharide portion basically composed of (1→3)-linked β-D-galactopyranosyl units with side chains (arabinose, galactose, and glucuronic acid)¹¹. The gum also contains proteins (hydroxyproline, serine, and

threonine), mineral salts (calcium, magnesium, sodium, iron, phosphorus and potassium)¹².

Synthesis:

Rather than being manufactured in a laboratory, Gum Acacia is a polysaccharide that occurs naturally and is obtained from plants¹³. However recently the development of an interpenetrating polymer network (IPN) has accomplished that contains Gum Acacia (GA), poly(methacrylic acid) (MAA), and poly(acrylic acid) (AA) used as antibacterial agents¹⁴.

Physicochemical properties:

Gum Acacia is the white or slightly yellowish, odorless natural hydrocolloids (highly soluble in water while insoluble in oils and organic solvents)¹⁵ exhibit low to moderate viscosity. This reduced viscosity of gum acacia enables it as an exceptional emulsifier and stabiliser. The boiling point is greater than 250°C, GA breaks down before it reaches its melting point.

Molecular weight:

Gum Acacia has wide molecular weight distribution because of heteropolymolecular nature¹⁶ varies between 250000 and 1000000 g/mol. Various molecular weight fractions influence emulsion droplet size and stability, with elevated molecular weights typically resulting in long-term stability¹⁷.

Industrial Uses of Acacia gum

Unique Physicochemical properties of GA make it useful in a wide range of industries.

1. Food industry:

European Union (EU) and Codex, approved the uses of GA in food products¹⁸. It act as Stabilizer and emulsifier and thickening agent in beverages, icing, confectionery, and other food products. Gum Acacia can be effortlessly integrated into foods without altering the original flavor or

texture, and used as an optimal functional dietary fiber component in food¹⁹.

2. Pharmaceuticals industry:

Gum Acacia is a versatile excipient that is frequently utilized as Demulcent, emulsifier, thickener, and tablet binder in the pharmaceutical business. It improves the stability, texture, and general efficacy of a variety of formulations, such as tablets, lozenges, and oral solutions²⁰. Gum Acacia is emerging as potent excipient for drug delivery system, as compare to synthetic excipient GA have the advantages of being readily available, less costly, and non-toxic²¹.

3.Cosmetics Industry:

Most people agree that using acacia gum in cosmetics and personal hygiene products is safe. Vegetarians and vegans can also use it. Because of versatility, acacia gum is a useful component in the cosmetics industries. It helps to improve the texture (mascaras and foundation), thickening and viscosity (lotion, creams and serums), of a variety of products and contributes to smoother products that form a thin film to moisturize the skin. Besides cosmetics, GA is used in hair care, oral care and shaving products¹⁰.

4.Medicinal Uses of Acacia gum

Gum Acacia was used widely in traditional medicine and folklore in the past now, various countries have recognized its importance in the traditional herbal treatment system. The food drug administration (FDA) and European Union (EU) both has accepted the GA as safe additive material^{21,22}. Gum Acacia has a variety of medicinal uses which are as follows

Wound healing:

In accordance to different research *Gum Acacia* has potential medicinal properties which contribute to

treat wound²³. It's antibacterial and anti-inflammatory and antioxidant activities are facilitating tissue regeneration and wound healing. It is also suggested that GA cause wound contraction²³ and stimulates angiogenesis and epithelialization leading to healing²⁴⁻²⁵.

Anti-Cancer property:

Gum Acacia is a potential source of anticancer compounds. it may help to reduce cancer risk, support treatment, and protect healthy cells through its antioxidant, anti-inflammatory, and immune-boosting properties⁴. In vivo research model showed that GA and curcumin microsphere significantly suppressed the cancer progress²⁶.

Diabetes Management:

Gum Acacia has low glycemic index it prevent glucose absorption and enhances the insulin secretion²⁷. In type 2 diabetes patients GA proved to be a good dietary supplement²⁸ by reducing lipid profile and obesity.

Rheumatoid arthritis:

Gum Acacia is a used as adjuvant therapy for Rheumatoid arthritis (RA). In clinical trials GA reduced the level of inflammatory markers (TNF-alpha) and ESR thus relieving the swollen and tender joints²⁹. Nutritional supplement of *Gum Acacia* a improved hepatic and renal profile in patient suffering from RA³⁰.

Sickle cell anemia:

In Sickle cell anemia patients, treatment with GA increased Total anti-oxidant capacity (TAC) and decreased the oxidative markers (MDA and H₂O₂) showed potent anti-inflammatory, anti-oxidant properties^{31, 32}. *Gum Acacia* a has shown protective effects against sickle cell crises³¹.

Infertility:

Gum Acacia has a potential impact on sperm quality, testosterone level and sperm motility in Men³³ also in

female alters expression of oxidative stress gene³⁴ and regulates hormonal balance. It reduced the prevalence of PCOs in female thus, regulating the menstrual health³⁴.

Gingivitis and Periodontitis:

Gum Acacia is used as a natural adjunctive treatment for gingivitis and periodontitis (11th most prevalent disease in world)³⁵. The results indicated that GA tends to reduce Gingival Index (GI) and Gingival Crevicular Fluid Interleukin 1 Beta (GCF IL-1 β) in patients due to its anti-inflammatory, anti-microbial and antioxidant properties^{8,35}.

Kidney diseases:

Anti-inflammatory and antioxidant properties of *Gum Acacia* helps to improve chronic kidney condition (CKD)³⁶. Some of the clinical research findings suggested that GA boost biochemical markers of kidney function thus encouraging its use into the treatment of CKD^{37, 38}.

Neuro-pharmacological effects:

Gum Acacia exhibits antiepileptic effects and anxiolytic effect. It reduced the level of oxidative stress markers and regulates the seizure behaviour³⁹. Many studies showed neuro-protective^{40, 41} and cognitive enhancing potential of GA⁴¹.

Gastrointestinal effects:

Gum Acacia acts helps to reduce the BMI and fat⁴². The emerging role of GA has gained popularity as potential prebiotics⁴³, enhancing the effect of probiotics thus acting as symbiotic in the digestive system⁴³, especially in elderly people, in addition to having positive effects on cardiovascular problems and hypo-cholesterolemic effect⁴⁴. *Gum Acacia* possesses gastro-protective, antifibrotic, and anti-ulcerogenic effects⁴⁵.

Gum Acacia Safety evaluation and toxicological studies:

Since ancient times, it has played a significant role in trade⁴⁶ and the US Food and Drug Administration approved GA as safe⁴⁶. Different safety studies (mutagenic⁴⁶, teratogenic⁴⁷, subchronic toxicity⁴⁸, chronic toxicity, carcinogenicity) confirmed the safety of GA. Acacia is Safe when taken orally in amounts Up to 30 grams daily for 18 days. However, it can cause minor undesirable effects, including gas, bloating, nausea, and loose stools. The side effects of gum acacia in pregnancy and breast feeding is an understudied area that warrants more focused scientific investigation. So it is advised to avoid it in such conditions.

CONCLUSION

This review is focused to compile both early and recent studies regarding the GA, a remarkable natural emulsifier also validating its versatile role in the food, pharmaceutical and cosmetics industry. Gum Acacia is a valuable asset in medicinal and clinical application. Gum Acacia 's medicinal properties make it a promising ingredient for promoting overall health and being readily available, less costly, and non-toxic. A growing trend in GA research was seen in natural products and polymers, which raised the demand for GA globally. In future further extensive research is required to fully comprehend its mechanism of action and maximize the application of GA in different industries

Declaration of conflict of interest

The authors declare no conflict of interest, financial or otherwise. **Consent for publication**

All authors have read and approved the final version of the manuscript.

REFERENCES

1. Balick, M. J. (2020). *Plants, people, and culture: The science of ethnobotany* (2nd ed.). CRC Press
2. Taylor & Franics Group. <https://doi.org/10.4324/9781003049074>
3. Petrovska, B. (2012). Historical review of medicinal plants' usage. *Pharmacognosy Reviews*, 6(11), 1. <https://doi.org/10.4103/0973-7847.95849>
4. Yakmaz, F., Bozkurt, A. S., & Görücü Yılmaz, Ş. (2024). PTZ-kindled rat model; evaluation of seizure, hippocampal EGR-1, and Rev-erba gene regulation, behavioral analysis, and antioxidant capacity of Gum Acacia . *Molecular Biology Reports*, 51(1), 279.
5. Elnour, A. A. M., Nour, A. H., Bin Mokaizh, A. A., & Mirghani, M. E. S. (2025). Biological applications of acacia gums (AGs) SME on breast cancer cell lines. In *Gum Acacia and Breast Cancer Biology* (pp. 283–306).
6. Serafi, A. S., Ahmed, M., Shahid, I., Azmat, A., Bader, A., Bafail, M. A., Alaamri, S., & Ahmad, R. (2024). Antihyperglycemic, antiglycation, anti-hypercholesteremic, and toxicity evaluation with gas chromatography mass spectrometry profiling for *Aloe arnatissima* leaves.
7. Bakhoun, N., Fall, D., Fall, F., Diouf, F., Hirsch, A. M., Balachandar, D., & Diouf, D. (2018). Senegalia senegal (synonym: Acacia senegal), its importance to sub-Saharan Africa, and its relationship with a wide range of symbiotic soil microorganisms. *Suid-Afrikaanse Tydskrif Vir Plantkunde [South African Journal of Botany]*, 119, 362–368. <https://doi.org/10.1016/j.sajb.2018.10.007>
8. Al-Jubori, Y., Ahmed, N. T. B., Albusaidi, R., Madden, J., Das, S., & Sirasanagandla, S. R. (2023). The efficacy of Gum Acacia in managing diseases: A systematic review of evidence-based clinical trials. *Biomolecules*, 13(1), 138. <https://doi.org/10.3390/biom13010138>
9. Pervez, Amjad; Ahmad, Syed Muzaffar; Lathiya, Shaher Bano; Khadijah, Erum (2009). "Food Habits of the Indian Crested Porcupine, *Hystrix indica* in Sindh, Pakistan". *Pakistan Journal of Zoology*. 41
10. Heuzé V., Thiollé H., Tran G., Hassoun P., Bastianelli D., Lebas F., 2016. *Gum Acacia tree (Acacia Senegal)* Feedipedia, a programme by

- INRAE, CIRAD, AFZ and FAO, <https://feedipedia.org/node/342> Last updated on December 20, 2016, 15:14
10. Mudgil, D., & Mudgil, S. (2024). Acacia gum: Chemistry, properties & food applications. *Food and Humanity*, 2(100264), 100264. <https://doi.org/10.1016/j.foohum.2024.100264>
 11. Mohamed, S. A., Elsherbini, A. M., Alrefaey, H. R., Adelrahman, K., Moustafa, A., Egodawaththa, N. M., Crawford, K. E., Nesnas, N., & Sabra, S. A. (2025). Gum Acacia : A commodity with versatile formulations and applications. *Nanomaterials (Basel, Switzerland)*, 15(4), 290. <https://doi.org/10.3390/nano15040290>
 12. Mariod, A. A. (2018). Chemical properties of Gum Acacia . In *Gum Acacia* (pp. 67–73). Elsevier.
 13. Zahid, M. U., Jatoi, N. R., Gul, S. N., Malik, S., Kayani, W. K., & Rasheed, F. (2025). Molecular perspectives on Acacia Gum as a functional polysaccharide for biomedical and industrial applications: A review. *International Journal of Biological Macromolecules*, 145412, 145412. <https://doi.org/10.1016/j.ijbiomac.2025.145412>
 14. Virk, K., Sharma, K., Kapil, S. *et al.* Synthesis of gum acacia-silver nanoparticles based hydrogel composites and their comparative anti-bacterial activity. *J Polym Res* 29, 118 (2022). <https://doi.org/10.1007/s10965-022-02978-8>Elmour, A. A. M., Abdurahman, N. H., Musa, K. H., & Rasheed, Z. (2023). Prebiotic potential of Gum Acacia for gut health. *International Journal of Health Sciences*, 17(6), 4–5.
 15. Inegbedion, F., Okojie, V. U., & Egharevba, F. (2021). Physicochemical properties of Gum Acacia . *Organic Polymer Material Research*, 2(2), 13–15. <https://doi.org/10.30564/opmr.v2i2.2592>
 16. Martin A. Masuelli. Hydrodynamic Properties of Whole Arabic Gum. *American Journal of Food Science and Technology*. 2013; 1(3):60-66. doi: 10.12691/ajfst-1-3-9
 17. Dickinson, E., Galazka, V. B., & Anderson, D. M. W. (1991). Emulsifying behaviour of Gum Acacia . Part 2: Effect of the gum molecular weight on the emulsion droplet-size distribution. *Carbohydrate Polymers*, 14(4), 385–392. [https://doi.org/10.1016/0144-8617\(91\)90004-](https://doi.org/10.1016/0144-8617(91)90004-)
 18. EU rules. (n.d.). Food Safety. Retrieved July 20, 2025, from https://food.ec.europa.eu/food-safety/food-improvement-agents/additives/eu-rules_en
 19. Kadirvel, V., & Narayana, G. P. (2023). Edible gums—An extensive review on its diverse applications in various food sectors. *Food Bioengineering*, 2(4), 384–405. <https://doi.org/10.1002/fbe2.12067>
 20. Ashour, M. A., Fatima, W., Imran, M., Ghoneim, M. M., Alshehri, S., & Shakeel, F. (2022). A review on the main phytoconstituents, traditional uses, inventions, and patent literature of Gum Acacia emphasizing acacia seyal. *Molecules (Basel, Switzerland)*, 27(4), 1171.
 21. Amiri, M. S., Mohammadzadeh, V., Yazdi, M. E. T., Barani, M., Rahdar, A., & Kyzas, G. Z. (2021). Plant-based gums and mucilages applications in pharmacology and nanomedicine: A review. *Molecules (Basel, Switzerland)*, 26(6), 1770. <https://doi.org/10.3390/molecules26061770>
 22. Obaid, B. P. S. (n.d.). *The medical uses of gum acacia-Gum Acacia (GA) in human*. *Ajrsp.com*. 1 (10)1-11. 2020.
 23. Elebiary, D. M., Mahdy, H. M., Mansour, A. M., Amer, W. H., & Abu-Elghait, M. (2024). Evaluation of Arabic gum antibacterial and wound healing activities against Staphylococcus aureus isolates obtained from skin infections. *Microbial Biosystems*, 9(1), 129–138. <https://doi.org/10.21608/mb.2024.304207.1125>
 24. Sharma A, Puri V, Kumar P, Singh I. (2020). Biopolymeric, nanopatterned, fibrous carriers for wound healing applications. *Current Pharmaceutical Design* 26 (38):4894-4908
 25. Andreu V, Mendoza G, Arruebo M, Irusta S. (2015). Smart dressings based on nanostructured fibers containing natural origin antimicrobial, antiinflammatory, and regenerative compounds. *Materials* 8 (8):5154-5193

26. Venkatesan, J., Hur, W., Gupta, P. K., Son, S. E., Lee, H. B., Lee, S. J., Ha, C. H., Cheon, S. H., Kim, D. H., & Seong, G. H. (2023). Gum Acacia - mediated liquid exfoliation of transition metal dichalcogenides as photothermic anti-breast cancer candidates. *International Journal of Biological Macromolecules*, 244(124982), 124982. <https://doi.org/10.1016/j.ijbiomac.2023.124982>
27. Ibrahim, R.M., Abdelhafez, H.M., EL-Shamy, S.A.E.M. *et al.* Arabic gum ameliorates systemic modulation in Alloxan monohydrate-induced diabetic rats. *Sci Rep* 13, 5005 (2023). <https://doi.org/10.1038/s41598-023-31897-x>
28. Farooqi, S.S., Naveed, S., Qamar, F., Sana, A., Farooqi, S.H., Sabir, N., Mansoor, A. and Sadia, H., 2024. Phytochemical analysis, GC-MS characterization and antioxidant activity of *Hordeum vulgare* seed extracts. *Heliyon*, 10(6).
29. E., Kaddam, L. A., Dahawi, M., Osman, M., Salih, M. A., Alagib, A., & Saeed, A. (2018). Gum Acacia fibers decreased inflammatory markers and disease severity score among rheumatoid arthritis patients, phase II trial. *International Journal of Rheumatology*, 2018, 4197537. <https://doi.org/10.1155/2018/4197537>
30. Kamal, E., Kaddam, L. A., Alagib, A., & Saeed, A. (2021). Dietary fibers (Gum Acacia) supplementation modulates hepatic and renal profile among rheumatoid arthritis patients, phase II trial. *Frontiers in Nutrition*, 8, 552049. <https://doi.org/10.3389/fnut.2021.552049>
31. Al-Jubori, Y., Ahmed, N. T. B., Albusaidi, R., Madden, J., Das, S., & Sirasanagandla, S. R. (2023). The efficacy of Gum Acacia in managing diseases: A systematic review of evidence-based clinical trials. *Biomolecules*, 13(1), 138.
32. Ali, H., Alvi, A., Nawab, A., Salman, S., Zafar, F. and Naveed, S., 2019. Novel drug delivery approaches in formulation development; stability considerations and quality features of herbal products. *RADS Journal of Pharmacy and Pharmaceutical Sciences*, 7(3), pp.155-164.
33. Nasir, O., Alqadri, N., Elsayed, S., Ahmed, O., Alotaibi, S. H., Baty, R., Omer, H., Abushal, S. A., & Umbach, A. T. (2020). Comparative efficacy of Gum Acacia (*Acacia senegal*) and *Tribulus terrestris* on male fertility. *Saudi Pharmaceutical Journal: SPJ: The Official Publication of the Saudi Pharmaceutical Society*, 28(12), 1791–1796
34. Kaleem, Atiya, Aisha Sana, Rafia Usman Khan, Safila Naveed, Fatima Qamar, Syeda Zainab, Javed Iqbal, and Brijesh Sathian. "Next-gen ferulic acid-stabilized gold nanoparticles: exploring their sensing capabilities and therapeutic efficacy." *Therapeutic Delivery* 16, no. 5 (2025): 447-457.
35. Gafar, A. M., Ramadan, A. M., ElSaid, N. A., & Nurelhuda, N. M. (2022). Effect of Gum Acacia on plaque-induced gingivitis: A randomised controlled trial. *The Saudi Dental Journal*, 34(6), 494–502.
36. Alobaidi, S. (2024). Therapeutic potential of Gum Acacia (*Acacia senegal*) in chronic kidney disease management: A narrative review. *Journal of Clinical Medicine*, 13(19), 5778. <https://doi.org/10.3390/jcm13195778>
37. Khalid S.A., Musa A., Saeed A., Ali N.E.A., Abugroun E.A., Mohamed G., Elnima E.I., Alkarib S.Y., Agib E.G., Phillips G.O., et al. Gum Acacia in renal disease (GARDS Study): Clinical evidence of dietary supplementation impact on progression of renal dysfunction. *J. Funct. Foods*. 2021;82:104515.
38. Ali N.E., Kaddam L.A., Alkarib S.Y., Kaballo B.G., Khalid S.A., Higawee A., AbdElhabib A., AlaaAldeen A., Phillips A.O., Saeed A.M. Gum Acacia (*Acacia senegal*) Augmented Total Antioxidant Capacity and Reduced C-Reactive Protein among Haemodialysis Patients in Phase II Trial. *Int. J. Nephrol*. 2020;2020:7214673.
39. Sadia Shakeel, Zafar Ali, Somia Gul, and Safila Naveed "Determination of the heavy metal content of Entoban herbal medicinal product." (2015): 764-769

40. .Almohaimed, H.M., Waly, H., Abou Khalil, N.S. *et al.* Gum Acacia nanoformulation rescues neuronal lesions in bromobenzene-challenged rats by its antioxidant, anti-apoptotic and cytoprotective potentials. *Sci Rep* **12**, 21213 (2022). <https://doi.org/10.1038/s41598-022-24556-0>
41. Mughal S, Sana A, Azam M, Qamar F, Naveed S, Owais A, Sadia H, Faizi S. An In-vitro evaluation of Skin Protection Factor of non-polar date seed extract from three different date varieties Ajwa, Aseel and Khapra by UV spectrophotometry. *IJNMS. International Journal of Natural Medicine and Health Sciences* 2023; 2 (2): 45-48
42. Safila Naveed., Khan, A., Khan, M.U., Aman, T., Adil, A., Qamar, F., Sadia, H., Khan, M. and Muzafar, W., 2023. ANXIOLYTIC AND ANTIDEPRESSANT ACTIVITY OF CARICA PAPAYA SEEDS AND LEAVES EXTRACTS IN MICE. *Journal of Population Therapeutics and Clinical Pharmacology*, 30(18), pp.433-447..
43. Laue, C., Papazova, E., Pannenbeckers, A., & Schrezenmeir, J. (2023). Effect of a probiotic and a synbiotic on body fat mass, body weight and traits of metabolic syndrome in individuals with abdominal overweight: A human, double-blind, randomised, controlled clinical study. *Nutrients*, 15(13). <https://doi.org/10.3390/nu15133039>
44. Jarrar, A. H., Stojanovska, L., Apostolopoulos, V., Feehan, J., Bataineh, M. F., Ismail, L. C., & Al Dhaheri, A. S. (2021). The effect of Gum Acacia (acacia Senegal) on cardiovascular risk factors and gastrointestinal symptoms in adults at risk of metabolic syndrome: A randomized clinical trial. *Nutrients*, 13(1), 194. <https://doi.org/10.3390/nu13010194>
45. Daffaalla, I. M., Elhibir, R. A., Abdelgadir, A. A., & Ahmed, E. M. (n.d.). *Gum Acacia effects on irritable bowel syndrome and other gastrointestinal disorders*. *Arabian Journal of Chemical and Environmental Research* 9(01)126-149. 2022.
46. Doi, Y., Ichihara, T., Hagiwara, A., Imai, N., Tamano, S., Orikoshi, H., Ogasawara, K., Sasaki, Y., Nakamura, M., & Shirai, T. (2006). A ninety-day oral toxicity study of a new type of processed Gum Acacia , from Acacia tree (Acacia senegal) exudates, in F344 rats. *Food and Chemical Toxicology: An International Journal Published for the British Industrial Biological Research Association*, 44(4), 560–566. <https://doi.org/10.1016/j.fct.2005.09.002>
47. Collins, T. F., Welsh, J. J., Black, T. N., Graham, S. L., & Brown, L. H. (1987). Study of the teratogenic potential of Gum Acacia . *Food and Chemical Toxicology: An International Journal Published for the British Industrial Biological Research Association*, 25(11), 815–821. [https://doi.org/10.1016/0278-6915\(87\)90259-6](https://doi.org/10.1016/0278-6915(87)90259-6)
48. Anderson, D. M., Ashby, P., Busuttil, A., Eastwood, M. A., Hobson, B. M., Ross, A. H., & Street, C. A. (1982). Subchronic effects of Gum Acacia (Acacia) in the rat. *Toxicology Letters*, 14(3–4), 221–227. [https://doi.org/10.1016/0378-4274\(82\)90055-8](https://doi.org/10.1016/0378-4274(82)90055-8)

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