International Journal of Research in All Subject
www.multiarticlejournal.com
ISSN: 3107-5878
Received: 16-01-2026, Accepted: 17-02-2026, Published: 05-03-2026
Volume 2, Issue 1, 2026, Page No. 128-130

Chemical composition of amylase determined by IR spectroscopy

Ioana Stanciu*
Department of Physical Chemistry, Faculty of Chemistry, University of Bucharest, Elisabeta Blvd, Bucharest, Romania

Abstract

In this article, we determined the chemical composition of amylase by IR spectroscopy using a PerkinElmer SpectrumOne spectrometer. The wavelength range in which absorption bands appear is between $4500 cm^{-1}$ and $400 cm^{-1}$. Amylase contains the following functional groups: Ag-O, N-H, O-H, C-O. Infrared (IR) spectroscopy was utilized to investigate the chemical composition and structural characteristics of the enzyme amylase. The IR spectrum exhibited distinct absorption bands corresponding to the functional groups typical of protein molecules. Prominent peaks were observed around $3300 cm^{-1}$ (N–H and O–H stretching), $1650 cm^{-1}$ (amide I, C=O stretching of peptide bonds), and $1540 cm^{-1}$ (amide II, N–H bending and C–N stretching). These characteristic protein bands confirm the presence of peptide linkages as the major structural feature of amylase. Minor peaks associated with side-chain functional groups further supported the complex tertiary structure of the enzyme. Overall, the analysis demonstrates that IR spectroscopy is an effective and non-destructive analytical technique for identifying the molecular composition and confirming the proteinaceous nature of amylase.

Keywords: Chemical composition, amylase, IR spectroscopy

Introduction

Amylose is a polysaccharide made of α-D-glucose units, bonded to each other through α(1→4) glycosidic bonds. It is one of the two components of starch, making up approximately 20–30%. Because of its tightly packed helical structure, amylose is more resistant to digestion than other starch molecules and is therefore an important form of resistant starch.

Amylose is made up of α(1→4) bound glucose molecules. The carbon atoms on glucose are numbered, starting at the aldehyde (C=O) carbon, so, in amylose, the 1-carbon on one glucose molecule is linked to the 4-carbon on the next glucose molecule (α(1→4) bonds). The structural formula of amylose is pictured at right. The number of repeated glucose subunits (n) is usually in the range of 300 to 3000, but can be many thousands [1-5].

There are three main forms of amylose chains can take. It can exist in a disordered amorphous conformation or two different helical forms. It can bind with itself in a double helix (A or B form), or it can bind with another hydrophobic guest molecule such as iodine, a fatty acid, or an aromatic compound. This is known as the V form and is how amylopectin binds to amylose in the structure of starch. Within this group, there are many different variations. Each is notated with V and then a subscript indicating the number of glucose units per turn. The most common is the V6 form, which has six glucose units a turn, [4] V8 and possibly V7 forms exist as well. These provide an even larger space for the guest molecule to bind.

This linear structure can have some rotation around the phi and psi angles, but for the most part bound glucose ring oxygens lie on one side of the structure. The α(1→4) structure promotes the formation of a helix structure, making it possible for hydrogen bonds to form between the oxygen atoms bound at the 2-carbon of one glucose molecule and the 3-carbon of the next glucose molecule.

Fiber X-ray diffraction analysis coupled with computer-based structure refinement has found A-, B-, and C- polymorphs of amylose. Each form corresponds to either the A-, the B-, or the C- starch forms. A- and B- structures have different helical crystal structures and water contents, whereas the C- structure is a mixture of A- and B- unit cells, resulting in an intermediate packing density between the two forms [6-12].

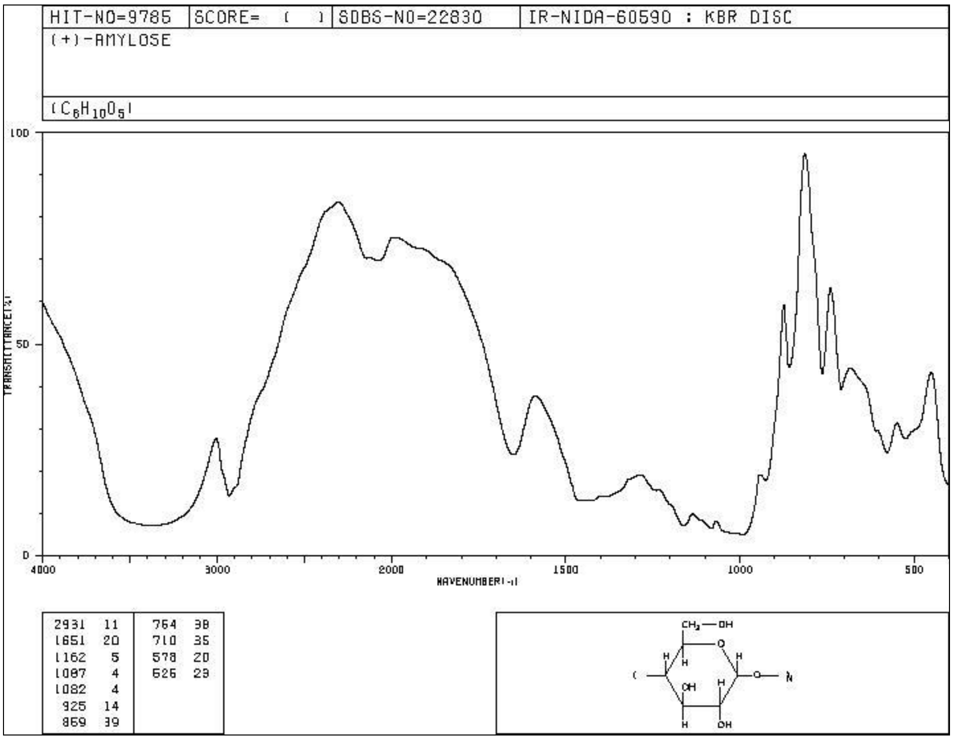
Materials and Methods

FT-IR spectra were recorded on PerkinElmer SpectrumOne spectrometer, operated at a resolution of $1.0 cm^{-1}$ with KBr and mylar beam splitter. Pure amylase the spectra were read between 4500 and $400 cm^{-1}$ with a resolution of $1 cm^{-1}$. The spectra of the samples were recorded thrice and averaged to ensure reproducibility. All the spectral measurements were performed at 25±3 ^{0}C.

FTIR spectra revealed the characteristic peak shifts in the test sample of interacted amylase with AgNPs. The binding of amylase with AgNPs was confirmed by FTIR analysis. The interacted sample exhibited peaks at 500, 517 and 528 cm−1 which is possibly assigned to the Ag-O bonds (Fig. 2). Amide I region is based on the stretching vibrations of C- O and N-H of the amide group. The bands obtained at $3500 cm^{-1}$ and between 1600 and $1700 cm^{-1}$ indicated the presence of amide groups upon adsorption onto AgNPs. The shift in the peak position on interaction with AgNPs represents the change in protein structure from its native form. An intense peak at $1645 cm^{-1}$ assigned to the bending vibrations of the N-H group resulted in a shift with the peak to $1738 cm^{-1}$. There were other characteristic bands at 1168 and $1033 cm^{-1}$ which could be of the stretches and bends of aliphatic amines. An intense absorption peak at $1216 cm^{-1}$ (Fig. 2) was due to interaction of the NH group of amylase with the Ag-O group of NPs. [8-16] The strong and broad peak at $3400 cm^{-1}$ (Fig. 2) can be attributed to the O-H vibration on the sample surface, [17] The band at 1435 cm−1 is due to the N-H stretching vibrations present in the amide linkages of the proteins, [18]

Fig 1: PerkinElmer SpectrumOne spectrometer

Results and discussions



2931	11	764	38
1651	20	710	35
1162	5	578	20
1087	4	526	23
1082	4		
925	14		
869	39		

Fig 2: Spectrul IR al amilazei

Conclusions

The structural formula of amylose is pictured at right. The number of repeated glucose subunits (n) is usually in the range of 300 to 3000, but can be many thousands. Amilazei cuprinde urmatoarele grupe functionale: Ag-O, N-H, O-H, C-O intre urmatoarele lungimi de unda 4500 cm^{-1}si 400cm^{-1}. The IR spectroscopic analysis confirmed that amylase is a protein-based compound composed primarily of peptide bonds and characteristic amino acid functional groups. The presence of amide I and amide II absorption bands verified the polypeptide backbone structure typical of enzymes. Additional peaks indicated the presence of hydroxyl and carboxyl groups from amino acid side chains, reflecting the complex tertiary structure of the molecule. These findings demonstrate that IR spectroscopy is a reliable and non-destructive method for identifying the chemical composition and verifying the protein nature of amylase.

Reference

1. Subagio A, Morita N. Food Chemistry,2003:81:97–102.
2. Dupont J, White PJ, Carpenter MP, Schaefer EJ, Meydani SN, Elson CE, *et al*. Journal of the American College of Nutrition,1990:9(5):438-470.
3. Veljković VB, Biberdžić MO, Banković-Ilić IB, Djalović IG, Tasi MB, Nježić ZB, *et al*. Renewable and Sustainable Energy Reviews,2018:91:531-548.
4. Beadle JB, Just DE, Morgan RE, Reiners RA. Journal of the American Oil Chemists' Society,1965:42(2):90-95.
5. Strocchi A. Journal of Food Science,1982:47(1):36-39.
6. Stanciu I. Rheological behaviour of biodegradable lubricant, Journal of Science and Arts,2019:3(48):703-708.
7. Stanciu I. Rheological investigation of soybean oil from soya beans, Journal of Science and Arts,2019:4(49):938-988.
8. Zolghadri S, Saboury AA, Amin E, MoosaviMovahedi AA. J. Iran. Chem. Soc,2010:7:S145.
9. Meneghetti SMP, Meneghetti MR, Wolf CR, Silva EC, Lima GE, Coimbra MDA, *et al*. Journal of the American oil chemists' society,2006:83(9):819-822.
10. Stanciu I. Journal of Science and Arts,2018:18(2):453-458.
11. Sheibani A, Ghotbaddini-Bahraman NASER, Sadeghi FATEMEH. Oriental Journal of Chemistry,2014:30(3):1205-1209.
12. Stanciu I. Some methods for determining the viscosity index of hydraulic oil, Indian Journal of Science & Technology,2023:16(4):254-258.
13. Stanciu I. Rheological behavior of corn oil at different viscosity and shear rate, Oriental Journal of Chemistry,2023:39(2):335-339.
14. Stanciu I. Rheological characteristics of corn oil used in biodegradable lubricant, Oriental Journal of Chemistry,2023:39(3):592-595.
15. Stanciu I. Effect of temperature on rheology of corn (*Zea mays*) oil, Oriental Journal of Chemistry,2023:39(4):1068-1070.
16. Stanciu I. Study Rheological Behavior of Rapeseed oils Compared to Mineral oil,2021:37(1):247-249. Oriental Journal of Chemistry.
17. Lucas HL, Ersoy AB, Kueltzo AL, Joshi BS, Brandau TB, Thyagarajapuram N, *et al*. Protein Science,2006: 15:2228.
18. Koneswaran M, Narayanaswamy R. Sensor. Actuat. B Chem,2009:139:104.