BUCK Scientific

Application Note #IR3001

The Rapid Determination of PROXIMATE Nutrients in Foodstuffs by Fast-Scanning Mid-IR

Problem

Measurement of basic nutritional components can be a time-consuming procedure with significant variances based on the skill of the analyst. The Standard Methods of Analysis of the AOAC define these tests and requirements in order to generate accurate and precise data.

To analyze *fat*, samples are typically acid-hydrolyzed and then Soxhlet extracted with volatile solvents. However, similar data can be obtained by scanning the sample and measuring the *Triglyceride Ester Carbonyl* band around 1750cm^{-1} in the mid-IR range, since all natural fats and oils are esters of glycerol.

Protein determinations require the sample to be decomposed by a prolonged sulfuric acid oxidation in order to convert organic nitrogen into inorganic ammonium ion. This test has several hazardous steps that require much experience to follow safely, but by taking an IR scan of the sample and integrating the *amino-acid and protein polyamide bands* at ~1550 cm^{-1}, an accurate protein content can be determined.

The determination of *moisture* is time consuming since most foodstuffs do not dry evenly in forced-air or gravity-convection ovens and therefore give imprecise analyses. But a sample scanned on a reflectance accessory will show the water hydroxyl at the 1640cm^{-1} band and at the ~3400cm^{-1} band.

Carbohydrates (starches & sugars) are calculated by difference after the other components listed above (plus ash) are determined. Using the same IR scan of the sample used for the tests described above, an assay for both the total carbohydrate content and sugar composition can be made using the characteristic "sugar backbone" around the 1100cm^{-1} region.

Principle

Using a flat, horizontal reflectance accessory made with a zinc selenide crystal (an ATR) placed inside an Infra-red spectrometer and connected to a computer, the Mid-IR spectrum of *any* sample can be quickly obtained and evaluated for both qualitative and quantitative information. The nature of the IR spectrum gives very specific absorption bands for specific functionalities (fat, protein, etc….) that are both unique and linear.

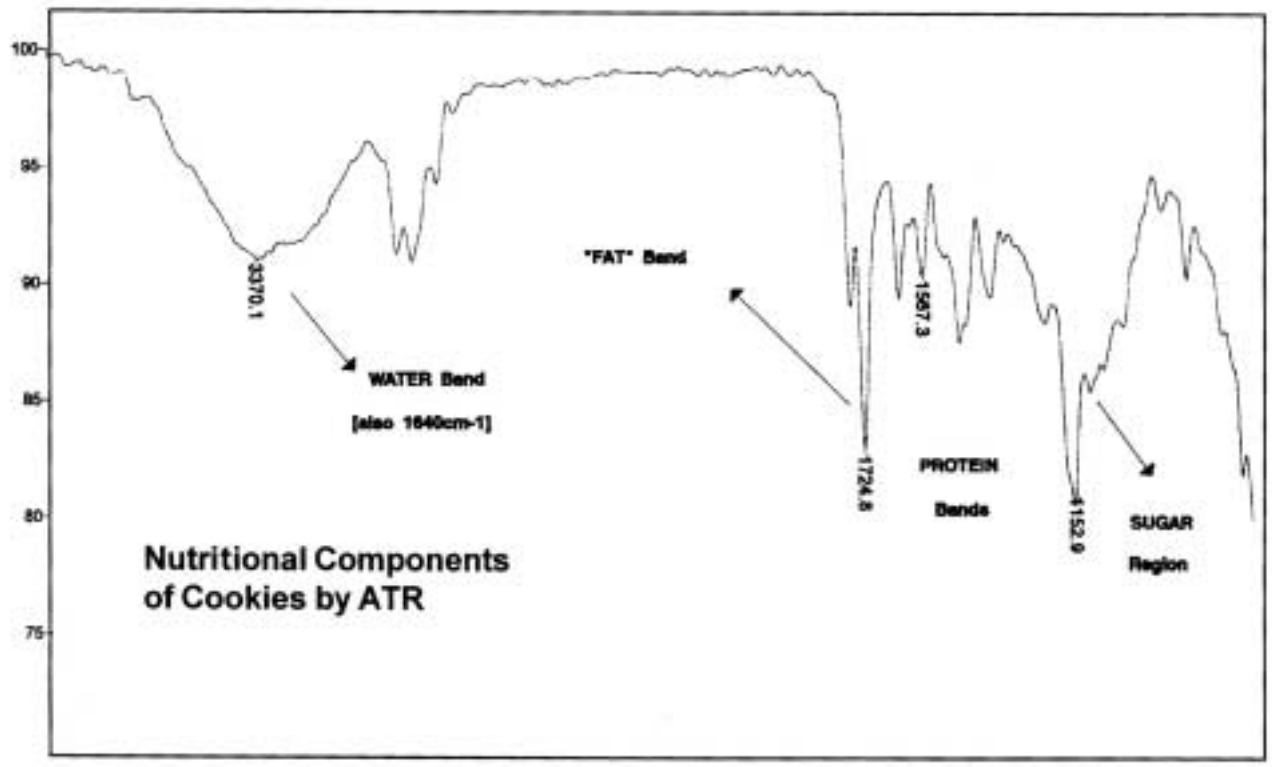
Practice

The Buck Scientific PLC-11M Prism Cell is placed in the M500 Scanning IR. The sample is homogenized in a processor and spread upon the inert ZnSe crystal of the prism cell. A spectral scan is started from the GRAMS software and converted into an absorbance spectrum when completed (about 3 minutes). The primary peaks for fat, protein, moisture, and carbohydrates are compared to standard spectra stored in the PC and quantitative values can be determined in under 5 minutes!

Analyst: Gerald J. DeMenna

SIC: 01, 02, 20

Instrumental PROXIMATE Analysis



Primary absorption bands for major nutritional components present in a commercially prepared sandwich cookie product. Sample was pressed against zinc selenide crystal of the prism cell using a pressure plate adapter. A standard scan time of 3 minutes was used to collect the data.

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1-800-562-5566

58 Fort Point Street East Norwalk CT 06855
Tel: 203-853-9444 Fax: 203-853-0569
www.bucksci.com sales@bucksci.com