

# Estimation of Milk Powder Protein content using PLSR Method - A Review

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**Abstract:** Milk Powder is known for Popular Nutrition food and due to the importance of dairy products in the markets it has particular interest. Milk powder is made from corn with vitamins, microelements and minerals and various type of milk, for making the milk powder, milk is used as a major material with mixture of various type of substances. The determination of the main constituents that compose the milk is important in the dairy food industry, for establishing the milk value, for consumer's information and for quality control. In this work we focus on proteins in milk powder by the use of Near Infrared Spectroscopy. The Visible-Near-Infrared (Vis-NIR, 350–2500 nm) reflectance spectroscopic method has been proven as a speedy, efficient and non-destructive method for estimating protein contents. Partial Least Square Regression (PLSR) is a mainstream method for quantitatively deriving information from reflectance spectra.

**Keyword-**Spectral Data, Vis-NIR, Milk Powder Protein content(MPPC), Partial Least Square regression(PLSR).

## I. Introduction

The determination of the main constituents that compose the milk is important in the dairy food industry for establishing the milk value, for consumer's information and for quality control. Content of proteins is an important factor that determine the quality of milk powder. Protein content of milk powder could be determined based on NIR region. The aim of this study is to explore the potential of the short-wave NIR region for quantitative analysis of proteins in milk powder. The study is to explore the potential of the short-wave NIR region for quantities analysis of proteins in milk powder [1]. To obtain insight into the chemical base for quantitative analysis the regression coefficient and loading weight for short-wave NIR spectra of milk powder have been investigated in detail in the present study, milk as the major material is a mixture component in milk powder [2].

Reflectance spectroscopy provides a good alternative that may be used to replace conventional methods of milk powder analysis Visible and near-infrared (Vis-NIR;350-2500 nm) reflectance spectroscopy, a rapid and non-destructive analytical technique requiring little sample pre-treatment, has been successfully used to determine Milk powder properties [3]. Spectroscopic technique widely used for various types of applications, the applications like, Soil analysis, Pharmaceutical analysis purpose, Vegetation analysis etc.. Spectroscopic technique can be used for analysing pharmaceuticals solid dosage forms material in non destructive way, we can analyse the medicinal solid dosage forms like, tablets, powder etc [4]. Recently the Spectroscopic technique can be use for biometric purpose like, Palm print authentication etc [5]. Spectroscopic technique widely use for fruit analysis, soil analysis and vegetations. In soil analysis by using spectroscopic technique we can analyze the soil content [6], and in fruit analysis we can analyze the quality of various types of fruits and trace its contents [7].In vegetation analysis using spectroscopic technique we can find the different types of diseases and prediction of plant growth as well as also find the contents from the different types of leaf using the vegetation indices, the contents are like chlorophyll, carotenoids etc.[8][9][10].

## II. Related Work

Di Wu, Haiqing Yang, Shuijuan Feng, Xiaojing Chen, Yong He et al, have researched on NIR Spectroscopy and concluded that SNV was a useful Pre-treatment for raw milk powder spectra, short-wave NIR as a rapid and low-cost technique to determine carbohydrates content of milk powder both LS-SVM model and partial least squares (PLS) model were established based on whole short-wave NIIR region [11].

Di Wu , Shuijuan Feng, Xiaojing Chen, Haiqing Yang, Yong He et al, used short-wave NIR as a rapid and non-destructive technique to determine fat content of milk powder, applied to LS-SVM model and partial least squares PLS model. They used fieldspec Analytical Spectral Devices, Boulder in USA for their research work [12].

Di Wu , Shuijuan Feng, Xiaojing Chen, Haiqing Yang, Yong He et al, research have done on (VIS/SWNIR) technique used for brand discrimination of milk powder. Fifty samples for each brand were studied based on the independent

components (Ics). The identification results of these two models are worse than LS-SVM which was established based on Ics [13].

Di Wu, Yong He, Shuijuan Feng et al, studied that short-wave NIR Spectra in the 800-1050nm region using wavelength, based on the quantitative analysis method of partial least squares(PLS) and least squares support vector machine(LS-SVM)these assigned wavelengths were used for the determination of three main components fat, proteins and carbohydrate in milk powder[14].

R. Nagarajan, Parul Singh, Ranjana Mehrotra et al, demonstrated the determination moisture content in forty milk powder samples, different moisture content were analyzes using NIR diffuse reflectance mode and unknown moisture content were taken for NIR Predication using developed calibration model[15].

Di Wu, Yong He, Jiahui Shi & Shuijuan Feng demonstrated on NIR and MIR Spectroscopy techniques were evaluated to determine iron and zinc content in milk powdered [16].

Di Wu Pengcheng Nie, Yong He, Yidong Bao et al, researched on NIR and MIR Spectroscopy techniques were evaluated to determine calcium content in milk powder to compare the predication abilities of LS-SVM models by UVE-SPA and only selected by UVE and the full Spectral variables[17].

### III. ASD fieldSpec4 Spectroradiometer

The ASD FieldSpec4 spectroradiometer can be used for Estimating the protein content from different types of milk powder in non-destructive way. The device having the useful specification it having Spectral range 350-2500 nanometer. It is having three types of sensors NIR, SWIR1 and SWIR2. The device covers 2151 bands. To collect the data on off field in a proper environment the hallogen light source is used as an illumination purpose. For collecting the database of samples the fiber optic cable is used that having 25 field of view and it is connected to the device. Storing and Visualizing the database RS3 and View Spec Pro device supportive softwares are used. Following is the setting structure of the ASD spectroradiometer:

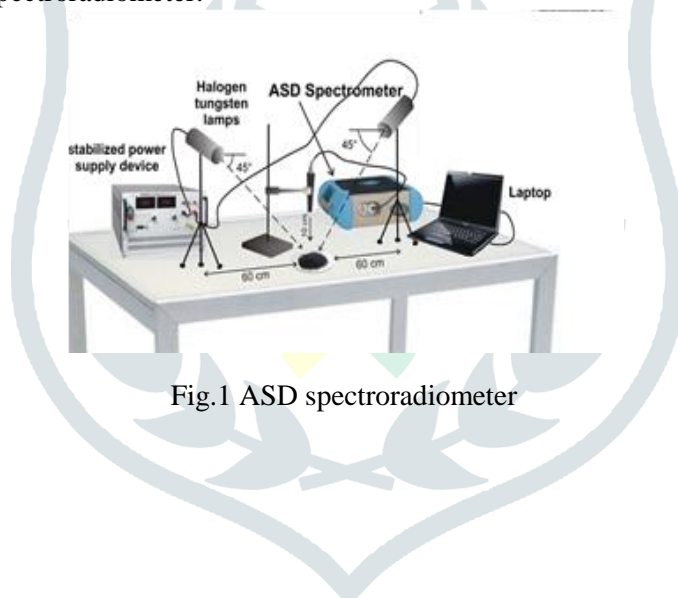


Fig.1 ASD spectroradiometer

### IV. Method

Partial least squares regression (PLSR) is a multivariate statistical technique that has been widely used in the field of chemometrics for its efficiency in cases where the number of independent variables is comparable to or greater than the number of samples. In PLSR, a large number of original predictor variables (wavelength variables in this case) are transformed into a small number of orthogonal factors (latent variables). These latent variables are used to build a linear model:

$$Y = Xb + E$$

In this equation,

$Y$  is the matrix containing the response variables,

$X$  is the matrix containing the predictor variables,

$b$  is the matrix containing the regression coefficients, and

$E$  is the matrix of residuals.

## V. Conclusion

Reflectance spectroscopy provides a good alternative method of milk powder analysis. An Estimation of protein content in milk powder is essential process because contents of proteins are an important factor that determines the quality of milk powder. Mostly the result of researches concluded that to determine the protein contents in the milk powder SWNIR i.e. Short-Wave Near-Infrared technique was applied.

In the research work we proposed a framework for identify protein by using ASD Fieldspec4 Spectroradiometer (350-2500nm) to estimate protein content in milk powder which is very efficient, rapid and non-wasting technique. This paper present a methodology that directly links free protein content with the diagnostic protein absorption band Visible-NIR spectroscopy is easy and faster technique to predict protein in milk powder.

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