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THE CHEMICAL COMPOSITION OF GRAPE FIBRE

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ABSTRACT

Dietary fibres from cereals are much more used than dietary fibres from fruits; however, dietary fibres from fruits have better quality. In recent years, for economic and environmental reasons, there has been a growing pressure to recover and exploit food wastes. Grape fibre is used to fortify baked goods, because the fibre can lower blood sugar, cut cholesterol and may even prevent colon cancer. Grape pomace is a functional ingredient in bakery goods to increase total phenolic content and dietary fibre in nourishment. The aim of this study was to determine the chemical composition of commercial fibres, obtained from different Grape sources concerning their chemical properties such as moisture, ash, fat, protein, total dietary fibre. The chemical composition of Grape fibre is known to vary depending on the Grape cultivar, growth climates, and processing conditions. The obliged characteristics of the fibre product are: total dietary fibre content above 50%, moisture lower than 9%, low content of lipids, a low energy value and neutral flavour and taste. Grape pomace represents a rich source of various high-value products such as ethanol, tartrates and malates, citric acid, Grape seed oil, hydrocolloids and dietary fibre. Used commercial Grape fibres have as a main characteristic, the high content of total dietary fibre. Amount of total dietary fibre depends on the variety of Grapes. Total dietary fibre content (TDF) in our samples of Grape fibre varied from 56.8% to 83.6%. There were also determined low contents of moisture (below 9%). In the samples of Grape fibre were determined higher amount of protein (8.6 – 10.8%), mineral (1.3 – 3.8%) and fat (2.8 – 8.6%). This fact opens the possibility of using both initial by-products as ingredients in the food industry, due to the effects associated with the high total dietary fibre content.

Keywords: Grape fibre; dietary fibre; chemical composition; total dietary fibre; Grape pomace

INTRODUCTION

Consumers prefer ready to eat foods and a diet that is low in calories, low in cholesterol, and low in fat or in other words "healthy foods". In accordance with this trend, consumers also want to eat foods with higher fibre content **(Ayadi, et al., 2009)**. Epidemiological studies suggest that fibre consumption helps to reduce obesity, some kinds of cancer, cardiovascular diseases, and gastrointestinal diseases **(Gómez et al., 2009)**.

Dietary fibre (DF) is a group of food components, which are resistant to hydrolysis by human digestive enzymes. Dietary fibre consists of polysaccharides, oligosaccharides and lignin **(Samappito and Trachoo, 2011)**.

Fibre is often classified as soluble dietary fibre (SDF) and insoluble dietary fibre (IDF). Because solubility refers simply to fibres that are dispersible in water, the term is somewhat inaccurate **(Figuerola et al., 2005)**. The physiological effects of total dietary fibre (TDF), in the forms of insoluble and soluble fractions of foods, have a significant role in human nutrition **(Ramulu and Udayasekhararao 2003)**. Among good sources of fibre cereal grains, legumes, fruits, vegetables, nuts and seeds are of importance **(Lopez et. al., 2011)**. Dietary fibres from cereals are more frequently used than those from fruits; however, fruit fibres have better quality **(Figuerola et al., 2005)**. In recent decades, for economic as well as environmental reasons, there has been a continuous and growing pressure to recover and exploit food wastes **(Garau et al., 2007)**.

However, a large number of recent studies have suggested that fruit and vegetable by-products obtained from the processing of apples, citrus fruits, mangoes, potatoes, carrots, asparagus, and brassica vegetables among others, could be used as potential sources of DF **(Centento et. al., 2010)**.

Dietary fibre holds all the characteristics required to be considered as an important ingredient in the formulation of functional foods, due to its beneficial health effects **(Dhingra et al., 2011)**. Dietary fibre can also impart some functional properties to foods, e.g., increase water holding capacity, oil holding capacity, emulsification and/or gel formation. That dietary fibre incorporated into food products (bakery products, dairy, jams, meats, soups) can modify textural properties, avoid synaeresis (the separation of liquid from a gel caused by contraction), stabilise high fat food and emulsions, and improve shelf-life. Fibre in foods can change their consistency, texture, rheological behavior and sensory characteristic of the end products, the emergence of novel sources of fibres, have been offering new opportunities in their use in food industry **(Elleuch et al., 2011; Guillon and Champ 2000)**. Nowadays, there is a growing interest in the exploitation of the residues generated by the wine industry. Grape (*Vitis sp.*, Vitaceae) is one of the world's largest fruit crops, with an approximate annual production of 58 million metric tons. The Grape belongs to the berry family as it is found attached to the stem. Grapes can be eaten raw or they can be used for making wine, jam, juice, jelly, Grape seed extract, raisins, vinegar, and Grape seed oil **(Zhu et. al., 2014)**.

The residues of Grape are composed of water, proteins, lipids, carbohydrates, vitamins, minerals, and compounds with important biological properties such as phenolic compounds (tannins, phenolic acids, anthocyanins, and resveratrol), depending on the type of waste, the cultivar and climatic and cultivation conditions **(Sousa, et. al., 2014)**. About 80% of the total crop is used in wine making **(Llobera and Caňellas, 2007; Schieber et al., 2001)**.

Grape pomace represents a rich source of various high-value products such as ethanol, tartrates and malates, citric acid, Grape seed oil, hydrocolloids and dietary fibre. Grape pomace consists mainly of peels (skins), seeds and stems and accounts for about 20 – 25% of the weight of the Grape crushed for wine production **(Arvanitoyannis et al., 2006; Yu and Ahmedna, 2013)**.

Grape pomace is a rich source of polyphenols. These include catechins, namely monomeric and oligomeric flavan-3-ols (proanthocyanidins) and glycosylated flavonols. Catechins, together with other polyphenols, are potent free radical-scavengers. Thus, different epidemiological studies have demonstrated the association between a diet rich in polyphenols and the decrease in the risk of suffering cardiovascular diseases and certain types of cancer **(Llobera and Caňellas, 2007)**.

This study is aimed to characterize commercial Grape fibres in terms of their chemical properties (moisture, ash, fat, protein, total dietary fibre) and feasibility of using in food industries improving the nutritional value of food products.

MATERIAL AND METHODOLOGY

Wheat flour was obtained from the K. K. V. – UNION, Ltd., Slovak Mills Company. Various kinds of commercial Grape fibres were purchased from market in Slovakia and their country of origin is Germany (A), Hungary (B) and Austria (C).

Chemical analysis: Moisture and ash content were determined according to **AOAC methods (1984)** and **Sowbhagya et al. (2007)**.

Lipids were determined gravimetrically by extraction with diethyl ether using a Soxhlet apparatus. Nitrogen content was estimated by Kjeldhal method and was converted to protein using a factor 6.25 **(AACC methods, 2000; Ayadi et al., 2009)**. Total dietary fibre (TDF) content of the Grape fibre was determined with using of the Megazyme International total DF assay (adopted from AACC method 32–05 and AOAC method 985.29) **(Sun-Waterhouse et al., 2010).**

The measurement of pH was determined according to **Kohajdová and Karovičová (2007)**. Caloric carbohydrates were determined by difference from the total dietary fibre, lipids, protein and ash contents **(Chau and Huang, 2003)**. The total energy was calculated based on the energy nutrient results obtained using the conversion factors of Atwater, as described by **Sousa, et al., (2014)** considering 4 kcal/g for carbohydrate, 4 kcal/g for protein, and 9 kcal/g for lipids.

RESULTS AND DISCUSSION

The chemical composition of Grape fibre is known to vary depending on the Grape cultivar, growth climates, and processing conditions **(Deng et al., 2011)**. The main characteristics of the commercialized fibre product are: total dietary fibre content above 50%, moisture lower than 9%, low content of lipids, a low caloric value and neutral flavour and taste **(Larrauri, 1999)**. The chemical composition of Grape pomace major constituents peels and seeds, has been reported by authors, with as dietary fibre (DF) contents **(Bravo and Saura-Calixto, 1998; Valiente et al., 1995; Yu and Ahmedna, 2013; Centento et. al., 2010; Deng et al., 2011)**.

The results of chemical composition of various kinds of commercial Grape fibres and fine wheat flour used in the study are presented in the Table 1. The commercial Grape fibre had low moisture content. Moisture content was below 9.0% pointed out by **Larrauri (1999)** as the upper limit for their handling and conservation. Grape fibres are not considered as an important protein source, although Grape fibre contains 9 – 13% proteins.

Table 1 Chemical composition of various kinds of commercial Grape fibres and fine wheat flour

	Fine wheat flour	**Grape dietary fibre A**	**Grape dietary fibre B**	**Grape dietary fibre C**
Moisture (%)	11.4 ±0.01	7.7 ±0.04	6.1 ±0.05	8.6 ±0.38
Ash (%)	0.6 ±0.00	1.3 ±0.04	2.9±0.01	3.8 ±0.04
Protein (%)	10.5 ±0.15	8.6 ±0.17	10.4 ±0.07	9.9 ±0.00
Fat (%)	1.1 ±0.02	2.8 ±0.13	5.1 ±0.03	8.6 ±0.00
pH	6.3 ±0.00	3.7 ±0.00	3.9 ±0.01	3.8 ±0.00
TDF (%)	2.3 ±0.04	83.6 ±0.67	73.2 ±0.27	56.9 ±0.08
Carbohydrate (%)	348.8	15.9	7.1	49.1
Energy value kJ/kg	3106.8	3148.6	4048.8	8135.3

TDF – Total dietary fiber

The total protein content and the amino acid composition of Grape fibre protein may vary significantly depending on the variety of Grape, location and fertilization conditions **(Sousa, et. al., 2014)**.

Protein content was also high, up to 10.5% and similar to the values reported for red Grape pomace (9%) **(Rodriguez et al., 2012)**, white deseeded Grape pomace (11%) **(Valiente et al., 1995)**. Higher protein values were found in the Grape skins and seeds (12%) **(Bravo and Saura-Calixto, 1998).** Ash content are lower (1.3 – 3.8%) than other values described for similar by-products obtained from white and red Grapes (5.7 – 9.2%) **(Bravo and Saura-Calixto, 1998; Valiente et al., 1995)**. Similar values were found in the fresh red and white varieties (pomace and stems) (0.9 – 3.0%) **(González-Centeno et al., 2010)**. Amount of total dietary fibre also depends on the variety of Grapes. The commercial Grape fibre B was characterized by a TDF content of 73.2%, similar contents were described with **(Pérez-Jimeénez et al., 2008)** in the red Grape skin (73.5%) and **(Llobera and Caňellas 2007)** in the red Grape pomace (74.5%). Similar content total dietary fibre for sample Grape fibre C were found for red Grape skins (54%), white Grape skins (59%), white Grape seeds (56%) **(Bravo and Saura-Calixto, 1998)** and white deseeded Grape pomace (62%) **(Valiente et al., 1995)**. Total dietary fibre for commercial Grape fibre A was 83.6%, this value is larger than the value determined by **(Llobera and Caňellas, 2007)** in the red Grape stem (77.2%). No previous studies on Grape fibre have been found in the literature to allow us to compare the high value of 83.6 of TDF obtained in our commercial Grape fibre A.

The fat content of Grape fibre depending on the variety and maturity of Grapes **(Llobera and Caňellas, 2007)**. Fat content of the Grapes fibre were between 5.1% in Grape fibre B and 8.6% in Grape fibre C. These values are in agreement with **Pérez-Jiménez et.al., (2008)** (7.7%), in Grape skins (6.9 – 7.8%) **(Bravo and Saura-Calixto, 1998)**, commercial Grape fibre (6.9%) **(Saura-Calixto, 1998)**. The lipids of the Grapes are mainly concentrated in its seeds and consist of about 90% monounsaturated fatty acids, known for their beneficial properties, particularly to the cardiovascular system **(Rockenbach et al., 2011)**. The pH values of the Grapes fibre were (3.7 – 3.9), which led to greater stability hampering the development microorganisms because fungi generally prefer acidic pH (4.5 – 5.0) and bacteria prefer near neutral pH (6.5 -7.0) **(Sousa, et. al., 2014)**.

According to **Larrauri (1999)**, an adequate fibre concentrate should have an energy value below than 8370 kJ/kg limit which is met by in all of various kinds of commercial Grape fibres studied.

CONCLUSION

The results obtained in this study suggest the possibility of using the most important by-products related to the winemaking process (Grape pomaces and stems) as potential sources of DF of good quality.

The commercial Grape fibres have as a main characteristic, the high content of total dietary fibre (TDF). Grape fibre is an excellent source of protein (8.6 – 10.8 %), mineral (1.3 – 3.8%), mostly fat (2.8 – 8.6%). This fact opens the possibility of using both initial by products as ingredients in the food industry, due to the effects associated with the high TDF content.

Owing to the large quantity generated from worldwide wine and Grape juice production every year. Grape fibre has potential to serve as an important source of dietary fibre for functional food development. Dietary fibre and bioactive compounds are widely used as functional ingredients in processed foods. The market in this field is competitive and the development of new types of quality ingredients is a challenge for the food industry. In this regard, it is interesting to consider not only the nutritional quality of the ingredient, but also its distribution, cost and other additional benefits, since the use of these ingredients would give added value to the production of these materials.

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