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Literature Review of Seed of *Linum Usitatissimum L.*

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***Abstract* - A review of literature describes[1] usefulness of image analyses software to determine genotype differences on quantitative linseed traits (*Linumusitatissimum* L.). Also the goal was to propose new quantitative characters of seeds suitable for determination infra-specific differences. The study was realized on seeds of 6 linseed genotypes from two harvested years – 2010 (5 genotypes), 2012 (5 genotypes). The 7 quantitative traits measured on whole seeds and 3 quantitative traits measured on longitudinal seed section were chosen. Seed samples were randomly selected from genetically and physically purified seeds. The experimental data were obtained by the software for image analysis with module for automatic measurement, from detailed digital images. The methodology for measuring parameters in micropyle region of flax seeds was proposed. According to results of descriptive statistics was found out that the smallest seeds had genotype Oural and the biggest seeds had genotypes Flanders and Recital. The three newly proposed characters from micropyle region of seed had shown higher variability than the traits measured on the whole seeds. Coefficient of variation had mostly values more than 10 %. The One-Way ANOVA confirmed statistically significant differences ($p < 0.05$) between all analysed samples in chosen quantitative traits. The results of the post hoc means comparison revealed that genotype Recital received the highest values of means and significantly differentiated from means of genotype Oural in the traits measured on whole seeds in both harvested years. Also there was found out that the Pearson correlation coefficient was mostly around $r = 0.50$ ($p < 0.001$), except two cases among traits - Area - Feret ratio and Diameter – Feret ratio. The correlations between parameters of micropyle seed region were found very weak ($r < 0.50$; $p < 0.001$).**

Literature Review

The flax (*Linum usitatissimum* L.) is the technical crop with wide range of different uses in industrial areas. Nowadays it has become also interesting commodity for food industry[2]. Linseed has important nutritive value connected to unsaturated fatty acids composition, lignans and mucilage components in seeds[3-4]. Due to mentioned valuable characters of flax the breeding and plant improvement processes are still the best way to look for new characters and features of genotypes. Many research collectives deal with flax collections characterization and evaluation[5]. They use different traditional or modern methods, like molecular analyses[6] or image analyses[6]. The use of image analyses tools has increased in previous years. Together with mathematical and statistical methods they revealed new detailed characters and relationships. Image analyses can in details describe morphological parts what is impossible with traditional morpho-metric methods[7].

Bio-fuel is a less polluting, locally available, accessible, sustainable, and reliable fuel derived from renewable sources. Liquid biofuels are obtained from agricultural sources, like; vegetable oils, fats, sugar and polysaccharides sources[8]. Fuel from vegetable oils for diesel engine is not radically new concept, in 1900, Mr. Rudolph Diesel first tested his diesel engine on groundnut oil as an alternative fuel without any problem[9-10]. Due to the energy crisis, many researchers from different countries are still investigating the use of different types of vegetable oils as diesel fuel substitutes. India and other developing countries can secure their energy dream with the production of renewable energy from edible and non-edible vegetable oil such as Karanj, Linseed oil and Jatropha, sunflower oil rapeseed oil palm oil, cotton seed oil and soybean oil[11]. A number of problems associated with using straight vegetable oils (SVOs) directly as a diesel engine fuel. The high viscosity of SVOs compared to diesel oil the main cause reported in the literature for the problems encountered in engines. High viscosity results in poor fuel atomization, incomplete combustion, deposits in the combustion chamber[12].There are many potential methods for utilizing vegetable oils as diesel fuel substitutes such as heating, dilution, blending, emulsification and transesterification[13].

A review[14] describes that an attempt has been made to use water degummed *Linum usitatissimum* seed oil as a potential alternative fuel for diesel engine. Furthermore, the basic fuel properties of water degummed *Linum usitatissimum* seed oil (WDLO) and its diesel blends in proportions (oil/diesel) of 20:80, 30:70, 55:45 and 80:20(v/v) were characterized and evaluated. This process can be an effective method of enhanced its fuel properties (viscosity, calorific value and specific gravity, flash point, cloud and pour point). The results show that the characteristic fuel properties of WDLO20 diesel blend was found close to those of diesel fuel

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on the basis of experimental analysis. Hence it is also emphasized that the water degumming method offers a potentially low-cost method with simple technology for producing an alternative fuel for compression ignition engines.

The phosphorus content in vegetable oil indicates the presence of phospholipids (gums).This parameter is very important for fuel use indeed, phospholipids are responsible for the fouling of valves, combustion chamber and cylinders even if the straight vegetable oils are used (gumming phenomenon) . Gums can cause problems during the transportation of fuels by settling and forming deposit on tanks walls or clogging pipelines. In engine where vegetable oil is used, gums or phospholipids can cause catalytic converter issue or coking within the engine[15]. Several researchers have reported that a high phosphorus (gum) content of the vegetable oil leads to an increased formation of deposit when it is used as fuel in diesel engines[16] so it must be removed or reduced from the vegetable oil. Phospholipids (gums) are undesirable constituents of vegetable oil that come from the cell membranes of seed and kernels. They vary in concentration depending on pressing and filtering techniques and it can be remove from oil through degumming process.

A review[17] describes that Flax (*Linum usitatissimum* L.) seeds are widely used for oil extraction and the cold-pressed flaxseed (or linseed) cakes obtained during this process constitute a valuable by-product. The flavonolherbacetindiglucoside (HDG) has been previously reported as a constituent of the flaxseed lignan macromolecule linked through ester bonds to the linker molecule hydroxymethylglutaric acid. In this context, the development and validation of a new approach using microwave-assisted extraction (MAE) of HDG from flaxseed cakes followed by quantification with a reverse-phase HPLC system with UV detection was purposed. The experimental parameters affecting the HDG extraction yield, such as microwave power, extraction time and sodium hydroxide concentration, from the lignin macromolecule were optimized. A maximum HDG concentration of 5.76 mg/g DW in flaxseed cakes was measured following an irradiation time of 6 min, for a microwave power of 150 W using a direct extraction in 0.1 M NaOH in 70% (*v/v*) aqueous methanol. The optimized method was proven to be rapid and reliable in terms of precision, repeatability, stability and accuracy for the extraction of HDG. Comparison with a conventional extraction method demonstrated that MAE is more effective and less time-consuming.

Flax (*Linum usitatissimum* L., Linaceae) is a common oilseed crop regarded as a functional food that constitutes a key source of phytochemicals. During the last decade, there has been an increasing interest in the human consumption of flaxseed in the diet in order to improve nutritional and health status[18]. Flaxseed is rich in oil with very high α-linolenic acid (omega 3 fatty acid) content; it also contains a high level of dietary fiber and good quality protein fractions[19]. Flaxseed hulls represent a rich source of valuable metabolites such as lignans[20], hydroxycinnamic acids (HCA)[21] and flavonols[22]. The main flaxseed lignan, secoisolariciresinoldiglucoside (SDG), has been shown to reduce the incidence of a wide variety of cancers, lower the risk of cardiovascular diseases, limit hypercholesterolemic atherosclerosis and delay the development of diabetes[23-26]. However, the possibility that other phytochemicals accumulated in flaxseed hulls also contribute to the health benefits ascribed to flaxseed cannot be excluded. In particular, attention may be paid to the flavonolherbacetindiglucoside (HDG; Figure 1) which has been recently demonstrated to be a constituent of the lignan macromolecule of flaxseed hulls, linked through ester bonds to hydroxymethylglutaric acid (HMG), together with SDG and HCA glucosides (HCAG).[22]

Flavonols present a large spectrum of biological activities, being the most active compounds within the flavonoid group. In fact, the beneficial effects on cardiovascular health of diets rich in fruits and vegetables have been attributed to flavonoids in general and often to flavonols in particular. The major dietary flavonols studied are quercetin, kaempferol, myricetin, and isorhamnetin. Epidemiological studies have shown an inverse correlation between flavonol intake and coronary heart disease and stroke[27]. Human intervention trials with isolated flavonols have demonstrated an anti-hypertensive effect. Besides their high antioxidant capacity, flavonols are also known to interact with estrogenic receptors[28]. Various studies have shown that flavonols have properties that alleviate several diseases, including inflammation and cancer[29]. The potential involvement of herbacetin in the stimulation of renal tubular epithelial cells, improvement of renal function, treatment of renal failure and promotion of bone formation has been mentioned in a patent claim[30]. Moreover *in vitro* anti-influenza viral activity through neuraminidase inhibition has been evidenced[31]. Therefore, HDG could contribute (perhaps synergistically with other flaxseed hull constituents) to the health benefits ascribed to flaxseed. To date, there is little information available concerning herbacetin's biological activities.

A review of literature[32] describes that *Linum usitatissimum* L. is one of the important genuses of the family "Linoceae.". It is native in the region extending from the eastern Mediterranean to India and was probably first domesticated in the Fertile Crescent. Flax was extensively cultivated in ancient Ethiopia and ancient Egypt.

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The flax seed oil is edible. Because of its quick drying property its oil is used for the preparation of paints, varnishes, printing ink, oil cloth, soap, patent leather, and waterproof fabrics[33]. Besides, it has been reported that oil from seeds removes biliousness[33]. Linseed taken in the diet may benefit individuals with certain types of breast[34-35] and prostate cancers. It may also stunt the growth of prostate tumors[36]. Scientists at American National Cancer Institute singled out flaxseed as one of six nutraceuticals for food applications[37].

A review[38] of the literature on flaxseed yielded 13 categories for which flaxseed had been studied in humans, including for exemple constipation/laxative, attention-deficit hyperactivity disorder, hyperlipidemia, atherosclerosis/coronary artery disease and human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) [9]. Moreover, the study of Arvind (2006), explored the antioxidative properties of linseed oil in the prophylactic action against oxidative stress induced by a radiomimetic drug, cyclo phosphamide[33].

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