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Study of physicochemical properties and nutritional and anti-nutritive compounds of camelina (Camelina sativa) meal (Soheyl)

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Abstract
This research was conducted for the first time in Iran on Camelina Sohail seed meal with the aim of investigating its physicochemical properties and its nutritional and anti-nutritional composition for the possibility of using it in animal and poultry feed. The prepared samples were related to four temperate regions of Iran, i.e. Ilam, Kermanshah, Fars, and Hamedan (cold temperate), which were obtained by two methods of solvent extraction and cold pressing. In general, the examined characteristics included qualitative, physicochemical, and anti-nutritional composition (glucosinolates). The results obtained included the appearance of flour, pellets or flakes, yellow to brown color, specific taste and smell, and camellia flour free of unacceptable factors (all unacceptable factors in any amount of camellia flour). Maximum moisture content was 10 g/100 g, total ash was maximum of 7 g/100 g, acid insoluble ash was a maximum of 1 g/100 g, and crude protein was a minimum of 35 g/100 g. The gram content of total glucosinolate was 30 mmol/kg and the nitrogen content of urea and free ammonia. In general, all the obtained results were in accordance with the national standard of Iran's animal feed - Camelina food - specifications and test methods.

Keywords: camelina “meal” animal food “ physicochemical”ash” anti-nutritional composition.

Introduction

Camelina sativa is a crop that belongs to the Brassicaceae family and is further known as false flax or gold of pleasure[1] Since it can be grown in different soils and climates, in summer or even in winter in temperate regions, it is a very compatible crop with harsh and different climatic conditions. In addition, its cultivation is low as it needs less water, fertilizer, and pesticide in comparison to other oilseed crops, such as sunflower, soybean, or canola[2]. Camelina was grown at least 3000years ago in Europe and it is further known as a natural plant of Northern Europe and Central Asia. After the 1960s, agricultural research on camelina plants was carried out in both Europe and North America and, as a result of these studies, camelina has been reported to be a suitable plant for sustainable agricultural systems. In recent years, the importance of camelina has become more important with the idea of supplying omega-3 fatty acids from plant sources[3].

However it has been grown in Europe for many years, and it is a new crop in Iran, despite several suitable regions for Camelina sativa cultivation in terms of soil and climate conditions are available[4].Camelina sativa is not well known and is not widely cultivated. In fact, it has only been introduced to Iran for about 6 years and the Soheil cultivar has been released in the last 2 years[5].It has been revealed that its production is profitable and it is an economical option to cultivate this plant in Iran as a new source of vegetable oil as there are many suitable regions such as Ilam, Kermanshah, Fars, and Hamedan and as well as other places[5].Soheil is the first introduced and registered cultivar of camelina in Iran, which has been modified for dryland conditions in all climates of the country and was introduced in 2017[6].

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Camelina meal, which is the grain residue after oil extraction, is used as a source of protein in livestock and poultry feed. The oil extraction process can be mechanical (compression), chemical (solvent), or a combination of both methods, which is done more and more in the chemical method. Depending on the method of oil extraction, the percentage of protein and other components of the meal produced can further vary. Camelina meal contains anti-nutritional substances such as glycosinolates, saponins, tannins, and phytic acid, which should be considered when using it in animal feed, especially poultry[7].

Phenolic and polyphenolic compounds are secondary metabolites occurring in plants and are produced via the shikimic acid pathway[8].Appropriate concentrations of phenolic compounds promote health due to their favorable antioxidant, anti-inflammatory, antimicrobial, anxiolytic, and anticancer effects. Therefore, it is important to analyze phenolic compounds in these oilseeds[9]. The main phenolic compound of rapeseed meals is sinapic acid derivatives. Sinapic acid constitutes over 73% of free phenolic acids. Sinapine, the choline ester of sinapic acid, is the main phenolic ester in rapeseed. In the plant, the choline residue of sinapine is transferred to the formation of phosphatidylcholine, and sinapoyl glucose, the precursor of sinapine, is a minor derivative[8].reported that camelina meal contains remarkable amounts of bioactive substances such as glucosinolates, vitamins and antioxidants and antioxidants[10]. The distribution of phenolics in plants at the tissue, cellular and subcellular levels is not uniform. The seeds of oil crops, particularly those with high contents of polyunsaturated fatty acids, provide an important source of antioxidants. Besides lipophilic antioxidants such as tocopherols, the seed includes polar phenolic compounds[11], [12]

The aim of this study is to determine the number of physicochemical characteristics including appearance, color, taste and smell, and unacceptable factors, in addition to moisture, ash, acid insoluble ash, crude protein, ammonia urea, and evaluation of nutrients and anti-nutrient compounds such as seed glucosinolates.

Materials and methods

Sample material

Camelina sativa cv Soheil grew in four different temperate regions of Iran, namely Ilam, Kermanshah "Figure 1", Fars, and Hamdan (cold temperate). The plants were grown in loamy clay soils and the growing plants were not irrigated. These plants were harvested in the summer when the seeds were ripe from different areas of the field. One square meter was taken and then all the samples from each field were mixed. The oil was extracted from the seeds by Soxhlet apparatus using N-Hexane for further analysis. Chemicals and solvents such as N-Hexane, KOH, Tocopherols, and sterols used in the experiments were obtained from Merck (Darmstadt, Germany). On the other hand, due to the importance of the physicochemical parameters of the camel meal, the parameters of moisture, protein, ash, insoluble ash, oil, glucosinolate form, color, aroma, and unacceptable factors of the meal, the meal obtained from Camelina seeds, Fars, Ilam, Kermanshah and Hamdan provinces were examined and evaluated by halal extraction and cold press in accordance with national standard methods and citing numerous and valid domestic and international articles and researches"Figure 2".

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Figure (1) Camelina seed sample of Iran- Kermanshah province for 2021

Figure (2) The meal sample obtained by extracting with solvent using two Soxhlet methods and with hexane solvent without heat along with oil

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Reagents and solvents

Chloroform, ethanol (96%), methanol, trichloroacetic acid, sodium carbonate, formic acid, acetic acid, dimethyl sulfoxide, iron (II) chloride, hexane, diethyl ether, and p-coumaric acid were obtained. from Merck.DPPHreagent, p-hydroxybenzoic acid reagent, was purchased from Sigma-Aldrich GmbH. Acetonitrile was obtained from Riedel-de-Haën. Ultrapure water (MiliQ, Millipore) was used to prepare the solutions.

Sampling

A sampling of camelina meal was performed for physical and chemical tests and isolation, identification, and quantification of the main antioxidant and phenolic components and evaluation of antioxidant properties, in accordance with Iranian National Standard No. 331 - Oilseed residues — Sampling[13].

Preparation

Preparation of camelina meal was performed for physical and chemical tests and isolation, identification, and quantification of the main antioxidant and phenolic components and evaluation of antioxidant properties, in accordance with Iranian National Standard No. 4360 - Oil seed residues - preparation of test samples[14].

Properties

Sensory and physical properties

Appearance

The appearance of Camelina meal must be in accordance with Physical observation and sensory and physical examination and according to the production method. and Iranian National Standard No. 22968 - Animal feeding stuff–Camelina meal– Specifications and test methods[6].

Color

The color of the Camelina meal must be in accordance with Physical observation and sensory and physical examination and Iranian National Standard No. 22968 - Animal feeding stuffs–Camelina meal– Specifications and test methods[6].

Taste and smell

The taste and smell of Camelina meal must be in accordance with Physical observation and sensory and physical examination and Iranian N

ational Standard No. 22968 - Animal feeding stuffs–Camelina meal– Specifications and test methods[6].

Unacceptable factors

Unacceptable factors in Camelina meal must be in accordance with Physical observation and sensory and physical examination and Iranian National Standard No. 22968 - Animal feeding stuffs–Camelina meal– Specifications and test methods[6].

chemical properties

Measurement of moisture content

Measurement of moisture content of camelina meal must be in accordance with Iranian National Standard No.321 - Oilseed residues - Determination of moisture and volatile matter content – Test method[15].

Measurement of total ash

Measurement of total ash of camelina meal must be in accordance with Iranian National Standard No.332 - residues Oilseed - Determination of total ash[16].

Measurement of insoluble ash in acid

Measurement of insoluble ash in the acid of camelina meal must be in accordance with Iranian National Standard No.414 - Oilseed residues - Determination of ash insoluble in hydrochloric acid – Test method[17].

Measurement of crude protein content[17].

Measurement of crude protein content

Measurement of the crude protein content of camelina meal must be in accordance with Iranian National Standard No.10703-1- Animal feeding stuff - Determination of nitrogen content and calculation of crude protein content – Part 1: Kjeldahl method[18].

Measurement of total glucosinolates content

Measurement of total glucosinolates content of camelina meal and permissible limit of glucosinolates must be in accordance with Iranian National Standard No.5183- Oilseed residues – determination of glucosinolates content –method using high–performance liquid chromatography[19] and EU regulations[20].

Identification of urea and ammonia nitrogen content

Identification of urea and ammonia nitrogen content of camelina meal must be in accordance with Iranian National Standard No.2513- Animal feeding stuff – Di-Calcium Phosphate- Specifications and test methods[21].

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Results and discussion

Properties

Sensory and physical properties

Appearance

The appearance of Camelina meal is in accordance with physical observations and sensory and physical examination and according to the production method and national standard of Iran No. 22968 - Camelina meal - Specifications and test methods, flour, pellet or flake[6].

Color

The color of the Camelina meal is in accordance with physical observations and sensory and physical examination and the national standard of Iran No. 22968 - Animal feed - Camellina meal - Specifications and test methods, yellow to brown[6].

Taste and smell

The taste and smell of melina meal are in accordance with the physical observations and sensory and physical examination and the national standard of Iran No. 22968 - Animal feed - Camellina meal - Specifications and test methods, has its specific taste and smell[6].

Unacceptable factors

Camelina meal in accordance with Physical observation and sensory and physical examination and Iranian National Standard No. 22968 - Animal feeding stuffs–Camelina meal– Specifications and test methods must be It must be free from unacceptable factors (all factors that are unacceptable in any amount in camelina meal). These factors include fungal growth and mold visible to the naked eye, live pests (insects), abnormal taste and odor caused by rot and sharpness, and sharp and winning materials[6].

chemical properties

Measurement of moisture content

Measurement of moisture content of camelina meal according to Iranian National Standard No. 321 - Residues of oilseeds - Determination of moisture and volatile matter - is the test method, which is based on the acceptable level of moisture and volatiles in camelina meal (based on the dry matter), the amount Its maximum is 10 grams per 100 grams[15].

Measurement of total ash

Measurement of total ash of Camelina meal according to Iranian National Standard No. 332 - Oil residue - Determination of total ash based on the acceptable amount of Camelina meal ash (based on the dry matter) is a maximum of 7 grams per 100 grams[16].

Measurement of insoluble ash in acid

Measurement of insoluble ash in the acid of Camelina meal according to Iranian National Standard No.414 - Oilseed residues - Determination of ash insoluble in hydrochloric acid – Test method based on the acceptable amount of Camelina meal insoluble ash in the acid (based on the dry matter) is a maximum of 1 gram per 100 grams[17].

Measurement of crude protein content

Measurement of the crude protein content of Camelina meal (Protein efficiency ratio (PER) of camelina meal is considered to be 6.25[6].) according to Iranian National Standard No.10703-1- Animal feeding stuff - Determination of nitrogen content and calculation of crude protein content – Part 1: Kjeldahl method based on the acceptable amount of Camelina meal crude protein content (based on the dry matter) is a minimum of 35 gram per 100 gr[18].

Measurement of total glucosinolates content

Measurement of total glucosinolates content of camelina meal and permissible limit of glucosinolates according to Iranian National Standard No.5183- Oilseed residues – determination of glucosinolates content – method using high–performance liquid chromatography and EU regulations based on the acceptable amount of total glucosinolates content (based on the dry matter) is 30 mmol per kg[19], [20].

Identification of urea and ammonia nitrogen content

Identification of urea and ammonia nitrogen content of camelina meal according to Iranian National Standard No.2513- Animal feeding stuff – Di-Calcium Phosphate- Specifications and test methods based on the acceptable amount of urea and ammonia nitrogen content (based on the dry matter) is free[21].

Conclusion

Camelina meal, which is the seed residue after oil extraction, can be used as a protein

source in animal and poultry feed. The process of oil extraction can be mechanical (press), chemical (solvent), or a combination of both methods, which is done more completely and more in the chemical method. Depending on the type of oil extraction method, the percentage of protein and other components of the flour produced is also different. the results obtained included the appearance of flour, pellets or flakes, yellow to brown color, specific taste and smell, and camellia flour free of unacceptable factors (all unacceptable factors in any amount of camellia flour). Maximum moisture content was 10 g/100 g, total ash was maximum of 7 g/100 g, acid insoluble ash was a maximum of 1 g/100 g, and crude protein was a minimum of 35 g/100 g. The gram content of total glucosinolate was 30 mmol/kg and the nitrogen content of urea and free ammonia. In general, all the obtained results were in accordance with the national standard of Iran's animal feed - Camelina food - specifications and test methods. therefore, the favorable condition of this meal can be a promise to reduce the import of animal feed and the independence of the country.

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References

[[1] J. R. Brock, A. A. Dönmez, M. A. Beilstein, and K. M. Olsen, “Phylogenetics of Camelina Crantz. (Brassicaceae) and insights on the origin of gold-of-pleasure (Camelina sativa),” Mol Phylogenet Evol, vol. 127, pp. 834–842, Oct. 2018, doi: 10.1016/j.ympev.2018.06.031.

[2] Z. Piravi-vanak et al., “Physicochemical properties of oil extracted from camelina (Camelina sativa) seeds as a new source of vegetable oil in different regions of Iran,” J Mol Liq, vol. 345, Jan. 2022, doi: 10.1016/j.molliq.2021.117043.

[3] P. Günç Ergönül and Z. Aksoylu Özbek, “Chapter 21 - Cold pressed camelina (Camelina sativa L.) seed oil,” in Cold Pressed Oils, M. F. Ramadan, Ed. Academic Press, 2020, pp. 255–266. doi: https://doi.org/10.1016/B978-0-12-818188-1.00021-9.

[4] C. Eynck and K. C. Falk, “17 Camelina (Camelina sativa),” Biofuel crops: production, physiology and genetics, p. 369, 2013.

[5] D. KAHRIZI, H. ROSTAMI AHMADVANDI, and A. L. I. AKBARABADI, “FEASIBILITY CULTIVATION OF CAMELINA (CAMELINA SATIVA) AS MEDICINAL-OIL PLANT IN RAINFED CONDITIONS IN KERMANSHAH-IRAN’S FIRST REPORT,” JOURNAL OF MEDICINAL PLANTS AND BY PRODUCTS, vol. 4, no. 2, pp. 215–217, 2015, [Online]. Available: https://www.sid.ir/en/Journal/ViewPaper.aspx?ID=503131

[6] INSO 22968, “Animal feeding stuffs– Camelinameal– Specifications and test methods,” 2021. [Online]. Available: http://www.isiri.gov.ir

[7] M. Ahmadizadeh, S. Rezaee, and P. Heidari, “Genome-wide characterization and expression analysis of fatty acid desaturase gene family in Camelina sativa,” Gene Rep, vol. 21, Dec. 2020, doi: 10.1016/j.genrep.2020.100894.

[8] F. Shahidi, Handbook of antioxidants for food preservation. Woodhead Publishing, 2015. Accessed: Jun. 22, 2022. [Online]. Available: https://books.google.fr/books?hl=en&lr=&id=LEOdBAAAQBAJ&oi=fnd&pg=PP1&dq=Handbook+of+antioxidants+for+food+preservation&ots=YUfCAv7KbY&sig=ZwpiQur3vG3Fz5zAXZarRTbEfPw&redir_esc=y#v=onepage&q=Handbook%20of%20antioxidants%20for%20food%20preservation&f=false

[9] H. Lang et al., “Simultaneous determination of 19 phenolic compounds in oilseeds using magnetic solid phase extraction and LC-MS/MS,” LWT, vol. 107, pp. 221–227, Jun. 2019, doi: 10.1016/j.lwt.2019.03.018.

[10] P. Terpinc, T. Polak, D. Makuc, N. P. Ulrih, and H. Abramovič, “The occurrence and characterisation of phenolic compounds in Camelina sativa seed, cake and oil,” Food Chem, vol. 131, no. 2, pp. 580–589, Mar. 2012, doi: 10.1016/j.foodchem.2011.09.033.

[11] W. Peschel, W. Dieckmann, M. Sonnenschein, and A. Plescher, “High antioxidant potential of pressing residues from evening primrose in comparison to other oilseed cakes and plant antioxidants,” Ind Crops Prod, vol. 25, no. 1, pp. 44–54, Jan. 2007, doi: 10.1016/j.indcrop.2006.07.002.

[12] F. Shahidi, “Antioxidant factors in plant foods and selected oilseeds,” 2000.

[13] INSO 331, “Oilseed residues — Sampling.”

[14] INSO 4360, “Oil seed residues - preparation of test samples,” 1998.
[15] INSO 321, “Oilseed residues - Determination of moisture and volatile matter content – Test method,” 2005.
[16] INSO 332, “Oilseed residues - Determination of total ash,” 1967.
[17] INSO 414, “Oilseed residues - Determination of ash insoluble in hydrochloric acid – Test method,” 2005.
[18] INSO 10703-1, “Animal feeding stuffs - Determination of nitrogen content and calculation of crude protein content – Part 1: Keldahl method,” 2007. [Online]. Available: www.isiri.org
[19] INSO 5183, “Oilseed residues – determination of glucosinolates content –method using high – performance liquid chromatography,” 2000.
[20] Council Directive 2002/32/EC of the European parliament, “►B DIRECTIVE 2002/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 7 May 2002 on undesirable substances in animal feed,” Official Journal of the European Communities, 2009, Accessed: Jun. 28, 2022. [Online]. Available: Official Journal of the European Communities,
[21] INSO 2513, “Animal feeding stuffs – Di Calcium Phosphate- Specifications and test methods,” 2009.