Scientific quarterly journal ISNN 1429-7264

Agricultural Engineering

2014: 3(151):179-185

Homepage: http://ir.ptir.org

DOI: http://dx.medra.org/10.14654/ir.2014.151.070

THE IMPACT OF THE THERMAL TREATMENT OF GRASS PEA ON THE CONTENT OF THE SELECTED CHEMICAL COMPONENTS

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ARTICLE INFO

Article history:
Received: June 2014
Received in the revised form:
August 2014
Accepted: September 2014

Keywords:
infrared radiation
grass pea
protein solubility
fibre fractions
carotenoids

ABSTRACT

The objective of the paper was to estimate the impact of infrared rays heating of grass pea seeds on the protein solubility in KOH, content of fibre fraction: NDF (neutral detergent fibre), ADF (acid detergent fibre) and ADL (acid detergent lignin) and the content of carotenoids. Grass pea seeds (*Lathyrus sativus* L.), of Derek variety constituted the research material. The investigated seeds were heated by infrared rays in the temperature of 180ºC in the time: 30, 60, 90, 120 or 180 s. It was found out that the used thermal treatment did not have a significant impact on the protein solubility in KOH. After 180 s of heating this parameter was above 95%. Heating with infrared rays caused changes in the content of the fibre fraction in grass pea seeds. As a result of the process, the content of the NDF fraction was reduced and the growth of ADF and ADL was reported. Heating grass pea seeds with infrared rays did not cause the decrease of the carotenoids content.

Introduction

Recently the growth of interest in alternative plants, which may be used in food production, may be reported. From among leguminous plants, grass pea is interesting (*Lathyrus sativus*). Grass pea seeds include a high amount of protein of a beneficial amino acid composition and characterize with a high content of protein. They also have a lower energy value in comparison to soybeans (Grela et al., 2011). On account of the above, they may constitute an attractive component of the vegetarian diets. The use of grass pea seeds limits the presence of anti-nutritious compounds e.g. neurotoxins and toxin and trypsin inhibitors. Thus, grass pea seeds are subjected to thermal processing, which causes deactivation of the anti-nutrients components (Grela et al., 2001; Szmigielski and Szczepanik, 2008). Thermal processes may also cause changes of content and property of other active native components of the heated material, such as e.g. changes in the fibre fractions, changes of the protein quality, reduction of the content of the thermolabile nutritious components (Krasucki et al., 2002; Căpriță et al., 2010; Grela et al.,1999).

Infrared radiation may be the source of heat in technological processes (Andrejko, 2007). In the recent years the research have been carried out on the use of radiation in the food industry, inter alia, for drying fruit, conditioning grain seed before milling and treatment of leguminous plants seeds. Convectional drying with the use of infrared rays in comparison to traditional convectional drying, shortens the time of apple drying and the initial pea seed treatment with infrared rays shortens the time of preparation (Rząca and Witrowa-Rajchert, 2009; Rydzak et al., 2012; Andrejko et al., 2008).

The objective of the paper

The objective of the paper was to estimate the impact of infrared rays heating of grass pea seeds on the protein solubility in KOH and the content of fibre fraction and carotenoids.

Material and methods

Research material consisted in grass pea seeds (*Lathyrus sativus* L.) of Derek variety which were obtained in the company "Spójnia" Cultivation and Seeding in Nochów. Grass pea seeds were heated with infrared rays (wave length $\lambda = 2.5\text{-}3.0$ μm) in the temperature of 180ºC in the time: 30, 60, 90, 120 or 180 s. Seeds were heated in the specially designed and made laboratory device (fig.1). Main elements of the stand are: bearing frame, belt conveyor and heating system with easy temperature control. Raw material is poured to the basket equipped with a slide valve and then it is fed to the conveyor belt (one layer).

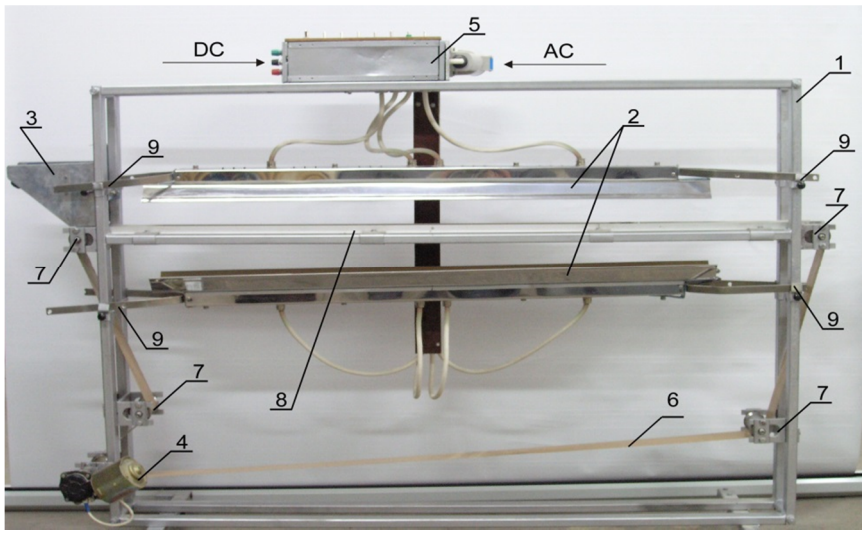

Figure 1. Laboratory device for infrared rays treatment of granular plant raw materials: 1 – frame bearer, 2 – head with 4 separately supplied radiators, 3 – charging hopper, 4 – direct current engine, 5 – control module, 6 – conveyor belt, 7 – rolls, 7 – heating zone, 9 – control of heads position (Andrejko et al., 2011)

Material placed on the conveyor belt moves to the heating zone, where it is subjected to infrared radiation. The device is equipped with two heating heads (4 radiators in each); the upper one placed over the conveyor belt and the bottom one located under the belt. Average temperature of a filament is approx. 500ºC.

In raw and heated seeds of grass pea protein solubility in 0.2% KOH (Araba i Dale, 1990) was determined, content of fibre fraction NDF (neutral detergent fibre), ADF (acid detergent fibre) and ADL (acid detergent lignin) were determined with Robertson and Van Soest method (1981) and the content of carotenoids according to Manza and Bühler-Steinbrunna (1988). All designations were carried out in three repeats. Results of designation were subjected to one-factor analysis of variance. Significance of differences between averages was verified with Tukey's test at $p \leq 0.05$. Calculations were carried out with Statistica 8.0.

Results and discussion

Protein solubility in KOH is one of indexes useful for assessment of the quality of protein of the heated material. In case of soya products it allows identification of excessively heated batch of material (Căpriță et al., 2010).

Protein solubility in KOH in raw grass pea seeds was 99.3% (fig. 2). No impact of heating with infrared rays of grass pea seeds on the content of protein soluble in KOH was reported ($p > 0.05$). It was reported that after 180 s of treatment, the researched value did not differ significantly from the value in raw seeds and was 95.1%. Căpriță et al. (2010) state that short (5 min) heating of soybean meal in temperature 120ºC did not also have a bigger impact on the protein solubility in KOH. However, prolongation of duration of the process led to reduction of this index below 70%.

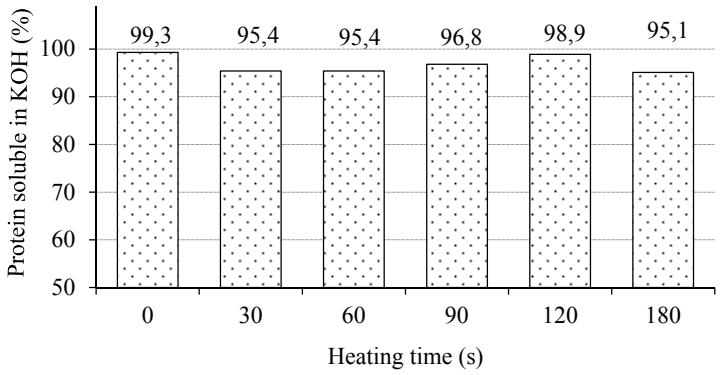

Figure 2. Protein soluble in KOH in seeds Lathyrus sativus L. (values do not differ significantly at $p \leq 0.05$)

Impact of the infrared rays heating on the content of fibre fraction content was presented in figures 3-5. Content of neutral detergent fibre (NDF) in raw grass pea seeds was 26.7% of dry mass. (fig.3) and was lower than in another Polish variety Krab (33.2%s.m.). Where-

as content of acid detergent fibre (ADF) which was 8.48% d.m.. (fig. 4) was similar to the amount in grass pea seeds of Krab variety (Smulikowska et al., 2008).

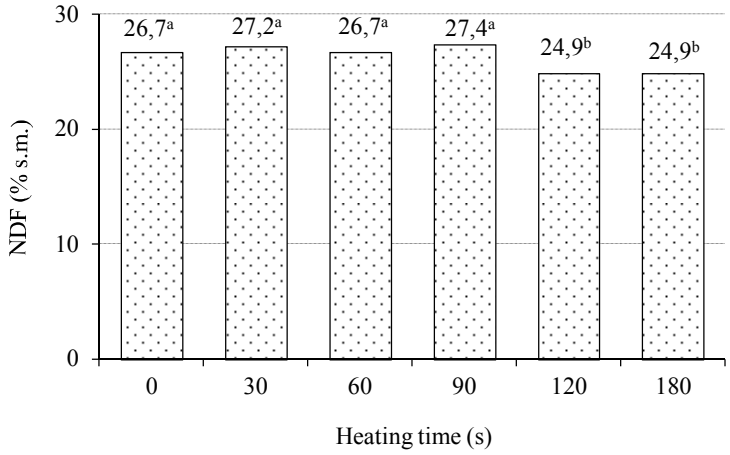

Figure 3. The content of neutral detergent fibre (NDF) in seeds Lathyrus sativus L. (values marked with various letters differ significantly at $p \leq 0.05$)

Heating with infrared rays caused changes in the content of specific fibre fractions in grass pea seeds. After treatment lasting 120 s, the content of neutral detergent fibre decreased by 7%, in comparison to the output sample. In case of ADF the increase of content after 60 and 90 s of heating was reported. Whereas, the ADL content in the final sample (heating by 180 s) was over three times higher than in raw seeds.

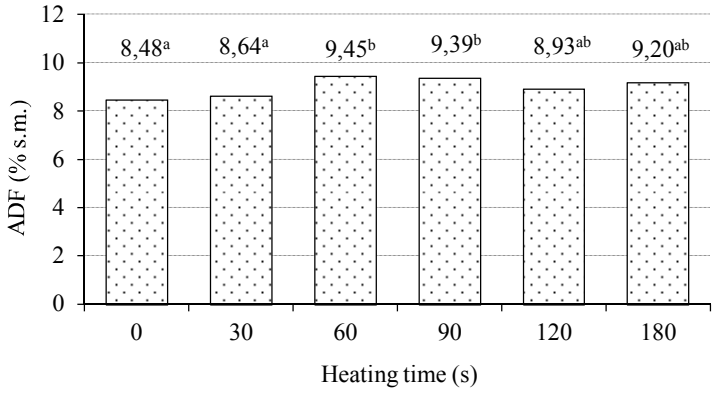

Figure 4. The content of acid detergent fibre (ADF) in seeds Lathyrus sativus L. (values marked with various letters differ significantly at $p \leq 0.05$)

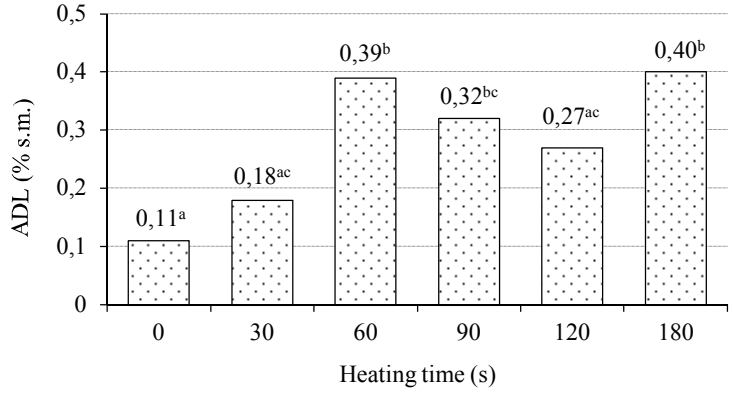

Figure 5. The content of acid detergent lignin (ADL) in seeds Lathyrus sativus L. (values marked with various letters differ significantly at $p \leq 0.05$)

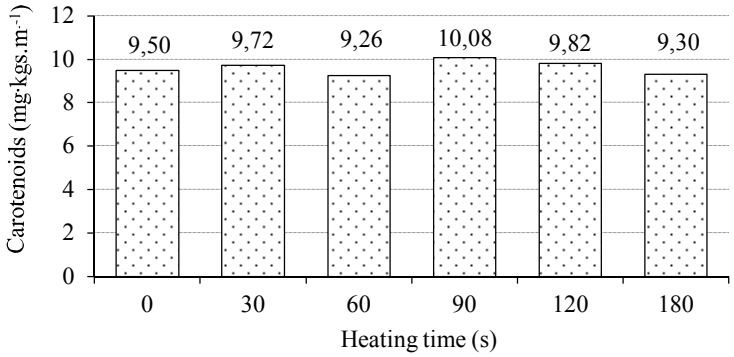

Figure 6. Content of carotenoids in seeds Lathyrus sativus L. (values do not differ significantly at $p \leq 0.05$)

Other authors also observed the impact of heating on changes in fibre fractions. The effect of drying rapeseed in temperature 120ºC (Krasucki et al., 2002) was decrease of the content of NDF and ADF fraction and increase of the process temperature to 180ºC led to the increase of NDF, ADF and ADL content in comparison to the control sample. Extrusion of mixture of grass pea and corn materials caused decrease of the NDF and ADF content and increase in ADL (Kasprzak and Rzedzicki, 2008).

Carotenoids as polyene compounds are included to natural antioxidants. Moreover, those which include in its fraction a fragment of retinol structure, prove activity of A vitamin (Sikorski, 2007). They may partially lose biological activity under the effect of light or heating. Grela et al. (1999) proved that extrusion of grass pea seeds caused decrease of the content of beta-carotene and luteine.

The content of carotenoids in raw and heated grass pea seeds (fig. 6) was at a similar level (from 9.30 to 10.08 mg·kgs.m^{-1}). It was lower than the value of averages presented by Korus et al. (2002) for Krab and Derek varieties, whereas it was similar to the sum of beta-karoten and luteine content which is presented by Grela et al. (1999) in grass pea seeds. The obtained results prove that infrared rays heating of grass pea seeds did not influence the carotenoids content ($p > 0.05$).

Conclusions

1. Heating grass pea seeds with infrared rays did not result in a significant decrease of protein solubility of protein in KOH.
2. The applied thermal treatment had a significant impact on the fibre fraction content in grass pea seeds. It caused decrease of the NDF fraction and ADF and ADL.
3. Infrared rays heating of grass pea seeds did not affect the content of carotenoids.
4. Analysis of the obtained results proved that the applied method of heating with infrared rays of grass pea seeds does not cause deterioration of the researched indexes of the quality and on this account it may be recommended as a method of deactivation of anti-nutrient compounds in grass pea seeds.

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WPŁYW PRZETWARZANIA CIEPLNEGO NASION LĘDŹWIANU SIEWNEGO NA ZAWARTOŚĆ WYBRANYCH SKŁADNIKÓW CHEMICZNYCH

Streszczenie. Celem pracy była ocena wpływu ogrzewania promieniami podczerwonymi nasion lędźwianu siewnego na rozpuszczalność białka w KOH, zawartość frakcji włókna: NDF (włókno detergentowe neutralne), ADF (włókno detergentowe kwaśne) i ADL (lignina detergentowo-kwaśna) oraz zawartość karotenoidów. Materiał badawczy stanowiły nasiona lędźwianu siewnego (*Lathyrus sativus* L.), odmiany Derek. Badane nasiona poddawano ogrzewaniu promieniami podczerwonymi w temperaturze 180ºC, w czasie: 30, 60, 90, 120 lub 180 s. Stwierdzono, że zastosowana obróbka cieplna nie miała istotnego wpływu na rozpuszczalność białka w KOH. Po 180 s ogrzewania parametr ten wynosił powyżej 95%. Ogrzewanie promieniami podczerwonymi spowodowało zmiany w zawartości frakcji włókna w nasionach lędźwianu. Na skutek procesu zmniejszeniu uległa zawartość frakcji NDF, a nastąpił wzrost zawartości ADF i ADL. Ogrzewanie nasion lędźwianu siewnego promieniowaniem podczerwonym nie spowodowało obniżenia zawartości karotenoidów.

Słowa kluczowe: promieniowanie podczerwone, lędźwian siewny, rozpuszczalność białka, frakcje włókna, karotenoidy