

# STUDY ON NIGELLA SATIVA (RANUNCULACEAE) RADIOACTIVITY CULTIVATED IN ROMANIA

**Claudia-Crina Toma<sup>1</sup>, Dumitru Tita<sup>1</sup>, Ovidiu Sandru<sup>2</sup>,  
Cristina Dehelean<sup>1</sup>, Bogdan Tita<sup>1</sup>**

## REZUMAT

Acest studiu analizează radioactivitatea semințelor și tulpinilor de *Nigella sativa* L. (Ranunculaceae), respectiv a tulpinilor de *Calendula officinalis* L. (Compositae) cultivate în localitatea Vladimirescu, din județul Arad. Este evaluată calitatea plantelor respective, ținând cont de utilitatea lor în fitoterapie.

**Cuvinte cheie:** *Nigella sativa*, Ranunculaceae, radiații  $\alpha$ ,  $\beta$ ,  $\gamma$

## ABSTRACT

This work deals with seeds and stems radioactivity of the *Nigella sativa* L. (Ranunculaceae) respectively *Calendula officinalis* L. (Compositae) stems cultivated in Vladimirescu village, Arad county. This study aims at establishing the quality of the above mentioned vegetals considering the opportunity of their usage in therapeutics.

**Key Words:** *Nigella sativa*, Ranunculaceae,  $\alpha$ ,  $\beta$ ,  $\gamma$  radiations

## INTRODUCTION

*Nigella sativa* L., popular called fennel flower, is an herbaceous plant of the Ranunculaceae family.<sup>1,2</sup>

Originary from countries in North Africa (Marocco, Egypt, Tunisia) and Middle Est (Syria, Jordan) where it grows spontaneously, the herb was acclimated in Romania by cultivation in Vladimirescu village, Arad county.<sup>3,4</sup>

For therapeutic purposes, the *Nigella sativae* semen is used, which is rich in volatile oils, fat acids,

oligoelements, saponine elements, alkaloids and is used empirically as an antiallergic, antiasthmatic, immunity and potency stimulant etc.<sup>1,5</sup>

Therapeutic uses determined cultivation of this plant in Romania as well.

For these vegetal products, above mentioned, with an already proved medical effect, to be used in therapeutic purposes, the international protocols have required studies which should test the acute and chronic toxicity of these products as well as studies which should exclude their radioactive contamination.

The studies regarding the two types of toxicity having already been performed, the next step is the assessment of the possible radioactive contamination, which is also the object of this study.

Because the soil where the plants grow, the rainwater and the possible radioactive deposits from the harvesting area could transfer to the vegetal material any type of radiation ( $\alpha$ ,  $\beta$  or  $\gamma$ ). This fact would qualify the vegetal material as unacceptable from the therapeutic point of view, so, an investigation

<sup>1</sup> Faculty of Pharmacy, Victor Babes University of Medicine and Pharmacy Timisoara, <sup>2</sup> Public Health Division Timisoara, Radiation Hygiene Laboratory

Correspondence to:  
Claudia Crina Toma, 2900, Arad, Piata Mica Street, No. 1  
Tel/Fax: 0257-214788, 0744-792968  
Email: claudiatoma2004@yahoo.com

Received for publication: Nov. 24, 2004. Revised: May 17, 2005.

to establish the radioactivity parameter has been considered necessary.

## MATERIAL AND METHOD

The vegetal product is represented by *Nigellae sativae* semen and *Nigellae sativae* herba, a crop of *Calendulae herba* cultivated in the same soil together with a soil sample taken from the cultivation area. Both the vegetal products and the soil sampling were taken off in June – July 2003 in Vladimirescu village, Arad county.

The plants were indoors dried, away from sunbeam and then dewatered in oven at 120° C (ETUVA) 100 up to the invariable weight (Table 1).<sup>5-7</sup>

The following step consists of sampling calcinations in a calcinations oven in order to get plant ash. Radioactive content was determined with  $\alpha$ - $\beta$  global and gamma spectrometric measures.<sup>8-13</sup>

This operation was done in the following devices: counter of alfa – beta particles FHT 1100 (Eberline) for  $\alpha$ - $\beta$  radiation and Oxford  $\gamma$  spectrophotometer with NaI probe to detect gamma radiations.<sup>14, 15</sup>

All determinations were repeated by six fold at the same conditions.

## RESULTS

Alpha type radiation represented by  $\alpha$  particles (protons and heavy ions) are not penetrating, but are dangerous when eaten. Penetrability is 3 – 4 cm in general, representing an extremely low external risk. Alpha type radiation can be stopped by interposing a paper sheet.

Beta type radiation are generated by electrons and positrons and have a rather slow penetrability in atmosphere, up approx. 10 m. Beta type radiations can be stopped by interposing a thin screen or an aluminium leaf.

Gamma activity is established by photons, particles with very high penetrability that are propagated in the atmosphere with light velocity. Gamma radiation is very dangerous, it cannot be blocked and therefore it is classified as very penetrating radiation gamma radiation.

The results obtained from the measuring activities are presented in table 1, the detection limit of the two devices used to detect  $\alpha$ ,  $\beta$  and  $\gamma$  radiation are  $\alpha$  – 0.09 Bq,  $\beta$  – 0.27 Bq and  $\gamma$ global – 11Bq.

We should also mention the fact that radioactivity is measured in Bq/Kg.

**Table 1.** Results of statistical analysis of radioactivity spectrophotometer measures

Vegetal product	Weight (g)	Statistical analysis (*)	Alfa activity (Bq/kg)	Beta activity (Bq/kg)	Statistical analysis (*)	Gamma activity (Bq/kg)	Statistical analysis (*)
<i>Nigellae sativae</i> semen	40.11	$\bar{X} = 40.18$	SLD	91.3	$\bar{X} = 91.8$	SLD	–
	40.13	$S_x^- = 0.0200$		91.5	$S_x^- = 0.1528$		
	40.17	$tS_x^- = 0.0514$		91.6	$tS_x^- = 0.3926$		
	40.20	$A = 40.18 \pm 0.05$		91.9	$A = 91.8 \pm 0.4$		
	40.22	–		92.1	–		
	40.25	–		92.4	–		
<i>Nigellae sativae</i> herba	8.02	$\bar{X} = 8.05$	SLD	168	$\bar{X} = 170$	SLD	–
	8.03	$S_x^- = 0.0082$		168	$S_x^- = 0.7817$		
	8.05	$tS_x^- = 0.0210$		169	$tS_x^- = 2.0091$		
	8.06	$A = 8.05 \pm 0.02$		170	$A = 170 \pm 2$		
	8.06	–		172	–		
	8.08	–		173	–		
<i>Calendulae herba</i>	11.03	$\bar{X} = 11.08$	SLD	200	$\bar{X} = 204$	SLD	–
	11.06	$S_x^- = 0.0122$		201	$S_x^- = 1.1304$		
	11.07	$tS_x^- = 0.0315$		204	$tS_x^- = 2.9051$		
	11.10	$A = 11.08 \pm 0.03$		205	$A = 204 \pm 3$		
	11.10	–		206	–		
	11.12	–		208	–		
Soil	75.13	$\bar{X} = 75.24$	SLD	244	$\bar{X} = 247$	181	$\bar{X} = 184$
	75.18	$S_x^- = 0.0313$		244	$S_x^- = 1.1547$	183	$S_x^- = 0.7746$
	75.20	$tS_x^- = 0.0804$		246	$tS_x^- = 2.9676$	184	$tS_x^- = 1.9907$
	75.27	$A = 75.24 \pm 0.08$		248	$A = 247 \pm 3$	184	$A = 184 \pm 2$
	75.31	–		249	–	186	–
	75.35	–		251	–	186	–

\* n = 6; k = n-1 = 5; t(96%) = 2.57

## DISCUSSIONS

There are no data referring to the *Nigella* radioactivity but there are plenty of other similar information about different other species with a medical value (*Atropa*, *alge*).<sup>15-17</sup>

Alpha activity of all three plants and soil as well is below detection limits (SLD).

Beta activity of the three plants was detectable and it ranges between 91.8 Bq/Kg at *Nigellae sativae* semen and 204 Bq/Kg at *Calendulae herba*.

The highest value was detected in the soil sample, which is 247 Bq/Kg.

The values of the beta activity measured for the three vegetable products and soil are below the limit of the values considered to be dangerous for people and animals, between 325-1100 Bq/Kg.<sup>8-12</sup>

As we can see in table 1, only the soil presents  $\gamma$  radioactivity, but its value is below the limit of 300 – 800 Bq/ Kg, interval acknowledged by specialized publications to be radioactive.<sup>9,10,16</sup>

Gamma radiation value measured for the three plants is below detection limits (SLD), soil  $\gamma$  radiation value 184 Bq/Kg was permissible.

It is interesting to specify that soil does not transfer  $\gamma$  type radioactivity to the three plants, which is significant for plants quality allowing therapeutic use without any risk.

Isotopes responsible for a radioactivity over detection limits may be:  $^3\text{H}$ ,  $^{40}\text{K}$ ,  $^{60}\text{Co}$ ,  $^{65}\text{Zn}$ ,  $^{131}\text{I}$ ,  $^{134}\text{Cs}$ ,  $^{137}\text{Cs}$ ,  $^{222}\text{Rn}$  etc.

The only one isotope that was detected was  $^{40}\text{K}$ .

## CONCLUSIONS

1. The radioactivity values recorded at the three plants are in permissible limits; therefore these plants are proper to be used in therapeutics products.

2. Among the three plants, the seeds of *Nigella sativa* L (*Ranunculaceae*) are least susceptible in

collecting radiation.

3. The cultivation area presents a normal radioactivity, thus showing an absence of radioactive area in that particular area selected for plants cultivation.

4. The presence of gamma radiation in the soil and the lack of it in the analyzed plants indicates that the investigated species present a low susceptibility other sensitive and therefore more predisposed to contamination species.

## REFERENCES

1. Bellakhdar J. *La pharmacopée marocaine traditionnelle*, IBIS Press, Paris; 1997, p. 126, 147, 431, 693.
2. Bruneton J. *Pharmacognosie, Phitochimie, Plantes medicinales*, Paris; 1993.
3. Toma C. *Pharmacognostic Researches of Nigella L.(Ranunculaceae)*. Master's Degree, Cluj-Napoca, 2004.
4. Grigorescu E, Lazar MI, Stanescu U, et al. *Phytotherapeutic Index*, Iasi, 2001.
5. Stahl E, Schild W. *Pharmazeutische Biologie (Vol. II)*. Gustav Fischer Verlag, Stuttgart-NY, 1981, p. 308-17.
6. Wagner H, Bladt S. *Plant Drug Analysis*. Springer Verlag, Berlin-Heidelberg, 1996, p. 99-101.
7. Tita D. *Quantitative Analytical Chemistry*. Mirton Ed., Timișoara, 1998, p. 4-15.
8. Manescu S. *Hygiene study (Vol.II)*. Ed. Medicala, București, 1985, p. 182-5.
9. Oncescu M. *Radioprotection Concepts*. Ed. Horia Hulubei, Bucuresti, 1996, p.11-15, 64.
10. *The Physics Messenger – Radioactivity Course to Supervise the Environment's Radioactivity*. Ed. Horia Hulubei, Bucuresti, 1997, p. 40-6.
11. Gopal-Ayengar AR, Nayar GG, George KP, et al. *Biological effects of high background radioactivity: studies on plants growing in the monazite-bearing areas of Kerala coast and adjoining regions*. *Indian J Exp Biol.*, 1970;8(4):313-8.
12. Marsden E. *Radioactivity of soils, plants and bones*. *Nature* 1960;16:192-5.
13. Shannon S. *Hazards of low level radioactivity*. New York, 1998, p. 345.
14. Lutz RA, Incze LS, Hess CT. *Mussel culture in heated effluents: biological and radiological implications*. Ed. RA Lucz, Elsevier, Amsterdam.
15. Mamoney MH, Khater A. *Environmental characterization and radioecological impacts of nonnuclear industries on the Red Sea coast*. *J Env Rad* 2004;73(2):151-68.
16. Lambrino V, Dumitru G, Paun R. *Study of Atropa Belladonna's natural radioactivity from different regions and the control of its active elements*. *Farmacia* 1985;33(1):35-40.