UNIVERSITATEA „ALEXANDRU IOAN CUZA”
DIN IAȘI

JOURNAL OF EXPERIMENTAL AND MOLECULAR BIOLOGY

TOME XIX, Number 2 **2018**

Editura Universității „ALEXANDRU IOAN CUZA” din Iași

EDITORIAL OFFICE

Universitatea „Alexandru Ioan Cuza" din Iași, Facultatea de BIOLOGIE
Laboratorul de Biochimie și Biologie Moleculară
Bulevardul Carol I, Nr. 20A, 700506, Iași, România
www.jemb.bio.uaic.ro / gbmpapers@yahoo.com

CONTENT

THE EFFECTS OF HORMONAL THERAPY IN MENOPAUSE

EDUARD CRAUCIUC[1]*, DIANA POPOVICI[1], ALIA SINDILAR[1], OVIDIU TOMA[2], DRAGOȘ CRAUCIUC[3]

Received: 2nd of April 2018 / Revised: 17th of April 2018
Accepted: 29th of May 2018 / Published: 29th of June 2018

Keywords: menopause, estrogens, hormone therapy.

Abstract. Through all the immediate and long-term consequences of estrogenic deprivation, menopause is an important public health issue with social, personal and economic impact. If immediate menopausal symptoms are sometimes noisy, the long-term, insidious consequences, especially cardiovascular and bone, are of major importance. In order to eliminate troublesome symptoms and prevent long-term consequences in order to provide a good quality of life for menopausal women, it is nowadays unanimously recognized that hormonal therapy is necessary in the context of adhering to recognized indications and contraindications, also rigourosly following the effects of therapy.

INTRODUCTION

Menopause, by modifying the hormonal profile (mainly by lowering estrogen hormones), is a risk factor in the development of atherosclerosis. Endothelial dysfunction plays a key role both in the pre-lesional and lesional stages of atherosclerosis (Atsma, F., et al, 2006; Al-Azzawi, F. & Palacios, S., 2009).

Endothelial dysfunction induced by *dyslipidemia*, especially oxidized LDL, is the first step in the initiation and evolution of the atherogenic process (Kalantaridou, S.N., et al, 2006).

When reaching menopause, women are prone to fluctuations of estrogen that can lead to dyslipidemia (with increased triglycerides, total serum cholesterol, LDL cholesterol, and lower HDL cholesterol) (Crauciuec, E., et al, 2006; Acken, H.S. Jr, 2000). The decrease in estrogen in the menopause leads to a change in the lipid profile, with increases in triglycerides, total serum cholesterol, LDL cholesterol and lower HDL cholesterol (with an antiatherogenic protective role) (Bădoi, D., 2012).

Studies have already shown that in the natural and surgical menopause the atherosclerotic process is based on endothelial damage caused by altered lipid metabolism. Hormonal treatment, mainly by ingesting estrogen, positively influences lipid metabolism and thereby decreases the risk of cardiovascular disease (Atsma, F., 2006; Knowlton, A.A., 2012).

With all the immediate and long-term consequences of estrogenic deprivation, menopause is an important public health issue with social, personal and economic impact. If immediate menopausal symptoms are sometimes noisy, the long-term, insidious consequences, especially cardiovascular and bone, are of major importance.

In order to eliminate troublesome symptoms and prevent long-term consequences, in order to provide a good quality of life for women in menopause, it is nowadays unanimously recognized that hormonal therapy is necessary in the context of respecting some recognized indications and contraindications and in the rigorous following of the therapy effects.

One of the main objectives of the clinical trial was to evaluate the lipid and carbohydrate profile in natural menopause and the effects of hormonal therapy. The evolution of climacteric symptomatology under treatment was also observed.

MATERIAL AND METHOD

In order to conduct the clinical study, we used the extended database of menopausal patients belonging to the Third Clinic of Obstetrics-Gynecology from "Elena Doamna" Hospital Iași and "Medical Life" Obstetrics-Gynecology Practice Iași, a database that records the menopausal patients from all over Moldova for over 15 years. Every patient recorded in the database has a medical chart containing almost 30 indicators; from this database we can extract what we are interested in, namely phytoestrogens and their effects for a certain period; this is how the three lots, the study period, the inclusion and exclusion criteria, the statistical study and the results were established.

Study groups. We studied the patients in natural menopause in 2016, ie 83 patients with anamnestic amenorrhea for at least 1 year, divided into the following study groups:

- **Lot I - 37 patients with natural menopause treated with Activelle** (1 mg estradiol + 0.5 mg norethisterone acetate);
- **Lot II - 22 patients** with natural menopause fed with natural phytoestrogens;
- **Lot III - 24 patients** in untreated natural menopause.

The inclusion criteria were as follows:

- anamnestic amenorrhoea for at least 1 year;
- absence of hormonal treatment at least for 1 year.

The clinical and paraclinical evolution of the patients was followed. Each patient had a form filled with information about: age, residence, smoking, alcohol consumption, anthropometric data, heredo-collateral history, personal physiological and pathological priors, onset of menopause, previous hormonal treatments, clinical symptomatology, paraclinical assessment, type of treatment in menopause.

At the onset of the study the presence of climacteric symptoms was assessed and we performed the following:

- measuring waist, weight, blood pressure;
- complete clinical and genital examination;
- Babeș - Papanicolau cytological smear;
- ultrasound for measuring the thickness of the endometrium;
- evaluation of lipid metabolism parameters: total serum cholesterol, triglycerides, LDL cholesterol, HDL cholesterol;
- blood glucose, TGP, hemoglobin;
- EKG;
- mammography and osteodensitometry.

Biochemical determinations used serum obtained after blood collection in "activator clot" tubes and centrifugation at 4000 rpm for 10 minutes. An automated clinical chemistry analyzer, RX Imola model, with the use of calibrators and control serum, was used to determine the biochemical parameters.

Hormonal estrogen therapy

Estrogen administration is the main way to treat menopause (Bădoi, D., 2012).

Classification of estrogen types:

- *natural:*
  - estrone; estriol;
  - 17-β estradiol;
  - estradiol valerate;
  - piperazin estriol sulfate;
  - phytoestrogens;
  - conjugated equine estrogens.
- *of synthesis:*
  - ethinylestradiol;
  - mestranol;
  - estrogen esters;
  - non-steroidal synthesis estrogens.

Foods with natural phytoestrogens

Whole grains, hops, humus and soybeans, through proven health benefits, are being used increasingly in the human diet and can be given the name of nutritional supplement (Bădoi, D., 2012; Cardenau, H, 2010).

Also, phytoestrogenic products from raspberries and sage leaves were consumed.

Administration requires individualized dosing and is performed in the form of cures of at least one month, usually in combinations with other plants (depending on individual needs), under the strict indication and supervision of a specialist (Crauciuec, E., et al, 2006).

Retrospective study. The data were selected from the observation sheets and processed using the statistical functions of the SPSS 18.0.

In calculating the significant difference between two or more groups, based on the distribution of the value series, to the significance threshold of 95% for the quantitative variables we apply: the t-Student test– parametric test that compares recorded mean values in 2 groups with normal distributions; F test (ANOVA) used when three or more groups with normal distributions are compared; "Pearson" correlation coefficient (r) is the correlation of two variables in the same group (direct / indirect correlation).

RESULTS

Structure of groups by age. Analyzing the age of the patients on the three study groups using the ANOVA test, the following aspects show (tab. I):

- group I: women with natural menopause treated with Activelle, the age varied between 40 and 62 years, with a moderate variation in the value series (9.46%); the mean age of the group was 51.70;

- group II: women with natural menopause fed natural phytoestrogens, the age varied between 48 and 58 years old, with the smallest variance in the range of values (4.94%); the mean age of the group was 51.68;
- group III: women with natural menopause without treatment, the age varied between 45 and 56, with a reduced range of the value series (6%); the mean age of the group was 52.13.

Table I. Statistical indicators of the age (years) of the patients on study groups

Group	Mean	std Dev.	Std Err.	Min	Max	IC95%	variance %	Median
I	51.70	4.89	0.80	40	62	49-54	9.46	52
II	51.68	2.55	0.54	48	58	50-53	4.94	51
III	52.13	3.13	0.64	45	56	50-55	6.0	52

The distribution according to the place of origin has shown the following aspects:

- in the groups of treated menopausal patients, the proportion of patients from rural areas was between 4.5 and 8.1%;
- 29.2% of patients with untreated natural menopause originated from rural areas, significantly higher distribution compared to other groups.

Evaluation of lipid metabolism parameters under hormonal treatment

The clinical study aimed at evaluating the parameters of lipid metabolism and the effect of hormonal treatment.

Total serum cholesterol (mg/dL)

In the untreated natural menopause group, if at onset the mean cholesterol values were significantly lower compared to those recorded in the groups chosen for hormone treatment, at the end of the study the mean values were significantly higher, suggesting the beneficial effect of the treatment (tab. II).

During the monitoring, mean cholesterol values showed significant differences, showing the beneficial effect of treatment:

- in the group of patients with naturally occurring menopause treated with Activelle mean total cholesterol levels decreased significantly from mean values of 196.95 mg/dL to 146.49 mg/dL (r= -0.99);
- in the group of natural menopausal patients fed with natural phytoestrogens, there was a significant decrease in mean total cholesterol values from about 202 mg/dL to 149 mg/dL (r= -0.51);
- to note that in the untreated group of patients with untreated natural menopause the evolution of the mean total cholesterol had an increasing trend during the monitoring, ranging from 165.83 mg/dL to 189.17 mg/dL (r= +0.78).

Table II. Average total cholesterol (mg/dL) values per study lot/group

Lot	monitoring time (months)			
	V0	V6	V12	V24
I	196.95 ± 40.64	179.68 ± 45.75	160.54 ± 40.96	146.49 ± 38.75
II	201.68 ± 33.44	187.73 ± 44.50	167.73 ± 46.39	148.64 ± 41.67
III	165.83 ± 30.63	176.25 ± 23.37	183.33 ± 22.00	189.17 ± 21.85

Triglycerides (mg/dL)

The evolution of mean triglyceride values during monitoring has shown significant decreases in hormone-treated natural menopausal groups, highlighting the beneficial effect of treatment (tab. III):

- in the group of patients with natural menopause treated with Activelle (group I), mean triglyceride levels decreased significantly during monitoring, from mean values of 132.10 mg/dL to 104.59 mg/dL (r= -0.56);
- in the group of natural menopausal patients fed with natural phytoestrogens (group II), there was a significant decrease in mean triglyceride levels from approximately 116 mg/dL to 103.81 mg/dL (r= -0.63);
- it should be noted that in the group of untreated natural menopause patients (group III) the evolution of the mean triglyceride values had an increasing trend during the monitoring, ranging from 149.20 mg/dL to 167.50 mg/dL (r= +0.77).

Table III. Average triglyceride (mg/dL) values per studied group

Lot	monitoring time (months)			
	V0	V6	V12	V24
I	132.10 ± 55.86	124.58 ± 41.83	115.32 ± 34.93	104.59 ± 28.79
II	115.50 ± 42.75	116.45 ± 43.31	110.18 ± 40.11	103.81 ± 35.41
III	149.20 ± 18.86	156.25 ± 25.52	162.67 ± 29.70	167.50 ± 24.36

The fact that, regardless of the time of the study, the highest mean triglyceride values were observed in the untreated group, significantly higher than in the treated groups, underlines the importance of estrogens in the metabolism of triglycerides.

LDL cholesterol (mg/dL)

The mean LDL cholesterol values during the study showed significant decreases (tab. IV):

- in the group of Activelle-treated natural menopausal patients (group I) mean LDL cholesterol values decreased significantly from 121.86 mg/dL to 102.27 mg/dL (r = -0.63);
- in the group of natural menopausal patients fed with natural phytoestrogens (group II) there was a significant decrease in mean LDL cholesterol from 126.95 mg/dL to 95,91 mg/dL (r= -0.89);

- it should be noted that in the batch of untreated natural menopause patients (group III) the evolution of mean LDL cholesterol had an increasing trend, ranging from 91.67 mg/dL to 117.08 mg/dL (r= +0.83).

Table IV. Mean LDL cholesterol (mg/dL) values per studied group

Lot	monitoring time (months)			
	V0	V6	V12	V24
I	121.86 ± 33.24	122.32 ± 36.32	111.19 ± 34.19	102.27 ± 32.31
II	126.95 ± 30.83	115.73 ± 29.81	107.73 ± 26.37	95.91 ± 24.23
III	91.67 ± 25.14	102.92 ± 21.56	111.25 ± 22.32	117.08 ± 22.16

At the start of the study, in the untreated natural menopausal group, the mean LDL cholesterol levels were significantly lower compared to those of the groups chosen for hormone therapy or phytoestrogens.
At the end of the study, mean LDL cholesterol values were significantly higher in the untreated group.
These results show that, due to lack of estrogen in menopause, hypercholesterolemia is an atherogenic risk factor.

HDL cholesterol (mg/dL)
In hormone treatment groups, during the monitoring, mean HDL cholesterol values showed significant increases (tab. V):

- in the group of Activelle-treated natural menopausal patients (group I) mean values of HDL cholesterol significantly increased from 54.20 mg/dL to 71.41 mg/dL (r = +0.96);
- in the group of natural menopausal patients treated with natural phytoestrogens (group II) there was a significant increase in mean HDL cholesterol values from 57.36 mg/dL to 69.91 mg/dL (r= +0.81);
- it should be noted that in the group of untreated natural menopausal patients (group III) the evolution of mean HDL cholesterol had a decreasing trend during the monitoring, ranging from 44.17 mg/dL to 41.08 mg/dL (r = -0.66), which shows the lack of protective effect of estrogen in this context.

Table V. Mean values of HDL cholesterol (mg/dL) per studied group

Lot	monitoring time (months)			
	V0	V6	V12	V24
I	54.20 ± 17.60	58.95 ± 14.40	65.84 ± 11.93	71.41 ± 11.80
II	57.36 ± 19.66	63.45 ± 16.57	66.41 ± 12.17	69.91 ± 8.96
III	44.17 ± 6.02	46.04 ± 7.94	43.92 ± 7.95	41.08 ± 8.04

Other biochemical parameters

À jéun glycemia (mg/dL)

The glycemic values determined on study groups show the following (tab. VI):

- the mean glycemia levels were initially significantly higher in group II (treated with phytoestrogens) (101.68 mg/dL) compared to the other groups;
- after 6 months of treatment, the mean values of glycemia were significantly more reduced for the group treated with Activelle (group I) (90.95 mg/dL);
- after 12 months of treatment, the mean values of glycemia were significantly increased for the group with natural menopause without treatment (group III) (101.33 mg/dL) when compared with the other groups;
- 2 years post-treatment the highest mean blood glucose levels are found in patients with natural menopause without treatment 103.08 mg/dL).

Table VI. Mean values of glycemia (mg/dL) on studied groups

Lot	monitoring time (months)			
	V0	V6	V12	V24
I	90.67 ± 19.54	90.95 ± 7.69	91.03 ± 5.44	90.08 ± 5.30
II	101.68 ± 10.75	94.51 ± 5.73	92.00 ± 6.13	91.18 ± 5.18
III	93.38 ± 4.48	96.71 ± 7.30	101.33 ± 10.98	103.08 ± 8.16

The evolution of the mean values of glycemia showed the following aspects:

- for the group of patients with natural menopause treated with Activelle, the mean values of glycemia decreased slightly during monitoring (r= -0.17);
- for the group of patients with natural menopause fed naturally with phytoestrogens there was a significant decrease in mean glycemia levels (r= -0.64);
- it is noted that in the group of menopausal patients without a hormone treatment, there was a significant increase in mean blood glucose levels after 2 years (r= +0.76).

TGP (UI/L)

The following must be noted about the studied groups, regardless of the moment of studying (tab. VII):

- the highest mean values of TGP can be found in the group without treatment (group III);
- for the groups following treatment, the highest mean values of TGP can be found in the patients treated with Activelle (group I).

Table VII. Mean values of TGP (UI/L) on studied groups

Lot	monitoring time (months)			
	V0	V6	V12	V24
I	23.90 ± 7.78	25.52 ± 9.21	25.70 ± 9.41	25.86 ± 8.55
II	23.77 ± 8.45	21.55 ± 1.84	21.14 ± 1.17	21.09 ± 1.19
III	27.71 ± 3.38	28.67 ± 3.21	28.79 ± 3.40	29.21 ± 3.45

During monitoring, the groups with natural menopause with hormonal treatment, showed the following evolution of the mean values of TGP:

- for group I of patients with natural menopause, treated with Activelle, the mean values of TGP increased significantly, from 23.90 UI/L to 25.86 UI/L (r= +0.75);
- for group II of patients with natural menopause treated with, the mean values of TGP decreased from 23.77 UI/L to 21.09 UI/L (r= -0.16);
- the evolution of mean TGP values had an increasing trend during the monitoring, ranging from 27.71 UI/L to 29.21 UI/L (r= +0.73).

Hemoglobin (g/dL)

The following aspects have been found after studying the groups (tab. VIII):

- at the start of the study, in the batch treated with synthetic or natural phytoestrogens the mean hemoglobin values were significantly lower than the untreated group;
- after 12 months of treatment, mean hemoglobin values became homogeneous on the study groups (11.14-11.31 g/dL), which is maintained at 2 years post-treatment (11.09-11.26 g/dl)

Table VIII. Mean hemoglobin (g/dL) values on study groups

Lot	monitoring time (months)			
	V0	V6	V12	V24
I	11.70 ± 0.75	11.30 ± 0.77	11.26 ± 0.69	11.26 ± 0.65
II	11.80 ± 1.09	11.40 ± 0.58	11.18 ± 0.50	11.09 ± 0.53
III	12.00 ± 0.26	11.70 ± 0.46	11.31 ± 0.46	11.21 ± 0.41

The evolution of the mean values of hemoglobin revealed the following aspects:

- in the group of patients with natural menopause treated with Activelle, mean hemoglobin values decreased significantly during follow-up (r= -0.69);
- also the group of natural menopausal patients treated with natural phytoestrogens showed a significant decrease in the mean values of hemoglobin (r= -0.67);
- it should be noted, however, that also in the group of hormonal untreated menopausal patients, there is a significant decrease in the mean values of hemoglobin after 2 years (r= -0.66).

DISCUSSIONS

Cholesterol is an organic alcohol, sterol that is identified in the cell membrane and body tissues and transported in the blood. It is concentrated in the marrow, brain and plaque of the atheroma, leading to atherosclerosis.

Triglycerides are an essential component of the lipid profile, included on the list of risk factors for the metabolic syndrome by most current guidelines. Hypertriglyceridemia is associated with endothelial dysfunction and increased risk of cardiovascular disease, particularly associated with lowering HDL cholesterol and elevating LDL cholesterol.

HDL cholesterol plays an important role in the metabolism of cholesterol, participating in its transport from extrahepatic tissues to the liver for catabolism and excretion (Hayward, C.S., et al., 2001). Together with LDL, it helps maintaining cellular cholesterol levels (Farhat, M.Y., et al., 1996; Jairath N., 2001).

High LDL cholesterol contributes to favoring the development of endothelial dysfunction, with a role in the pre-lesional stage of atherosclerosis (Carl, B. & Laven A.,2007).

The most important studies on hormonal therapy in menopause are (ACOG, 2004):
- the observational study Nurses Health Study (NHS) (70.000 de femei women analysed), in which treated women were cardiac asymptomatic and showed a lower incidence of cardiovascular disease and overall mortality in women under hormone therapy compared to those without hormone therapy. It is important to know that most women in this study started TH in perimenopause and had no cardiovascular disease detected at the beginning of the study.
- HERS (The Heart and Estrogen/Progestin Replacement Study) was the first published trial of secondary prevention in a group of 2763 women with known cardiovascular disease, monitored right from the time of appearance. For an average period of time of 4.1 years there was no significant difference between those taking hormone therapy and placebo. There was a possible improvement on the longer term, but the study did not last for more than 7 years.
- the largest randomized study is WHI (Women's Health Initiative), which included 16,608 women with an intact uterus who used only conjugated equine estrogens and medroxyprogesterone acetate as hormonal therapy versus placebo, over a period of time of over 5.6 years. The study was stopped earlier due to an increase in the number of cases of breast cancer and a lack of cardiovascular benefits in women with hormone therapy. An additional group of 10,739 women hysterectomized women with the same therapy, conjugated equine estrogens + medroxyprogesterone acetate versus placebo, was analyzed, showing that there are no cardiovascular benefits for these women.

WISDOM study that was taking place in England in that period and that used the same therapy was interrupted after the WHI results were published.
WHI study is considered a very important one because it changed the perception about TH, but this study had many limitations: the mean age of the women of 63 years old, more than 10 years later than the age when menopause begins, significant differences among the women taking part in the study, only one type pf treatment, and one administration manner.
Thus, at the beginning of the 21st century, prescribing and using TH is still controversial, randomized studies (WHI, HERS) showing that estrogen may be beneficial for preventing early atherosclerotic lesions, but are ineffective and even harmful if the disease is installed.
Based on the results of the randomized trials, the observational studies (PEPI, NHS) and their comparison showed that the relative risk of coronary artery disease increases with years of menopause and that in the hormone therapy-coronary / cardiovascular disease equation, the beginning of hormonal therapy means everything: hormone therapy should begin before the fibrous capsule formation of the atheromatous plaque, which was found to be between 45 and 55 years of age; women starting hormonal therapy around menopause have a significant reduction in the risk of coronary artery disease (RR= 0.66 for single estrogens and 0.72 for estrogens+ progestative).
Hormonal therapy is beneficial in postmenopausal women, taking into account the results validated over time in observational studies and is being discussed as primary prevention in cases without coronary artery disease at the age of 50 years under 60 years of age during the 10 years from the onset of menopause. For elderly women, therapy is individualized, the benefit being relative to the recommended age and dose.
There is an ongoing study called KEEPS (The Kronos Early Estrogen Prevention Study) which uses 0.45 mg conjugated equine estrogens or 50 μg transdermal estradiol in women at most 36 months after the last menstrual period and will show the effects on cardiovascular disease. Today there is scientific evidence that estrogen has effects on almost all systems and apparatuses of the female body (Waren, M.P., 2004). Because of this, various symptoms have been associated with decreased

estrogen, occurring in menopause. It is important to emphasize that not all symptoms occur to any woman, but there are some who encounter the highest frequency, such as vaso-motor and uro-genital symptoms (Peterson HB, 2004).
Even if there is a category of symptoms that are rarely encountered, they can affect the quality of menopausal woman's life (Davey, D.A., 2012).
In this study, patients treated with synthetic estrogens showed an increased frequency of hot flashes, migraines, asthenia, insomnia, reduced libido and vaginal dryness. Hormone therapy removes all these symptoms and besides the immediate improvement in the quality of life, it exerts a long-term protective role on the risks of osteoporotic fractures, cardiovascular disease and the risk of Alzheimer's disease. It is considered today that, with the exception of absolute contraindications and taking into account the necessary precautions in a number of general illnesses, 80% of women could benefit from hormone therapy. For control of menopausal symptoms, hormonal therapy administered for up to 5 years is appropriate, with prolongation for a further 5 years, if the symptom reoccurs at interruption. Hot flushes, palpitations, insomnia and psychological problems improve after estrogen therapy for 3 months in 90% of cases (Hudiță, D., et al, 2003; Christenson, E.S., et al., 2012).
The major beneficial effects of hormonal therapy in menopause are represented by (Maki, P.M., et al, 2004; Gruber, C.J., 2002):

- *resolving menstrual irregularities and perimenopausal bleeding*

Continuous-combined therapy (only after histological investigation of the cause of bleeding) with sequential estro-progestative preparations solves the problem, effectively controlling the proliferation of the endometrium and restoring the regularity of menstrual cycles. Continuous-combined TH can be recommended after a year of amenorrhea; the continuous-combined treatment is safe for the endometrium when it is proposed for the long term (Bodinet, C. & Freudenstein, J., 2004).

- *the immediate, common symptoms of menopause*

There are publications that signal the results of experimental and clinical studies on the efficacy of phytoestrogens in the postmenopausal woman (Clarkson, T.B. et al, 2001).
The evaluation of the effectiveness of the therapy is done clinically, asking the patient about his / her general condition, the persistent symptomatology or the ones appeared under therapy.
Clinical evaluation shows evidence of underdosage or overdose, which should be noted in the patient's follow-up sheet, estrogen doses then being adjusted according to the type of patient-indicated signs (tab. IX).

Table IX. Criteria for clinical assessment of estrogen tolerance (according to Pelinescu-Onciul D, 2001)

Signs of underdosing	**Signs of overdosing**
- persistence or recurrence of heat waves	- mastodynia
- vaginal dryness	- weight gain
- asthenia	- abdominal bloating
- headache	- "heavy" lower limbs
- feeling cold	- nervousness, irritability, insomnia
- lack of tone, depression	
- joint pain	
- urinary disorders	

CONCLUSIONS

Based on the cases studied, the epidemiological characteristics revealed a slightly higher mean age of the patients treated with synthetic or natural phytoestrogens, coming predominantly from cities or towns, married and with an average educational status.
The patients started therapy in less than 5 years after the onset of menopause, thus respecting the "window of opportunity".
The moment they started treatment was around the age of 50.
Patients fed with natural phytoestrogen had a normal weight, while patients treated with synthetic estrogens were overweight.
Treatment with estrogen, synthetic or natural, has resulted in an improvement in the onset symptoms: hot flushes, migraines, asthenia, reduced libido, insomnia and vaginal dryness.
The climacteric symptomatology resolved under treatment.
In patients with natural menopause, hypercholesterolemia is an atherogenic risk factor due to estrogen deficiency.
The highest mean triglyceride values are noted in the untreated group, which shows the importance of estrogens in triglyceride metabolism.
Patients with natural menopause, whether or not treated with estrogen, recorded significant decreases in mean hemoglobin level.
Under hormonal treatment, changes in lipid profile have been achieved with a cardiovascular protective role, by the antiatherogenic effect of lowering total serum cholesterol, triglycerides and LDL cholesterol, and especially by the increase in HDL cholesterol.

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[1] "Gr.T.Popa" University of Medicine and Pharmacy, Iași, România, „Elena Doamna" Iaşi Clinical Hospital
[2] "Alexandru Ioan Cuza" University, Iași, România
[3] The Institute of Forensic Medicine, Iași, România

* crauciuc@yahoo.com

STUDY ON PHYTIC ACID CONTENT IN SOME ROMANIAN CEREAL SEEDS

MARCEL AVRAMIUC[1*]

Received: 26th of April 2018 / Revised: 10th of May 2018
Accepted: 27th of May 2018 / Published: 29th of June 2018

Keywords: phytic acid, cereal**,** flour, bran

Abstract. The phytic acid content of the flour and bran from seeds, belonging to four cereal species, as well as the effect of thermal treatment on this acid was the purpose of this paper. The biological material was represented by dried seeds (moisture content 10%) of twelve Romanian cultivars (c), belonging to four cereal species: wheat (3 c), rye (3 c), oat (3 c) and maize (3 c). The seeds of each species were ground to get integral flour and bran. The phytic acid content was analyzed, using Garcia-Villanova method, in the flour and bran, before and after thermal processing (180°C for 50 minutes). They also determined pH values of the integral flour and bran in the four cereal species. Analyzing the phytic acid in integral flour and bran of raw samples, the highest and close values were in rye and maize, and the least ones in wheat and oat. Thermal processing of the both products (flour and bran) led to highest and significant reducing percent of phytic acid in rye, followed by oat and wheat samples with close values, the least reducing percent of phytic acid being in maize samples.

INTRODUCTION

Phytic acid (myo-inositol hexakisphosphate, InsP6) is an organic compound present in plant seeds and grains *(Rose, 1912; Averill and King, 1926; Harland and Oberleas, 1987; Reddy et al., 1989*), roots and tubers (*Harland and Oberleas, 1987; Wolters et al., 1993; Ravindran et al., 1994*), fruits and vegetables (*Harland and Oberleas, 1987; Wolters et al., 1993; Ravindran et al., 1994*), nuts (*Harland and Oberleas, 1987; Wolters et al., 1993*, cited by *Reddy, 2002*) and in other vegetable sources.

Phytic acid is a strong chelator of divalent minerals such as copper, calcium, magnesium, zinc, and iron (*Sathe and Reddy, 2002*), and studies on animals and humans highlighted that phytates decrease mineral bioavailability by forming complexes with these minerals (*Reddy et al., 1989; Krebs, 2000*).

According to some authors (*Cheryan, 1980; Thompson, 1993*) phytic acid can also form complexes with proteins as phytate-protein and phytate-mineral-protein, adversely influencing protein digestion and bioavailability. With starch, phytate can bind either directly, by hydrogen bonding, with a phosphate group or indirectly, through the proteins (*Rickard and Thompson, 1997*), which may result in a decrease of starch solubility and digestibility (*Sathe and Reddy, 2002*).

Food phytates have not only negative effects, as mentioned before, but also beneficial effects including lowering of serum cholesterol and triglycerides, and protection against certain diseases such as cardiovascular diseases, renal stone formation, and certain types of cancers (*Thompson, 1993; Rickard and Thompson, 1997; Zhou and Erdman, 1995; Shamsuddin et al., 1997; Grases et al., 2000; Urbano et al., 2000; Graf, 1983*, cited by *Sathe and Reddy, 2002*).

In this paper, the phytic acid content of the flour and bran from seeds, belonging to four cereal species, was studied, as well as the effect of the heat treatment on this compound.

MATERIALS AND METHODS

Research materials. The biological material, coming from the last year crop, was represented by seeds of twelve romanian cultivars (c) belonging to four cereal species: wheat (3 c), rye (3 c), oat (3 c) and maize (3 c). The seeds were dried (moisture content 10%), and after that they were ground to get integral flour and bran, for each species.

Procedure and research methods. The phytic acid content was analyzed in integral flour and bran, before and after the thermal processing of the same materials, in oven at 180°C for 50 minutes. They also determined pH values of the integral flour and bran in the four cereal species.

The phytic acid was determined using Garcia-Villanova method (*Bordei et al., 2007*). They weighed 2 g of flour or bran, added 40 ml of HCl-Na_2SO_4 solution and leaved to stand for 90 minutes, stirring intermittently (to extract phytic acid). They filtered and collected 25 ml of the filtrate, which were placed in a stoppered tube, then added 20 ml of HCl-Na_2SO_4 solution, 20 ml hydrochloride solution of ferric chloride, and 20 ml of 20% sulfosalicylic acid solution. It boiled water in the closed tube for 15 minutes on a water bath, then cooled under a stream of water. It formed the ferric filtrate

precipitate which was separated by filtration. From the clear (obtained) filtrate, it took 25 ml, placed in an Erlenmeyer flask, added about 175 ml of distilled water, and then adjusted the pH to 2.5 ± 0.5 with glycine. The mixture obtained was heated to 70°C and was titrated the excess of Fe^{3+} (which has not precipitated with phytic acid), with 0.15M EDTA solution until the color shifted to bright yellow. The result was expressed in g phytic acid per 100 g product (%). Four replicates for each determination were used to get the data of experiments.

Determination of pH was made with a digital pH meter supplied by Hanna Instruments.

Statistical analysis. The experimental data were statistically processed using SAS Version 8.02 (*SAS Institute, 2005*)**.** To analyze the significance of differences among samples, generalized linear model analysis was carried out, and for multiple comparisons, Duncan's multiple range test ($P<0.05$) was used.

RESULTS AND DISCUSSIONS

In the Table 1 are rendered the values of phytic acid and pH in samples coming from four cereal species, before and after thermal processing.

Table 1. Phytic acid content mean values (±SD) and pH in flour and bran of cereal seeds

Cereal samples	Raw samples				Thermal processed samples	
	Flour		Bran		Flour	Bran
	pH	Phytic acid (%)	pH	Phytic acid (%)	Phytic acid (%)	Phytic acid (%)
W1	5.3	1.22±0.5**FG***	5.2	3.17±0.9**AB**	0.96±0.03**GH**	2.54±0.7**C**
W2	5.4	1.16±0.7**FG***	5.3	2.98±0.4**AB**	0.89±0.08**H**	2.42±0.8**CD**
W3	5.2	1.07±0.6**G**	5.3	2.83±0.5**B**	0.83±0.05**H**	2.33±0.5**D**
R1	4.6	1.20±0.8**FG**	4.7	3.17±0.5**AB**	0.81±0.04**H**	2.27±0.4**D**
R2	4.7	1.45±0.4**F**	4.7	3.34±0.4**A**	0.92±0.05**GH**	2.34±0.6**D**
R3	4.6	1.27±0.7**FG**	4.8	3.28±0.7**A**	0.81±0.07**H**	2.35±0.3**D**
O1	5.4	1.08±0.6**G**	5.2	3.10±0.5**AB**	0.82±0.06**H**	2.48±0.5**CD**
O2	5.4	1.12±0.9**G**	5.3	2.78±0.8**BC**	0.83±0.04**H**	2.27±0.8**D**
O3	5.3	1.18±0.7**FG**	5.3	3.04±0.6**AB**	0.91±0.02**GH**	2.40±0.9**CD**
M1	5.8	1.17±0.4**FG**	5.7	3.10±0.3**AB**	0.97±0.06**GH**	2.62±0.6**C**
M2	5.8	1.31±0.5**F**	5.5	3.29±0.7**A**	1.07±0.8**G**	2.80±0.5**BC**
M3	5.7	1.25±0.2**FG**	5.6	3.24±0.6**A**	1.03±0.05**G**	2.72±0.2**BC**

SD=standard deviation; W1-3=wheat cutivars; R1-3=rye cultivars; O1-3=oat cultivars; M1-3=maize cultivars;
*Means with the same letters within a column are not statistically diferent ($P<0.05$)

As seen from Tab. 1, the pH values of cereals flour ranged between 4.6 (rye) and 5.8 (maize), and pH of cereals bran between 4.7 (rye) and 5.7 (maize).

Analyzing the phytic acid in integral flour of raw (unprocessed) samples, the highest values were in rye (1.45%) and maize (1.31%) with close values, and the least ones in wheat (1.07%) and oat (1.08%) with close values too ($P<0.05$).

According to some authors (*Lolas et al, 1976; Eechkhout and Depaepe, 1994; DeBoland et al., 1975; Kikunaga et al., 1985; Harland and Prosky, 1979*), cited by *Reddy N.R.* (*2002*), the phytic acid content of some cereal grains ranges between the following limits: 0.39%-1.35% (wheat), 0.54%-1.46% (rye), 0.42%-1.16% (oat) and 0.75%-2.22% (maize).

In the bran of raw samples, the phytic acid registered the highest and close values in rye (3.28% - 3.34%) and maize (3.24% - 3.29%), and the least one in oat (2.78%) and wheat (2.83%).

As seen, the phytic acid content in bran was higher then in flours, because, according to *Reddy (2002)*, in most cereals phytate is concentrated in the germ and aleurone layers (pericarp)

of the grain cells. In maize 88% of phytate is concentrated in the germ portion of the grain (*O'Dell et al., 1972*).

By some data, the phytic acid content of wheat bran ranges between 2.02% and 5.27% (*Harland and Prosky, 1979; Ellis and Morris, 1982; Harland and Oberleas, 1986; Kirby and Nelson, 1988; Lehrfeld and Wu, 1991; Eechkhout and Depaepe, 1994; Gualberto et al., 1997; Kasim and Edwards, 1998*) and the phytic acid of oat bran between 0.60% and 1.42% (*Frolich and Nyman, 1988; Gualbert et al., 1997; Kasim and Edwards, 1998*).

After thermal processing, the phytic acid of flour registered the highest value in maize (1.07%), and the least ones in rye (0.81%), oat (0.82%) and wheat (0.83%) with close values ($P<0.05$).

The highest phytic acid content of thermal processed bran was in maize (2.80%) and the least ones in oat, rye and wheat samples, with close values (2.27% - 2.33%).

Analyzing the average values of phytic acid in flour and bran it can be observed that in all cases they were reduced by thermal processing.

The table 2 highlights the reduction percentage of phytic acid in cereals flour and bran due to thermal processing.

Table 2. Reduction percentage of phytic acid average values in flour and bran thermal processed, compared to raw

Cereal samples	Phytic acid reduction percents	
	Flour	Bran
W1	−21.31% **d**	−19.87% **e**
W2	−23.27% **cd***	−18.79% **e**
W3	−22.43% **cd***	−17.66% **ef**
R1	−32.50% **ab**	−28.39% **bc**
R2	−36.55% **a**	−29.94% **b**
R3	−36.22% **a**	−28.35% **bc**
O1	−24.07% **cd**	−20.00% **e**
O2	−25.89% **c**	−18.34% **ef**
O3	−22.88% **cd**	−21.05% **de**
M1	−17.09% **f**	−15.48% **fg**
M2	−18.32% **e**	−14.89% **fg**
M3	−17.60% **ef**	−16.05% **fg**

W1-3=wheat cutivars; R1-3=rye cultivars; O1-3=oat cultivars; M1-3=maize cultivars; *Means with the same letters within a column are not statistically diferent ($P<0.05$)

Thus, compared to raw samples, the thermal processing of flour, at 180°C for 50 minutes, led to highest and significant reducing percent of phytic acid in rye (−36.55%), followed by oat and wheat samples with close values; the least reducing percent of phytic acid (−17.09%) was in maize samples ($P<0.05$).

Under the same conditions, the thermal processing of bran led to highest and significant reducing percent of phytic acid in rye (−29.94%), followed by oat and wheat samples with close values, the least reducing percent (−14.89%) being also in maize samples ($P<0.05$).

One can observe that thermal processing, at 180°C for 50 minutes, caused a higher reducing of phytic acid content in flour, compared to bran. It is possible that the presence of cellulose and lignin in the bran composition to partially protect the phytic acid from the harmful

action of high temperatures.

Some of these results are consistent with observations and data reported by certain authors.

A significant percent of phytate hydrolysis can take place due to activation of endogenous phytases and acid phosphatases, during the early part of the cooking phase (*Sathe and Venkatachalam, 2002*).

According to some authors (*Reddy et al., 1989; Mckenzieparnell and Davies, 1986; Sathe and Venkatachalam, 2002*), the phytic acid content of cereals in reduced by fermentation and bread making with 8.9% in the whole-meal breads (unleavened) and with 66-100% in white breads.

It seems that pH and cooking temperature are important factors reducing the content of phytic acid, because in doughs with pH 4.3–4.6 phytic acid is more effectively reduced than in doughs with higher pH (*Fretzdorff and Brümmer, 1992*).

In our experiment the least pH values (4.6-4.7) were registered in rye samples, and also at these samples were recorded the highest reductions in the content of phytic acid by exposure to high temperature.

CONCLUSIONS

The analyze of phytic acid content in the integral flour and bran of grains, belonging to four cereal species, evidenced some significant differences between species.

Thus, the highest phytic acid content of integral flour and bran was in rye and maize with close values, and the least one in wheat and oat with close values too.

In all analyzed samples, the phytic acid content of bran was significantly higher then of integral flours.

The thermal processing of flour and bran (180°C for 50 minutes) led to highest and significant reducing percent of phytic acid in rye, followed by oat and wheat samples with close values, the least reducing percent of phytic acid being in maize samples.

The thermal processing caused a higher reducing of phytic acid content in flour, compared to bran, probable due to the presence of cellulose and lignin in the bran composition, which partially protect this acid from the harmful action of high temperatures.

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ACKNOWLEDGMENTS
Many thanks to Suceava Genebank and to Suceava Agricultural Research and Development Station for the biological material provided.

[1] Faculty of Food Engineering, Stefan cel Mare University of Suceava
* avramiucm@fia.usv.ro

ELVIRA TĂNASE, Senior Lecturer PhD
80th Birthday Anniversary

Conferențiar universitar dr. ELVIRA TĂNASE
la a 80 – a aniversare

Conferențiarul universitar Elvira Tănase s-a născut la 4 iunie 1938, în comuna Dărmănești, Județul Suceava, ca cel de al doilea copil din cei patru ai părinților săi, mama Ștefania (casnică) și Victor Achiței (funcționar căi ferate). Doamna Elvira Tănase a făcut parte dintr-o familie deosebită, unită, cinstită, distinsă și respectată, toți membrii ei având dragoste față de muncă și responsabilitate cetățenească, manifestată prin respectarea legilor țării și prețuirea pentru localitățile moldovenești , de asemenea, pentru toată România.

Elvira Achiței, căsătorită Tănase, a urmat școala primară și gimnazială la Școala elementară din Gura Humorului (1945 – 1952), apoi studiile liceale la Școala Medie Mixtă de 10 ani din Câmpulung Moldovenesc între anii 1952 – 1955. După absolvirea liceului, a susținut examenul de admitere la Facultatea de Chimie a Universității „Alexandru Ioan Cuza" din Iași, unde și-a luat licența în specialitatea Chimie Organică în anul 1960.

Numărându-se printre colegele și colegii din anul său care au dovedit o foarte bună pregătire profesională, pasiune pentru specialitatea aleasă, disciplină și dragoste de muncă, absolventa Elvira Tănase a fost încadrată, la 1 octombrie 1960, ca preparator la disciplina de Chimie biologică (al cărui titular era profesor dr. Elisabeta Văscăuțeanu), Catedra de Chimie fizică și Chimie generală, Facultatea de Chimie a Universității „Alexandru Ioan Cuza" din Iași. Între 1 octombrie 1961 și 1 octombrie 1964, Elvira Tănase a ocupat postul de asistent suplinitor la aceeași disciplină de Chimie biologică. Începând cu anul universitar 1964-1965, este asistent suplinitor, apoi din 1969, asistent titular la disciplina de Chimie generală din Universitatea „Alexandru Ioan Cuza" din Iași.

De la data de 15 septembrie 1974, în urma transferării Facultății de Chimie de la Universitatea „Alexandru Ioan Cuza" la Institutul Politehnic „Gh. Asachi" din Iași, Colectivul de Chimie și Biochimie, din care făcea parte și doamna Elvira Tănase, a trecut la Facultatea de Biologie-Geografie. Toți membrii micului Colectiv de Chimie și Biochimie veniți de la Facultatea de Chimie s-au integrat rapid și eficient în colectivul Catedrei de Biologie Animală de la Facultatea de Biologie-Geografie, remarcându-se prin punctualitate, responsabilitate, conștiinciozitate și devotament față de noul loc de muncă.

În urma concursului ținut în noiembrie 1981, doamna Elvira Tănase devine șef de lucrări titular la disciplina de Chimie generală de la Facultatea de Biologie-Geografie-Geologie. Onorează această funcție până în decembrie 1990, când trece pe postul de conferențiar, la disciplina de Chimie generală, poziția 13 din Statul de funcțiuni și personal didactic al Catedrei de Biologie

Senior Lecturer PhD ELVIRA TĂNASE
80th Birthday Anniversary

Senior Lecturer Elvira Tănase was born on 4 June 1938, in Dărmănești Town, Suceava County, as the second child of the four of her parents' offspring, mother Ștefania (housewife) and father Victor Achiței (railway clerk). Mrs. Elvira Tănase was part of an outstanding, united, honest, distinguished and respectable family, all its members being hardworking and responsible citizens; accordingly they observed Romanian laws and cherished Moldavian towns and equally the entire territory of Romania.

Elvira Achiței, married Tănase, attended elementary and middle school with the Elementary School of Gura Humorului City (1945 – 1952), then secondary education with *the Compulsory Secondary School of Câmpulung Moldovenesc City* over the period from 1952 to 1955. After graduating from secondary education, she took the admission examination with the Faculty of Chemistry of "Alexandru Ioan Cuza" University of Iași City, where she passed the final examination, in 1960, in the specialty of Organic Chemistry.

Being amongst the peers of her year class who proved thorough vocational training, passion for the specialty chosen, tenacity and love for work, the graduate Elvira Tănase was employed, as of 1 October 1960, as Graduate Assistant of Biochemistry (Professor PhD Elisabeta Văscăuțeanu being the Course Coordinator), the Department of Physical Chemistry and General Chemistry, the Faculty of Chemistry of "Alexandru Ioan Cuza" University of Iași City. Over the period from 1 October 1961 to 1 October 1964, Elvira Tănase held the position of Junior Assistant of the same course of Biochemistry. As of the academic year 1964-1965, she is Junior Assistant, then as of 1969, Senior Assistant of the course of General Chemistry of "Alexandru Ioan Cuza" University of Iași City.

As of 15 September 1974, following the relocation of the Faculty of Chemistry from "Alexandru Ioan Cuza" University to "Gh. Asachi" Polytechnic Institute of Iași City, the Teaching Staff of Chemistry and Biochemistry, equally including Mrs. Elvira Tănase, was welcomed with the Faculty of Biology - Geography. All members of the Staff of Chemistry and Biochemistry coming from the Faculty of Chemistry rapidly and efficiently adapted to the teaching staff of the Department of Animal Biology within the Faculty of Biology – Geography, remarking themselves via punctuality, responsibility, consciousness and devotion as opposed to the new workplace.

Following the contest held in November 1981, Mrs. Elvira Tănase becomes Senior Reader of General Chemistry with the Faculty of Biology – Geography – Geology. She holds this position as of December 1990, when she is promoted to Senior Lecturer PhD of General Chemistry, the 13th

vegetală de la Facultatea de Biologie a Universității „Alexandru Ioan Cuza" din Iași. Această promovare a doamnei Elvira Tănase s-a făcut în urma concursului susținut sub auspiciile Comisiei având-l președinte pe domnul prof. dr. Constantin Toma, iar ca membri : prof. dr. Nicolae Iorga, conf. dr. Vlad Artenie și conf. dr. Constantin Ciugureanu, toți de la Universitatea „Alexandru Ioan Cuza" din Iași.

În calitate de asistent, șef de lucrări și conferențiar, doamna Elvira Tănase a condus lucrări practice de laborator la disciplinele de Chimie biologică și Chimie generală cu studenții biologi și naturaliști, la disciplina de Chimie generală cu studenții din anul I Inginerie geologică și geofizică, la disciplina de Chimie cu studenţii de la Facultatea de Fizică, la disciplina de Tehnologie cu studenţii de la Facultatea de Ştiinţe Economice, la disciplinele de *Biochimie anorganică* şi *Structura chimică a glucidelor şi lipidelor* cu studenţii de la specializarea de Biochimie a Facultăţii de Biologie din cadrul Universității „Alexandru Ioan Cuza" din Iași.

Ca șef de lucrări și conferențiar, doamna Elvira Tănase a predat următoarele cursuri :

- cursul de *Chimie organică* la studenţii străini din anul pregătitor ;
- cursul de *Chimie generală* la studenții din anul I, secția de Științe Naturale și Agricultură de la Facultatea de Biologie-Geografie-Geologie ;
- cursul de *Tehnologie* la studenţii din anul II de la Facultatea de Ştiinţe Economice ;
- cursul de *Chimie generală* la studenții din anul I de la secția de Biologie și de la secția de Ecologie de la Facultatea de Biologie ;
- cursurile de *Biochimie anorganică* şi *Structura chimică a glucidelor şi lipidelor* studenţilor din anul II de la specializarea Biochimie de la Facultatea de Biologie.

În activitatea de conducere a lucrărilor practice de laborator la disciplinele menţionate şi în predarea cursurilor enumerate, doamna conferenţiar Elvira Tănase s-a impus prin reale calităţi de cadru didactic valoros şi competent. În acest sens a dovedit o temeinică pregătire de specialitate, devotament faţă de profesia aleasă, înţelegere a problemelor studenţilor, preocupare permanentă pentru modernizarea conţinutului lucrărilor de laborator şi a cursurilor ţinute. Prelegerile prezentate de doamna conferenţiar Elvira Tănase se distingeau prin ţinuta lor ştiinţifică, fiind bine fundamentate teoretic, accesibile şi prezentate într-o manieră clară, ceea ce atrăgea interesul generaţiilor de studenţi, la a căror formare au contribuit.

În ideea de a ajuta studenții în însușirea unor cunoștințe de specialitate cât mai profunde, Elvira Tănase, în calitate de coautor, a elaborat și a multiplicat două manuale de lucrări practice și a publicat un curs :

- în anul 1981, împreună cu conferențiar dr. Vlad Artenie, manualul *Practicum de biochimie generală*, pentru studenții din anul II de la secția de Biologie a Facultății de Biologie-Geografie-Geologie, iar din anul

position of the Charter of Positions and Teaching Staff of the Department of Plant Biology of "Alexandru Ioan Cuza" University of Iași City. Mrs. Elvira Tănase's promotion was done following the contest organized under the coordination of the Board presided by Mr. Prof. PhD Constantin Toma, and including the members: Prof. PhD Nicolae Iorga, Senior Lecturer PhD Vlad Artenie and Senior Lecturer PhD Constantin Ciugureanu, of "Alexandru Ioan Cuza" University of Iași City.

As Assistant, Senior Reader and Senior Lecturer, Mrs. Elvira Tănase coordinated practical laboratory works at the courses of Biochemistry and General Chemistry with students of Biology and Natural Sciences, at the course of General Chemistry with 1st year students of Geological Engineering and Geophysics, at the course of Chemistry with students of the Faculty of Physics, at the course of Technology with students of the Faculty of Economic Sciences, at the courses of *Inorganic Chemistry and Chemical Structure of Carbohydrates and Lipids* with students of the specialty of Biochemistry of the Faculty of Biology within "Alexandru Ioan Cuza" University of Iași City.

As Senior Reader and Lecturer, Mrs. Elvira Tănase taught the following lectures:

- the lecture of *Organic Chemistry* for foreign students of the preparatory year;
- the lecture of *General Chemistry* for 1st year students, year class of Natural Sciences and Agriculture of the Faculty of Biology – Geography – Geology;
- the lecture of *Technology* for 2nd year students of the Faculty of Economic Sciences;
- the lecture of *General Chemistry* for 1st year students of the year class of Biology and year class of Ecology of the Faculty of Biology;
- the lectures of Inorganic Chemistry and Chemical Structure of Carbohydrates and Lipids for 2nd year students of the specialty of Biochemistry of the Faculty of Biology.

While coordinating the activity of the laboratory practical works of the courses aforesaid and in teaching the lectures enumerated, Mrs. Senior Lecturer Elvira Tănase imposed herself via genuine qualities of valuable and proficient professor. Accordingly, she revealed thorough vocational training, devotion as opposed to the career chosen, sympathy with regard to the students' issues, ongoing preoccupation for the modernization of the corpus of laboratory works and lectures held. The lectures presented by Mrs. Senior Lecturer Elvira Tănase distinguished themselves via their scientific nature, being well substantiated from theoretical standpoint, accessible and presented in a clear manner, facts catching the attention of generations of students, thus contributing to their training.

To support students in acquiring new solid specialty knowledge, Elvira Tănase, as co-author, drafted and multiplied two textbooks of practical works and published a lecture:

1990 pentru studenții de la Facultatea de Biologie care au audiat cursuri de biochimie ;

- în anul 1984, împreună cu profesor univ. dr. Elena Budeanu și lector dr. Valentina Jurcă, un manual de *Lucrări practice de chimie generală*, destinat studenților din anul I de la secția de Biologie a Facultății de Biologie-Geografie-Geologie, iar după anul 1990 studenților biologi și ecologi de la Facultatea de Biologie care aveau în planul de învățământ disciplina de *Chimie generală* ;

- în anul 1992, doamna conferențiar dr. Elvira Tănase, împreună cu alți colegi de la Facultatea de Biologie, sub coordonarea profesorului dr. Vlad Artenie, a publicat cursul „*Chimie Organică* pentru studenții străini din anul pregătitor" în Editura Universității „Alexandru Ioan Cuza" din Iași.

Trebuie să mai notăm că doamna conferențiar dr. Elvira Tănase a ținut prelegeri de sinteză în cadrul perfecționării cadrelor didactice din învățământul preuniversitar, a îndeplinit funcția de secretar al comisiei pentru examenul de licență, de președinte la examenul de bacalaureat, a participat ca membru în comisiile de admitere la secția de Biologie, respectiv la secția de Geologie de la Universitatea „Alexandru Ioan Cuza", a condus mai multe lucrări de licență la Facultatea de Biologie, a îndrumat studenții la practica pedagogică și la practica productivă.

În anul 1979, doamna Elvira Tănase obține titlul științific **de doctor în chimie,** specializarea Chimie Organică, în urma susținerii cu succes a tezei de doctorat „Sinteza de noi tiocarbanilido-tiosemicarbazide derivate de la acidul antranilic, produsele de ciclizare si combinațiile cu unii cationi metalici", elaborată sub conducerea științifică a profesorului doctor docent inginer Constantin H. Budeanu de la Facultatea de Tehnologie Chimică a Universităţii Tehnice „Gh. Aschi" din Iași. Teza de doctorat realizată de Elvira Tănase aduce contribuții importante la cunoașterea derivaților acidului antranilic (acidlui *orto* – aminobenzoic) care este un reactiv specific pentru identificarea și determinarea unor metale și a nitriților.

În paralel cu bogata activitate didactică, doamna conferențiar Elvira Tănase a desfășurat o susținută activitate de cercetare științifică. Singură sau în colaborare a publicat 65 de lucrări științifice în reviste din țară sau străinătate și este coautoare a unui brevet de invenție. Lucrările științifice, elaborate de doamna Elvira Tănase, singură sau în colaborare, se axează pe următoarele direcții :

- sinteza și studiul unor noi acil-tiosemicarbazide derivate de la acidul antranilic cu

potențială activitate biologică ;

- cercetări de biochimie vegetală vizând particularitățile biochimice ale unor plante cultivate (soia, fasole) și spontane (*Berberis* L.) ;
- studii de biochimie animală axate pe cercetarea unor indicatori ai profilului

metabolic-sanguin la găinile purtătoare de *Salmonella*

- in 1981, together with Senior Lecturer PhD Vlad Artenie, the textbook *Practicum of General Biochemistry*, for 2nd year students of the year class of Biology of the Faculty of Biology – Geography – Geology, and in 1990 for the students of the Faculty of Biology where she recorded lectures of Biochemistry;

- in 1984, together with Professor PhD Elena Budeanu and Reader PhD Valentina Jurcă, a textbook of *Practical Works of General Chemistry*, for 1st year students of the year class of Biology of the Faculty of Biology – Geography – Geology, and after 1990 for students of Biology and Ecology of the Faculty of Biology whose curriculum comprised the course of *General Chemistry*;

- in 1992, Mrs. Senior Lecturer PhD Elvira Tănase, together with other peers of the Faculty of Biology, under the coordination of Professor PhD Vlad Artenie, published the lecture of „*Organic Chemistry* for Foreign Students of the Preparatory Year" with the Publishing House of "Alexandru Ioan Cuza" University of Iași City.

We should equally mention that Mrs. Senior Lecturer PhD Elvira Tănase held synthesis lectures within the further training of the teaching staff of pre-academic tuition, held the position of registrar of the final examination board, of chairman at the general certificate of secondary education examination, participated as member in the boards for the admission examination with the year class of Biology, respectively with the year class of Geology of "Alexandru Ioan Cuza" University, coordinated several final papers with the Faculty of Biology, guided the students towards pedagogic and productive practicum.

In 1979, Mrs. Elvira Tănase earned the scientific degree of **Doctor (PhD) of Chemistry,** specialty Organic Chemistry, following the successful defence of the doctoral thesis *„Sinteza de noi tiocarbanilido-tiosemicarbazide derivate de la acidul antranilic, produsele de ciclizare si combinațiile cu unii cationi metalici" (Synthesis of new thyocarbanilido-tiosemicarbazide derivated from anthranilic acid, ….and combinations with some mattalic cations0,* elaborated under the scientific coordination of Professor PhD Docent Engineer Constantin H. Budeanu of the Faculty of Chemical Technology of "Gh. Aschi" Technical University of Iași City. The doctoral thesis written by Elvira Tănase brings significant contributions to the knowledge of the derivates of the anthranilic acid (*ortho* – aminobenzoic acid) which is a reactive specific for the identification and determination of a series of metals and nitrites.

In parallel with the rich teaching activity, Mrs. Senior Lecturer Elvira Tănase conducted a sustained scientific research activity. On her own or as collaborator, she published 65 scientific works in national or international journals and is co-author of a patent. The scientific works drafted by Mrs. Elvira Tănase, on her own or as collaborator, focus on the following guidelines:
synthesis and study of a series of new acyl-thiosemicarbazides derived from the anthranilic acid with

pullorum, precum și numeroase cercetări realizate pe bază de contracte în care se studiază particularitățile biochimice privind nutriția salmonidelor în condiții de creștere intensivă în apa lacului de acumulare Bicaz.

Lucrările științifice publicate de doamna conferențiar Elvira Tănase abordează teme originale, atât de importanță fundamentală cât și practică. Multe din rezultatele acestor cercetări științifice au fost prezentate la diferite manifestări științifice naționale (Congresul Național de Chimie, Conferința de Biochimie și altele) și internaționale (International Symposium "Aquaculture and Fishing" – Galati, 1995).

Pe lângă obligațiile de cadru didactic și sarcinile de cercetare științifică, pe care le-a îndeplinit cu răspundere, doamna conferențiar Elvira Tănase a avut o mare responsabilitate familială, concretizată în creșterea, în condiții deosebite, a celor două fiice ale sale, Mirela și Irina, care au reușit să devină licențiate spre bucuria mamei lor, astăzi fiind și dânsele mame.

La împlinirea vârstei de 80 de ani, Consiliul profesoral al Facultății de Biologie și membrii Colectivului de Chimie generală și Biochimie îi aduc un respectuos omagiu doamnei conferențiar dr. Elvira Tănase și îi urează multă sănătate, cu liniște sufletească, împreună cu alese bucurii.

Profesor Universitar Asociat Emeritus Dr. Vlad ARTENIE

potential biologic activity;
researches of Plant Biochemistry envisaging the biochemical peculiarities of a series of cultivated plants (soy, beans) and spontaneous plants (*Berberis* L.);
researches of animal biochemistry focused on the research of a series of indices of the blood-metabolic profile in hens bearers of *Salmonella pullorum*, as well as numerous researches conducted based on contracts studying the biochemical peculiarities pertaining to the nutrition of salmonids under circumstances of intensive growth in the waters of the Bicaz accumulation lake.
The scientific works published by Mrs. Senior Lecturer Elvira Tănase deal with original topics, of both fundamental and practical importance. Many of the findings of these scientific research works were presented on the occasion of various national scientific manifestations (National Congress of Chemistry, Biochemistry Conference and others) and international scientific manifestations (International Symposium "Aquaculture and Fishing" – Galati, 1995).
Apart from her obligations of professor and scientific research tasks, which she diligently fulfilled, Mrs. Senior Lecturer Elvira Tănase had a tremendous family responsibility, materialized in the upbringing, under special circumstances, of her two daughters, Mirela and Irina, who succeeded in completing bachelor studies, to their mother's joy. Today, Mirela and Irina are also mothers.

Upon her turning 80-year old, the Teaching Board of the Faculty of Biology and the staff of General Chemistry and Biochemistry bring their most respectful homage to Mrs. Senior Lecturer PhD Elvira Tănase and wish her health, peace and tranquillity, alongside cherished joys.

Associate University Professor Emeritus, Ph.D. Vlad ARTENIE

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