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**The Influence of Age, Occupation and Diseases Suffered on the
Concentration of Fructose in the Semen**

Wpływ wieku, zawodu oraz przebytych chorób na poziom fruktozy w nasieniu

There are several factors influencing the gynecologist's interest in andrology. The role played by the male partner in reproduction is appreciated more and more nowadays. It is found that in civilized countries the percentage of infertile marriages reaches 10—20 (2). In such infertile marriages, 30—40% of the cases can be attributed to the male partner. It was Moench (6) who first threw doubt on the opinion that, in an infertile marriage, not only the woman but also the man should be subjected to examination. There are various methods of examining men and further new methods are constantly developing. These methods provide facilities for a better understanding of the pathogenesis and pathophysiology of sexual glandular diseases in men (1, 5, 9, 12, 13, 14). Available methods of determining the presence and amount of gonadal and gonadotrophic hormones have put the hormone balance of testicles into a new perspective in relation with the anterior lobe of the pituitary gland and suprarenal cortex (quantitative determination of gonadotrophic hormones and 17-ketosteroids in urine (3, 5). The biopsy of testicles, basing on anatomopathologic examinations, provides the possibility of finding changes in the parenchyma of testicles (14). During the last ten years, Borelli, Mann, Nadworny, Schirren, Vasterling (1, 5, 7, 12, 20), examined the chemical composition of seminal plasma in order to devise new diagnostic tests. The previously accepted methods of microscopic examination of spermatozoa led to the estimation of the generative role of the testicle but it could not help in the estimation of the endocrinologic function of the testicles (4). On the other hand, biochemical examinations provide facilities for the estimation of the functional or even the anatomic state of accessory glands: the seminal vesicles of the pubic gland and Cowper glands (5, 13, 18, 21). The activity of the accessory glands is connected with the endocrinologic part of the testicle, i.e. the Leydig cells (5, 13, 17).

In order to estimate the secretory activity of the system of Leydig cells in testicles, the fructose concentration in the seminal plasma is determined (5, 9, 12, 16, 19). The examinations of fructose concentrations in animal semen have frequently

been carried out but sufficient experiments on men have not yet been made, especially in respect of clinical diagnosis and subsequent therapy.

In the present paper I wish to show the suitability of applying the determination of fructose concentration in the seminal plasma of infertile men to the diagnosis of the secretory insufficiency of testicle.

MATERIAL AND METHOD OF EXAMINATION

The experiments were carried out in the Andrologic Outpatient Department in Lublin; 140 men were examined and treated for their matrimonial infertility. The threefold examination of each patient's semen was performed and in consequence 420 results of the examinations of ejaculates were obtained. The intervals between the consecutive examinations of semen were 3 weeks to 3 months. The sexual abstinence of the patients lasted, in most cases, 6 to 8 days. The samples of semen were obtained by means of masturbation. Sexual life, general clinical state of the patients and, first of all, the clinical state of the patients' sexual organ were taken into account. Each man was subjected to urologic examination. In some cases the blood and urine of the patients were analysed. There were no patients suffering from diabetes. The age of the men examined was 20 to 51. The amount of fructose in seminal plasma was determined by Roe's method in Nadworny's modification (7, 11).

To 0.5 ml of previously fluxed semen, 7.5 ml of distilled water was added and after mixing, 1 ml of 10% solution of zinc sulphate in water and 1 ml of 0.5 N solution of sodium hydroxide were admixed. The mixture was placed in boiling water and kept there for 1 minute so that a better coagulation of the semen albumens could be secured. Clear liquid was obtained after centrifugation of the mixture. 2 ml of the clear solution (corresponding to 0.1 ml of examined semen) was added to 2 ml of 0.1% solution of resorcin in ethanol and 6 ml 30% solution of hydrochloric acid. The solution obtained was kept in a water bath for 10 minutes at a temperature of 80°C. In these circumstances the reaction between the fructose of semen and resorcin results in a coloured compound. When the solution had been cooled under running water, it was subjected to colorimetric examination. The measurements were carried out with the Coleman Colorimeter. (Photo-Electric Coleman Colorimeter, model 8, USA, 1949, filter 8—209, wave length 525 m, with circular test tubes 6—110 with layer thickness of 10 mm.).

The obtained extinction values were the basis of the calculation of fructose concentration in semen. The calibration of the Coleman Colorimeter was accomplished with the use of standard solution of Merck fructose in distilled water. The results obtained from the colorimeter readings of extinction and calibration plot were multiplied by 10, and the figures thus obtained were the amounts of fructose in semen in gamma/ml. The errors of the measurements were within the limits of 2%.

THE RESULTS OF MEASUREMENTS

The results of the measurements of fructose concentration are referred to the patient's age, occupation, and diseases suffered in infancy and later.

In order to discuss in detail the results obtained, the 140 examined cases are divided into 4 groups. The first group consists of 72 men (51.4%)

in the age group 20—30 years. The majority (62 cases) shows the contents of fructose in the semen, within physiological limits, 1300—4200 γ /1 ml. In 10 cases only the fructose concentration was lower, namely 400—1000 γ /1 ml. The second group consists of 55 cases (39.2) of men in the age group 31—40 years. In these cases the fructose concentration was within the limits of 750—5250 γ /1 ml. A fructose concentration below 1200 γ /ml was found in 9 men only. The third group consists of 10 men (7.2%) in the age group 41—50 years. In these cases the fructose concentration amounts to 1500—3700 γ /1 ml. The fourth group consists of 3 men (2.2%) in the age group 51—60 years. Here the fructose concentration is 2150—4200 γ /ml. The results obtained are shown in Table 1.

Table 1. Fructose and the age of men

A G E				
Fructose concentration in γ /1 ml	20—30	31—40	41—50	51—60
	400—5350	750—5250	1500—3700	2150—4200
Number of cases	72	55	10	3

The above presented figures show that there are clear correlations between the fructose concentration in the semen plasma and the age of patients examined. Both young (20—30 years old) and middle-aged patients display low, decreased, or normal values of fructose concentration. The men over 40 years of age have normal fructose concentration in the semen within limits of 2000—3000 γ /1 ml.

Taking into account the fructose concentration in the semen of 140 patients and their occupations, the following groups were distinguished:

The first group — 39 men (27.8%) — intellectual workers. The fructose concentration remains within normal limits (1300—3600 γ /1 ml) in 36 of them. Only three patients of this group have low fructose concentration in their semen (namely 500—800 γ /1 ml). The second group — 101 men (72.2%) — manual workers were subdivided as follows:

a) Group of 18 men working as car drivers and car repairmen. In this group the fructose concentration oscillated within a fairly wide range, namely 700—5050 γ /1 ml. The low values, below 1200 γ /1 ml occurred in 2 patients only (700 and 750 γ /1 ml of semen).

b) Group of 38 men, working on country farms showed a level of fructose concentration within the limits of 600—5250 γ /1 ml. In this group a comparatively large proportion showed the predominance of the medium (1700—3000 γ /ml) and low (600 γ /ml in 10 cases) values of fructose concentration in the semen.

c) Group of 44 men — working as craftsmen (joiners, tailors, electricians, transport workers) showed the normal level of fructose concentration (1400—5600 γ /1 ml), except 4 cases, showing the concentration of 600—700 γ /1 ml.

d) This group consists of one petrol pump worker. The level of fructose concentration in his semen was within normal limits, namely 1650 γ /1 ml.

Table 2

Occupation	Intellectual workers	manual workers					Petrol pump workers
		Drivers repairmen	Farm workers	Electricians	Transport workers	Joiners tailors	
Fructose concentration γ /1 ml	500—4300	700—5050	600—5250	1300—4000	400—4100	1500—5300	1600
Number of patients	39	18	38	10	20	14	1

The information described above is presented in Table 2. From the above results of comparison of fructose concentration in the patient's semen and their occupation no clear conclusions can be drawn. The representatives of all the occupations showed low values of fructose concentration in the semen as well as decreased and normal ones. The only exception was the group of 10 farm workers with the low fructose concentration (below 1200 γ /1 ml).

The obtained material was, afterwards, considered from the point of view of relation between the fructose concentration in the patients' semen and diseases suffered by them in the past. First of all, it was divided into 10 groups, according to the type of disease suffered. Table 3 represents the division.

Among 140 examined patients, the largest group consisted of men who could not name the diseases they had suffered from in the past. The 69 men (49,3%) displayed normal concentration of fructose in the semen (over 1200 γ /1 ml). 26 men (18,6%), who had suffered from virus diseases (measles, small-pox, *roseola*, *influenza*) in childhood, displayed normal fructose concentration in the semen, namely 1500—3300 γ /1 ml. The next group consisted of 15 men who in childhood or in mature age had suffered from *pneumonia*, *tuberculosis*, whooping cough, or

Table 3. The fructose concentration and diseases suffered

Diseases suffered	The amount of fructose in $\gamma/1$ ml	Number of cases
In good health	1400—5300	69
Virus diseases (measles, small-pox, <i>roseola</i>)	1500—3300	26
Bacterium diseases (<i>pneumonia</i> , <i>nephritis</i> , <i>tuberculosis</i>)	800—4100	15
<i>Parotitis</i>	400—4250	14
<i>Gonorrhoea</i>	500	1
Inflammation of testicle	1000—2150	9
Trauma of testicle (<i>hydrocele</i>)	1700	1
<i>Ejaculatio praecox</i>	1700—3500	4
Cranial trauma	600	1

tonsillitis. Ten patients from this group showed decreased values of fructose concentration (800—1000 $\gamma/1$ ml) in the semen, and only 5 had a fructose concentration higher than 1500 $\gamma/1$ ml. 14 patients (10%) had suffered in their childhood from *parotitis* together with inflammation of the testicles. Nine of these patients had fructose concentration in the semen 1300—4250 $\gamma/1$ ml and five — below 800 $\gamma/1$ ml.

Inflammation of the testicles before the period of puberty was registered in 9 men (6.4%), whose concentrations of fructose in the semen were within the limits of 1000—2150 $\gamma/1$ ml. Four men (2.8%) with *ejaculatio praecox* revealed fructose concentration within the range 1700—3500 $\gamma/1$ ml. Decreased values of fructose concentration in the semen were found in men who suffered from *gonorrhoea* or trauma of the cranium connected with the loss of consciousness (500—600 $\gamma/1$ ml), but a patient who had trauma of testicle showed the normal level of fructose concentration (1700 $\gamma/1$ ml). The above results indicate that the infectious diseases suffered by the patients notably influenced the fructose concentration in the semen. The majority of men who had suffered from infectious diseases displayed a decreased level of fructose concentration in the semen (below 1200 $\gamma/1$ ml).

DISCUSSION

The above described results of my work do not indicate that there is any connection between the concentration of fructose in the seminal plasma of the 140 examined patients and their age. However, Schirren (12) has stated that such a relation occurs since in ageing organism the fructose concentration in the semen decreases because of feebleness

of the hormonal activity of the testicles. Figure 1 shows the fructose concentration as a function of the age of patients, according to Schirren (12).

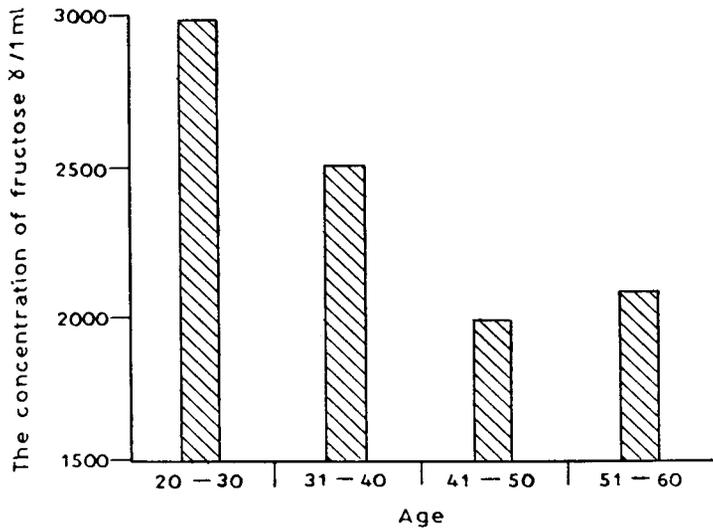


Fig. 1. Fructose concentration in the semen and the age of men

Nowakowski and Ritzman (8, 10) also observed this correlation. Nowakowski (8), who carried out the examination of patients aged between 61 and 70 years, notified that the concentration of fructose in the plasma of semen diminished in direct proportion to the age of the patient. In this case there is a distinct correlation between the secretion of testosterone and the concentration of fructose in the semen. When an organism grows old the gradual atrophy of endocrine glands takes place, and the secretion of testosterone by Leydig cells decreases. Tillinger (14) also noticed that the gradual atrophy of Leydig cells takes place when a patient grows senile. Nowakowski (8) maintains that the size of testicles does not lessen, because Leydig cells represent only 12% of bulk in relation to the tubules and canaliculi of the testicles. Pincus and Romano (as quoted by Schirren) published the information that the older the man the lower the secretion of testosterone, and the lower the secretion of 17-ketosteroides in urine (10). The occupation of men examined seems not to have any influence on the concentration of fructose in the semen. It seems that it would be very useful to examine more numerous groups of men, including representatives of various professions, in which the general state of health and the endocrine activity of gonads is under harmful influence. This could help to draw more precise conclusions.

The influence of infectious diseases on the concentration of fructose in the plasma of semen in the examined men is fairly clearly established. In agreement with other authors (10, 12) I could find decreased values of fructose concentration in men who had suffered in the past from *parotitis*, *gonorrhoea* and *tuberculosis*. Similar observations were made by Ritzman (6) who found among 11 patients showing the concentration of fructose below 1200 γ /1 ml as many as 7 cases of *parotitis*. In considering the results obtained I would like to mention that among the 19 men with the low concentration of fructose (below 1200 γ /1 ml) in semen as many as 17 had some disease in the past. Pathologic conditions probably caused the lesion of the endocrine activity of testicle. It must be presumed that not only the lesion within the testicle but also other disturbances of fructose synthesis in organism take place (diseases of seminal vesicles, of metabolism etc.).

Conclusions

1. The examination of the concentration of fructose in the semen of 140 men did not show any distinct relation with the age of the patients.
2. The occupation of the patients did not influence the concentration of fructose in their semen.
3. A decreased concentration of fructose in semen (below 1200 γ /1 ml) occurred in men who had suffered in the past from infectious diseases.

Summary

An examination of fructose concentration in the semen of 140 men was carried out in the Andrologic Outpatient Department in Lublin. The men were examined and treated for their matrimonial infertility.

The fructose determination was carried out by Roe's method as modified by Nadworny. The obtained results were considered in relation to the patients' age, occupation and diseases suffered. The experiments indicated that there was no distinct correlation between the concentration of fructose in the semen and the age and occupation of patients. However, most of the men who had suffered from various diseases (especially from infectious diseases) showed decreased fructose concentration below 1200 γ /1 ml.

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Wpływ wieku, zawodu oraz przebytych chorób na poziom fruktozy w nasieniu

Streszczenie

Badania poziomu fruktozy w plazmie nasienia przeprowadzono u 140 mężczyzn zgłaszających się w Wojewódzkiej Przychodni Andrologicznej w Lublinie, z powodu niepłodności małżeńskiej. Fruktozę oznaczano według metody Roe zmodyfikowanej przez Nadwornego. Uzyskane wartości fruktozy w nasieniu odnoszono do wieku, zawodu oraz przebytych chorób. Na podstawie przeprowadzonych badań nie zauważono wyraźnej zależności poziomu fruktozy nasienia od wieku i wykonywanego zawodu pacjentów. U większości mężczyzn, którzy przebyli różne schorzenia a przede wszystkim choroby zakaźne poziom fruktozy w nasieniu był poniżej wartości prawidłowych (poniżej 1200 γ /1 ml).

**Влияние возраста, профессии и перенесенных заболеваний
на уровень фруктозы в семени****Резюме**

Определен уровень фруктозы в плазме 140 мужчин, обращавшихся в андрологическую консультацию по поводу супружеского бесплодия. Содержание фруктозы было определено по методу Роз в модификации Надворного. Полученные данные автор сопоставлял с возрастом, профессией и перенесенными заболеваниями пациентов. Исследования не выявили отчетливой зависимости уровня семенной фруктозы от возраста и профессии. Тогда как у большинства мужчин, перенесших разные заболевания, а в первую очередь инфекционные, уровень семенной фруктозы был ниже нормы (меньше 1200 γ /мл).

