RESEARCH REGARDING EFFECT OF MONOSODIUM GLUTAMATE ON HEALTH OF LABORATORY MICE

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Abstract

Utilization of food additives represents a technique which is more and more present in modern food industry but this one doesn't have always favourable effects on human organism but on contrary. The study carried out by us aimed to present the impact of one of the most controversial food additives, monosodium glutamate, on organism of laboratory mice and implicit on human organism. Research were carried out on three mice batches, each with 10 individuals, from which one was the control batch LM and two experimental batches LE1 and LE2. Mice from LM received specific nourishment and the animals belonging to the other two batches received besides that specific food different doses of monosodium glutamate, respectively 3% at batch LE1 and 5% for batch LE2. Experimental mice have enjoyed water at their discretion during the whole research period. Research took place during a period of 28 days. In the whole period has been monitored feed consumption, dynamic of corporal mass, and at the end were gathered blood samples for study of some haematological indexes and some parameters connected with blood biochemistry. At the end of the study we observed that MSG induced higher corporal mass gains with 38.4–59.4% at mice from experimental batches face to the ones from control batch, and feed consumption was higher with 7.5–13.8% at experimental batches face to the same reference batch – fact which leads to obesity. Blood analysis show the fact that at animals from experimental batches was recorded a qualitative degradation of blood and very high deviations for the majority of analysed sanguine biochemical parameters. Those aspects show a severe degradation of mice's health state which formed the experimental batches.

Key words: monosodium glutamate, food additives, mice, health

INTRODUCTION

Contemporary society has a growing emphasis on role of nourishment and its impact on human organism health. Besides necessities of human organism in nutritive substances, foods are a prevention factor for some diseases, helps at slowing of organism aging and last but least assures an improvement of our life quality. Otherwise, are introduced new terms in this domain and modern sciences, such as nutrigenomics, proved us one more time the important role which is played by nourishment. This new science comes with some very well-argued hypothesis and sustains the fact that *we are really what our parents and ancestors ate.* Also, we have to take in account the fact that each individual is unique, so also the alimentary diets must be personalized.

Food which is analysed by the perspective of its complexity could not be perceived only as delectation or as a physiological necessity. The profound study of those issues shown the fact that food is a bearer of information from environment and have a direct connexion with human organism [8]. Informational matrix is codified in macronutrients; micronutrients and non-nutrients with neglect the qualitative and quantitative rates between those components.

Following the development of manufacturing and capitalization technology from the last two centuries, foodstuffs suffered multiple changes regarding their natural character. So, in contemporary world agriculture became a chemically one mainly due to its intensification, soils are more and more chemically and biologically polluted

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resulting raw materials which by processing leads to obtain of foodstuffs with modified properties. Natural sensorial characteristics are substituted quite frequently by food additives which influence the colour, taste, aroma and texture of foods.

Starting form the hypothesis that all foods must be safety for consumption we can say that utilization of some banned food additives or utilization of additives in higher rates than imposed by actual norms could lead to alteration of consumers' health state.

One of the most utilized food additives is monosodium glutamate (E621) which could be founded also on other names such as: Chinese salt, sodium caseinate, malt extract, hydrolysed vegetal protein etc. This one provokes a unique gustative sensation called also umami being utilised also as aroma enhancer in many cuisines [4], [5]. Recent research suggests the existence of some receptors for glutamate-L (GLU) and transduction molecules in intestinal mucosa as well as in oral cavity. Afferent gastric nerve response specifically to stimulus excited by GLU in stomach and adjusts the autonomous reflexes. Intra-gastric infusion of monosodium glutamate also activates some brain zones (insular cortex, limbic system and hypothalamuses) and it is capable to induce gustative preferences learned by mice [1], [9], [11].

In the last years, additionally face to basic standard tastes (sweet, sour, bitter and salty), umami taste was classified as being the fifth basic taste. Typical umami taste is caused by monosodium glutamate with is utilised for seasoning of many foodstuffs in different cultures [10], [11]. Studies concluded that utilization of monosodium glutamate into a standard nourishment increase the alimentary intake. Over-nourishment induced in this way caused metabolic disorders associated with oxidative stress, obesity, cerebral diseases (Parkinson, Alzheimer, cerebral cancer, cerebral vascular accident) and even infertility [2],[3], [12].Due to toxicity of monosodium glutamate were also recorded pronounced manifestation of fear, allergies (especially at persons which suffers of asthma) [7].

MATERIAL AND METHOD

Highlighting the impact of monosodium glutamate on organism was realised by tests on laboratory mice. For the current study we formed three mice batches LM, LE1andLE2; each of those being composed by 10 individuals. Mice from control batch received specific nourishment and animals from the other two batches received besides that specific food different doses of monosodium glutamate, respectively3% at batch LE1and5% for batch LE2. Experimental mice have enjoyed water at their discretion during the whole research period.

Administrated food was under the form of granules and the ingredients were: corn, wheat, soybean meal, sunflower, fish flour, powder milk, sugar, monocalcium phosphate, calcium carbonate, salt, amino acids and a mix of minerals and vitamins; nutritive value was: metabolisable energy 3200 kcal/kg, CP– 20.8%, CC– 4.3%, lysine– 1.11%, methionine + cysteine– 0.71%.

Study was carried out during 28 days, while were made 5 individual weightings and after that the data were statistically processed being calculated the mean, standard deviation of mean and variation coefficient. Also, was effectuated the testing calculation of variance by applying Fisher test.

In the whole period has been monitored food consumption, and at the end were gathered blood samples for study of haematological indexes (white blood cells, red blood cells, haemoglobin, haematocrit, platelets, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration(MCHC)) and some parameters connected with blood biochemistry (glucose, albumin, total proteins, total cholesterol, triglycerides, TGO/AST, TGP/ALT) [6].

RESULTS AND DISCUSSIONS

Dynamics of weight increase

At the beginning of the experiment were individually weighted all the mice, after this weighting we observed that between those three batches were recorded significant statiscally differences because mice from batch LE2had a mean corporal mass of 19.3 g, value which was lower with 8.8–22.2%

than the ones recorded at batch LE1and LM (tab. 1).

From the point of view of batches' homogeneity, we observed that at batch LM V% was 27.9 which indicate that batch is heterogeneous, but at experimental batches were highlighted a medium homogeneity (V%=22–23.3).

At the second weighting the differences between those three batches were lower but also significant from statistically point of view. So, at batch LM mean corporal mass was 25.8 g, with 8.1–17% lower face to the means calculated for the other two batches. In this situation those three batches presented a medium homogeneity.

Table 1 Corporal mass of studied mice

Weightings	Statistics	LM	LE1	LE2
initial	$\overline{x} \pm s_{\overline{x}}$ (g)	23.6±2.1	21.0±1.5	19,3±1,3
	V%	27.9	23.3	22,0
	Fisher test	LM vs. LE1 vs. LE2; $F_{0.05}(2.96) < \hat{F} = 4.78 < F_{0.01}(5.49)$ Between batches differences are significant (*)		
second	$\overline{x} \pm s_{\overline{x}}$ (g)	25.8±2.1	23.7±1.6	21,4±1,5
	V%	25.2	22.0	21,7
	Fisher test	LM vs. LE1 vs. LE2; $F_{0.05}(2.96) < \hat{F} = 4.82 < F_{0.01}(5.49)$ Between batches differences are significant(*)		
third	$\overline{x} \pm s_{\overline{x}}$ (g)	28.8±1.2	29.0±1.9	25,5±1,0
	V%	22.5	20.0	12,6
	Fisher test	LM vs. LE1 vs. LE2; $F_{0.05}(2.99) < \hat{F} = 3.51 < F_{0.01}(4.68)$ Between batches differences are significant(*)		
fourth	$\overline{x} \pm s_{\overline{x}}$ (g)	30.6±1.3	33.0±2.1	28,3±2,1
	V%	11.5	19.0	23,2
	Fisher test	LM vs. LE1 vs. LE2; $\hat{F} = 2.83 < F_{0.05}(3.03)$ Between batches differences are insignificant		
fifth	$\overline{x} \pm s_{\overline{x}}$ (g)	31.2±1.9	33.1±2.1	29,8±1,3
	V%	13.9	19.4	14,3
	Fisher test	LM vs. LE1 vs. LE2; $\hat{F} = 2.79 < F_{0.05}(3.10)$ Between batches differences are insignificant		

Homogeneity of studied batches was improved from one week to another, reaching that at last weighting to be calculated values for those three variability coefficients between 13.9%and 19.4%. At the last weighting we observed that at control batch weighted arithmetic mean was 31.2 g, with 6% lower than at batch LE1and with 4.5% higher face to mean from batch LE2.

Dynamics of weight increase of experimental animals seems not to be very revealing because we didn't start in our study with homogenous batches and without significant statistical differences, but we consider the analysis of weight gain could enlighten much more better the effect of monosodium glutamate on studied mice's organism. So, we observed that starting from first growing week mice from batch LE1differentiates through realization of an average daily gain higher that at control batch with 22.6% while at batch LE2calculated gain was with 3.2% lower that at LM (tab. 2).

After second week of experiments mice from experimental batches surpassed net the ones from control batch; LM ADG=0.43, with 34.9–74.4% lower than the calculated values for experimental batches.

During whole experimental period mice which received food with monosodium glutamate realised an average daily gain higher with 38.4–59.4% face to mice which didn't received taste and aroma enhancer. These values reveal much better the effect of monosodium glutamate on corporal development of experimental animals.

Between corporal mass of an individual and feed consummated quantity by it, exist a close correlation, fact shown also by the data from table 3.

Table 2 Weight growing gains

Batches	Corporal mass at the beginning of the period (g)	Corporal mass at the end of the period (g)	Cumulated gain (g)	ADG (g)
1st week				
LM	23.6	25.8	2.2	0.31
LE1	21.0	23.7	2.7	0.38
LE2	19.3	21.4	2.1	0.30
2nd week				
LM	25.8	28.8	3.0	0.43
LE1	23.7	29.0	5.3	0.75
LE2	21.4	25.5	4.1	0.58
3rd week				
LM	28.8	30.6	1.8	0.26
LE1	29.0	33.0	4.0	0.57
LE2	25.5	28.3	2.8	0.40
4th week				
LM	30.6	31.2	0.6	0.09
LE1	33.0	33.1	0.1	0.014
LE2	28.3	29.8	1.5	0.21
Cumulated				
LM	23.6	31.2	7.6	**0.271**
LE1	21.0	33.1	12.1	**0.432**
LE2	19.3	29.8	10.5	**0.375**

Table 3 Feed consumption

Specification	LM	LE1	LE2
Total feed consumption (g/period)	1134	1290	1219
Average feed consumption (g/day)	40.5	46.07	43.53
Average feed consumption (g/head/day)	5.40	5.11	4.35
ADG (g)	0.271	0.432	0.375
Feed conversion (g feed/g gain)	**19.92**	**11.82**	**11.60**

Feed consumption of experimental animals from batch LM, during whole research period (28 days), was 1134 g, with a mean daily consumption of 40.5 g while at experimental batches those two indicators presented values higher with around 7.5–13.8%. This state of fact shows one more time the fact that MSG stimulate significantly feed consumption, fact revealed by calculus of feed conversion rate (g feed/g gain) which is higher at experimental batches with 31.5–41.8%.

Also, in our current study we effectuate also haematological and biochemical determinations on blood (tab. 4 and 5) by which were observed that shape and number of haematin, composition and characteristics of blood cellular elements as well as the chemical composition of total blood, serum or sanguine plasma.

Sanguine analysis enlightened a qualitative degradation of blood and very significant deviations of biochemical parameters at experimental batches, fact which reveals an altered health state.

Table 4 Results of haematological analysis

Analysed parameters	M.U.	LM	LE1	LE2	*Normal limits*
White blood cells (WBC)	$10^3/mm^3$	5.7	5.5	4.5	*3-15*
Red blood cells (RBC)	$10^6/mm^3$	8.11	6.88	6.17	*5-12*
Haemoglobin (HGB)	g/dL	14.3	11.5	12.7	*11.1-18*
Haematocrit (HCT)	%	39.4	31.8	38.6	*36-52*
Platelets (PLT)	$10^3/mm^3$	607	603	591	*140-600*
Mean corpuscular volume (MCV)	μm^3	49	46	46	*44-49*
Mean corpuscular haemoglobin (MCH)	pg	17.7	16.7	20.5	*12-24.5*
Mean corpuscular haemoglobin concentration (MCHC)	g/dL	36.3	36.0	44.2	*21.6-42*

Table 5 Results of blood biochemical analysis

Analysed parameters	M.U.	LM	LE1	LE2	*Normal limits*
Glucose	mg/dL	205	178	62	*203.21-270.95*
Albumin	g/dL	4.06	3.12	3.53	*4.216-4.621*
Total proteins	g/dL	6.45	5.42	5.64	*6.036-6.473*
Total cholesterol	mg/dL	140	125	137	*136.5-162.24*
Triglycerides	mg/dL	103	**167**	**225**	*86.45-106.11*
TGO/AST	u/L	62	**102**	**235**	*49.95-65.51*
TGP/ALT	u/L	18.9	**48**	**57.3**	*17.84-25.72*

CONCLUSIONS

Monosodium glutamate, a food additive utilised on a large scale in foodstuff industry due to the fact that induce the hyper-excitability of nervous centres and determine those "umami" taste, stimulate feed consumption.

At the end of the study we determined that MSG induced higher weight increase gains with 38.4–59.4% at mice from experimental batches face to the ones from control batch, and feed consumption was higher with 7.5–13.8% at experimental batches face to the same reference batch – fact which leads to obesity.

Blood haematological and biochemical analysis show the fact that at animals from experimental batches was recorded a qualitative degradation of blood and very large deviations for majority of analysed sanguine biochemical parameters. Those aspects indicate a severe degradation of health state at mice which formed the experimental batches.

Finally, we can conclude, extrapolating those results to human organism, that higher and constant intakes of foodstuffs which contain monosodium glutamate present a risk for human's health. Having in view the above-mentioned things it is necessary to recommend the consumption in a lower rate of processed foodstuffs and implicitly a very low consumption of food additives.

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