ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Usage of Biological Active Supplements in Technology of Prophilactic Meat Products.

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ABSTRACT

Implemented prediction of molecular properties and the estimation of changes in the quantitative content of biologically active additives (dietary supplements), lecithin, vitamins B1 and PP when used in meat technology preventative for people with diabetes Results of research showed that the technological processing does not influence on under investigation molecules. Evaluation of safety and prophylactic properties of additives in laboratory animals confirmed the feasibility of their usage in meat products technology.
Keywords: molecular structure, geometrical optimization, molecular properties, heat treatment.

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ISSN: 0975-8585

INTRODUCTION

Sugar diabetes is fairly considered as "noninfectious epidemic of 21 centuries". The number of people among the diabetic population doubling every 13-15 years. Currently, the fight against this disease is an important public health problem in all over the world.

In assessing the provision of people with diabetes with essential food ingredients revealed that the usual diet in most cases, does not compensate for the body's needs of this category of people in vitamins. The special shortcoming is noted for vitamins *PP* (4.46–5.26 mg/day), *B1* (0.42–0.55 mg/day) and lecithin (4–5 g/day).

There was studied the possibility of usage of vitamins *PP*, *B1* and lecithin in technology of meat products for vitamins shortcoming elimination and reduction the insulin needs. [3] The analysis of standard rate of protein consumption showed, that it is necessary to add in novel meat products recipe 1,73–2,13 mg of vitamin PP and 0,21–0,28 mg of vitamin B1(per 100 g of product) [2,7].

One of the most important discoveries is identification of the physiological properties of lecithin, which helps to reduce insulin need, protects the liver from fatty degeneration in diabetes, but only in case of regular acceptance. Lecithin is an essential component of cell membranes, the major fat emulsifier, an effective solvent and a cholesterol conductor.

Adult human organism can synthesize only quarter of lecithin required rate. Remain quantity of daily lecithin balance (3/4 part) should be taken with food. Upon the recommendation of nutritionist healthy people have to intake about 5-6 g of lecithin every day. Without needed lecithin level internal organs become overburdened. That effect on organs wear ability and promote performance decrement and early heavy disease and internal organs degradation [4].

Vitamins play an integral role in carbohydrates metabolism. Vitamin *B1* helps to activate transketolase, which neutralizes toxic products resulting from the sugar disruption. In some cases people with diabetes has fluctuation in vitamins metabolism, especially of vitamin *PP,* so micro nutrient to logical correction of vitamins balance is indispensable for the prevention and rehabilitation of diabetes complications [2, 5].

MATERIALS AND METHODS

Seeing the technology of meat products includes heat treatment, there were studied changes in molecular properties of vitamins *PP*, *B1* and lecithin in fresh and cooked sausage. Analysis of influence of temperature parameters on studying biological active supplements was produced by application Hyper Chem v.8 by molecular and dynamics, semiempiric and quantum and chemical methods.

Determination of quantity changes of vitamin *B1* after heat treatment was set by method with usage of acid hydrolysis and identification of tiochrom fluorescence intensiveness. [6]

Content of vitamin *PP* in samples of fresh and cooked sausage was investigated by method, based on formation of colored derivation of glutakan aldehyde.

Lecithin content was determined by phosphorus quantity. Therefore, lipid fraction from fresh and cooked samples was extracted by alcohol mixture of chloroform.

Phosphorus quantity was determined by photocolorimetric analysis with vandate and molybdate method which provides usage of ammonium molybdate in the presence of molybdenum blue.

RESULTS AND DISCUSSION

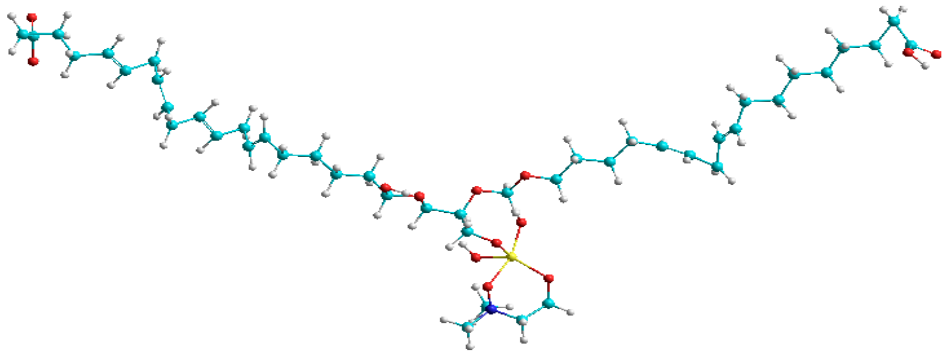
Well known that vitamins *PP*, *B1* and lecithin are unstable to heat treatment. As well known too, that heat treatment of cooked sausage is carried out until achievement of 72±1^{o}C in the middle field of product. In

ISSN: 0975-8585

this case, it is necessary to execute analysis of probability of biological active supplements usage in technology of meat products.

There were investigated native molecular properties of vitamins *PP* and *B1* and lecithin and their changes while heat treatment. At first, have done vitamins *PP, B1* and lecithin molecular structures modeling by computer chemistry. After that have materialized virtual geometrical optimization of molecules which were done by molecular dynamics and quantum and chemical methods in Hyper Chem v.8 [3]

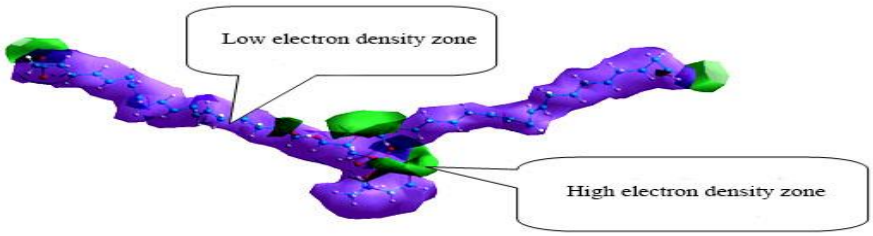
Figure 1: Space structure of lecithine.



Predicted performance of components evidences about of correctness of made lecithin molecule geometrical optimization. Total energy of each investigated molecules is relatively low (-696169 kcal/mol for *B1*, -32707,9 kcal/mol for *PP* and -245735 kcal/mol for lecithin). Also rms gradients are close to zero point (0,01 kcal/ Å×mol for *B1*, 0,08 kcal/ Å×mol for *PP* and 0,05 kcal/ Å×mol for lecithin). That fact indicates balance of system energetic properties and effectiveness minimization of potential energy. Value of dipole moment (5,285; 1,999; 9,681 debye for vitamins *B1, PP* and lecithin respectively) characterizes equitability of electron density.

Electrostatic potential of vitamins B1, PP and lecithin molecules surface was measured with application of semiempiric and quantum and chemical methods. Result of measurement of electrostatic potential distribution on lecithin molecule surface pictured on fig. 2.

Figure 2: Electrostatic potential distribution on lecithin molecule surface.



Besides search of minimums which correspond to stable state, very important to investigate the saddles points of molecular system potential energy surface. In the view of kinetic chemistry, the saddles point on the surface of potential energy corresponds to reagent of chemical reaction and field of stable states of chemical reaction products. In this regard, saddles point is considered from the position of transition complex. Actually, these complexes in saddle point can't be empirically investigated because of extremely short life of molecular system complexes in activated state. Transition complex breaks up under heat fluctuation and molecular system returns to state of stable products of reaction. Therefore, quantum and chemical methods is an exclusive source of information about of transition states of molecular systems. Difference between values of potential energy in minimum and saddle points equals to energy of activation. Finally, value of energy of activation helps to estimate chemical reaction rate constant at set-level temperature.

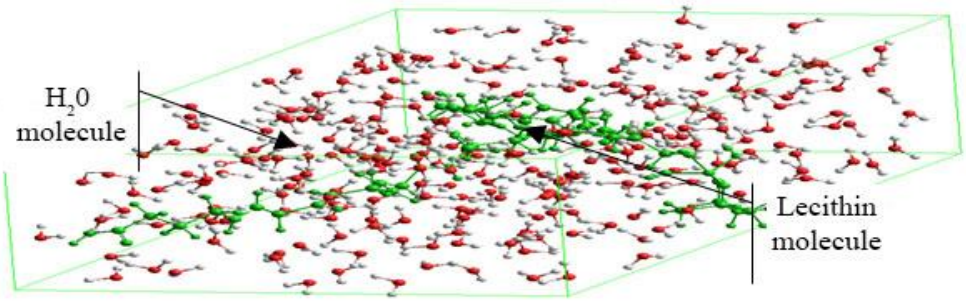
ISSN: 0975-8585

Modeling of heat treatment was done with usage of Brownian dynamics method in consequence of high water content in meat stuff [1]. The effect on under investigation system was changed in Brownian dynamics to friction forces, which have effect on each atom, and random forces.

Between two serial random effects at particular period of time atom moves under influence of friction force and kinetic energy from another atoms Described process is close to behavior of microscopic particle in viscous fluid. [4]

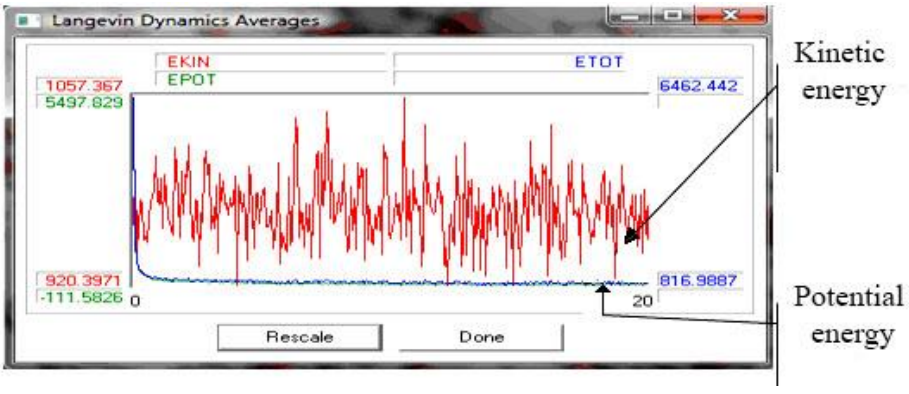
Modeling of heat treatment of biological active supplements molecules in water was done in module Periodic boundary conditions. This module is oriented to decide challenge of modeling of water systems with infinitely match quantity of particles. At the same time, this module suggests to use the periodicity cell, which has finite dimensions for macroscopic system. In case of particle while integration exceeds the limits of periodicity cell equal particle with equal speed concurrently enters the cell from another side. Computer modeling of periodicity cell of vitamins *B1, PP* and lecithin molecules was successfully done and one of them is represented on fig. 3.

Figure 3: Computer modeling of lecithin heat treatment



Heat treatment modeling was continuing till stabilization of system's energetic state (Fig. 4).

Figure 4: Energetic state of molecular system



Obtained results from fig. 4 mean that potential energy became stable in model of heat treatment. It is evidence that results of modeling are reliable.

Molecular properties of vitamins *B1, PP* and lecithin were investigated by semiempiric and quantum and chemical methods with usage of molecular dynamics **(table 1).**

Energy of activation (table 1) of molecular system, which is equal to difference between energy of transition state and energy of geometrical optimization, is higher for vitamin *B1* and lecithin, than delta (difference of changing) of potential energy (432,2 and 323,9 kcal/mol versus 425,1 and 22,1 kcal/mol respectively for vitamin *B1* and lecithin). For vitamin *PP* this comparison showed inverse result: 18,0 versus

19,7 kcal/mol. Therefore, lecithin and vitamin B1 and lecithin molecules do not to energized state, do not change their structure and do not react with chemical compounds while under treatment. However, it is revealed that set regimes of heat treatment can promote to reduction of vitamin *PP* content in product.

Meat products consist of numerous chemical compounds (proteins, lipids, carbohydrates, vitamins etc.), which can influence on energetic state of system [5]. In view of this fact there was produced experimental research of final content of vitamins B1, PP and lecithin in developed sausage after heat treatment. Research data are formed **in table 2**.

It was determined that differences in content of investigated substances in fresh and cooked sausage is insignificant within the limits of experimental error.

Investigation of laboratory animals (rats) blood marker enzymes serum activity showed, that developed sausage does not raise cytolysis and has not toxic effect on animals organisms. Introduction the developed sausage to daily diet of animals with induced diabetes supported to reduction of glucose level to 8,48 mmol/l.

Table 1: Valuation of vitamins B1, PP and lecithin energetic state under heat treatment

Index	Potential energy, kcal/mol		
	vitamin *B1*	vitamin *PP*	lecithin
Energy of activation	323,9	18,0	432,2
Difference of potential energy before and after heat treatment	22,1	19,7	425,1

Table 2: Research vitamins B1, PP and lecithin content in developed sausage after heat treatment. q ≤ 0,05

Components	Fresh sausage	Cooked sausage
	Content	
Lecithin, %	2,52	2,63
Vitamin *B1*,mg/%	6,17	6,17
Vitamin *PP*, mg/%	3,78	3,76

CONCLUSION

Analytical and experimental researches allowed evaluating quantity changes of biological active supplements in case of usage in prophylactic meat products technology. Results of research acknowledge practicability of usage of vitamins *B1, PP* and lecithin in technology of special meat products for people with diabetes.

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