

NITROSAMINES: INDOOR AIR POLLUTION AND HEALTH RISK ASSESSMENT

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Abstract

The quantitative parameters of the carcinogenic nitrosamines entrance into the indoor air are presented in this study. The nitrosamine's content was determined in the most popular Ukrainian cigarettes and in the rooms supplied with gas-stoves. For the risk assessment of the indoor air pollution and its effect on the health of the population in respect to the oncologic morbidity we used the well-known mathematical models. It is shown that nitrosamine indoor air pollution leads to the risk of malignant neoplasms development at the level of 3-4 cases per million people per year.

Introduction

During last years quality of indoor air requires steadfast attention of the ecologists, hygienists, engineers, builders. Numerous sources of contamination create quite often high concentration of substances inside buildings, and the duration of their effect is maximum on comparison with other mediums. As all buildings have constant air change with external medium, toxic substances present in atmospheric air are found and in locations, and quite often in higher concentration, than in atmospheric air.

Therefore air medium of the closed locations even in cases relatively low concentration because of plenty of toxic substances and small volumes of air is not indifferent for the man and it can seriously influence on the state of health, serviceability and capacity for work.

Now it is proved and quantitatively defined the influence of various levels of chemical contamination of air medium of residential and public buildings to such parameters of the population health as common disease, allergy, immune status etc. [1] According to earlier carried out researches, in air of residential and public buildings simultaneously there are more 100 volatile chemical substances, many of them have carcinogenic properties and under the long contact can call development of malignant neoplasms [2,3]. Nitrosamines (NA) concern to such substances. For

substances of this class the authentic direct correlation dependence of air medium contamination of dwelling apartments conditions and atmospheric air is established. Besides to NA contamination of dwelling apartments internal sources - smoking of tobacco items and combustion of natural gas in gas-stoves introduce their contribution.

The purpose of the work - to determine quantitative parameters of the contents carcinogens of NA' class - nitrosodimethylamine (NDMA) and nitrosodiethylamine (NDEA) in air medium of residential buildings stipulated by smoking and work of gas-stoves, and to calculate carcinogenic risk of their effect on human.

Methods

In the work we studied the contents carcinogens of NA' class in main and side streams of smoke of the cigarettes, most used in Ukraine: "Stolichnye" (with filter) and "Prima" (without filter) and in air of kitchen locations equipped with gas stoves of Ukrainian production of two models.

Cigarettes were smoked on equipped with time element "smoking" machine imitating process of smoking. The cigarettes with filter and without filter were smoked in identical conditions.

Study of influence of gas combustion in gas stoves on air medium carried out on two samples of plates indoors in volume 20 m³, equipped by cooling system. For each plate the definition of background NA concentrations with switched off gas stoves and carcinogens concentration with full load on plate was carried out.

Determination of NA in air medium was carried out by well-known highly sensitive specific methods [4].

The experiment' results were treated statistically with use of known methods, account of risk of neoplasms development carried out with allowance of costs of annual time of the person on various kinds of activity with the help of multistage linearized model [5].

Results

Table 1 shows availability carcinogenic NDMA and NDEA in tobacco smoke of investigated cigarettes

Table 1. The contents of NA in tobacco smoke

Type of cigarettes	Contents of NA, ng/ cigarette	
	NDMA	NDEA
“Prima” (without filter)	57.5±1.6	38.6±1.4
“Stolichnye” (with filter)	14.2±1.2	9.1±0.7

It is necessary to notice, that the Ukrainian cigarettes contain quantitatively more NA, than import cigarettes of the same type [6].

The high levels of NA contents in tobacco smoke of investigated cigarettes allow to assume, that the contents these carcinogens in air of dwellings also can be significant.

For definition of degree of NA' contamination in dwelling apartments we carried out two series of experimental researches. The smoking machine within one hour smoked 20 cigarettes “Prima” (without filter) in room with square about 15 m². In the first case the circulation of air during smoking was minimum, and in other - the ventilators were included and the window was open. The tests of air in the room took at once after ending smoking (table 2).

Table 2 - NA' contents in room, where cigarettes were smoked

Conditions of cigarettes smoking	Contents of NA, ng/m ³			
	NDMA		NDEA	
	before “smoking”	after “smoking”	before “smoking”	after “smoking”
Without circulation of air	20.1±1.2	156.7±5.4	14.3±1.1	80.7±4.9
Force circulation of air		581.1±9.7		322.4±6.3

The results of the table 2 show, that the NA contents in the room is much lower in case of cooling absence. If cooling was on, their contents in 1m³ of an air sharply increased (~ in 4 times). It is possible to explain this, on the first sight, a paradoxical outcome that if cooling was off the NA amount, forming under the smoke, rather stable, and when during smoking cooling was on, with inflow of air to location fresh

amount of oxides of nitrogen includes in process that results additional reactions with NA formation.

If in this room cigarettes are not smoked any more, the carcinogens' concentration reduce ~ on 50 % for 3-4 hours and correlate with decrease of smoke.

In the table 3 the results of NA definition in air medium of dwelling apartments supplied with gas stoves represented.

The table 3 - Contents of NDMA and NDEA in kitchen air

NA	Contents of NA, Min-Max/Mmiddle+ m, ng/m ³		
	Background level	Gas-stoves №1	Gas-stoves №2
NDMA	<u>0-0.030</u> 0.025+0.010	<u>0.105-0.630</u> 0.208+0.019	<u>0.220-0.800</u> 0.300+0.020
NDEA	<u>0-0.016</u> 0.011+0.009	<u>0.093-0.295</u> 0.166+0.019	<u>0.131-0.330</u> 0.214+0.015

As the table 3 shows, during burning gas in a gas stoves a lot of NA come to air medium of kitchen the plenty NA - concentration of these substances considerably exceed their magnitudes on highways or in regions of accommodation of the specific industrial enterprises [4].

Discussion

The results, obtained in experimental researches, allow to consider the revealed NA concentrations in dwelling apartments stipulated by smoking and burning of natural gas, as significant, which can represent potential danger of oncologic diseases development. It is confirmed also by results of account of carcinogens doses, which can be received by the people, living in these locations, and account of risk of malignant neoplasms development (table 4).

Table 4 - NA' doses, acting on human inside dwelling

Source of NA	Daily NA' receipt, mkg	Risk of neoplasms development for one year
Combustion of gas in gas stoves	0.32-0.63	1-2 * 10 ⁻⁶
Tobacco smoke	0.70-1.13	2-3 * 10 ⁻⁶

As it is shown in table 4, risk of malignant neoplasms development under the action of NA indoor air with products of smoking makes 2-3 cases, and the working gas stoves gives additional risk of cancer development - 1-2 cases on 1 million population per one year.

Conclusions

Thus, obtained results have shown, that the air medium inside dwelling is polluted NA, forming in outcome of the human habitability. The dose of these substances, received by the person, is dangerous in carcinogenic relation and stipulates emerging additional cases of oncologic diseases development .

It calls about necessity of mandatory monitoring of these substances inside dwellings and constant realization of preventive measures concerning smoking and equipment of kitchens special cleaning, catching NA from air medium.

References

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