# HYGIENIC ASSESSMENT OF WORKPLACE ENVIRONMENTAL AIR POLLUTION OF TBILISI CITY MUNICIPAL TRANSPORT AND THEIR SERVICES

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In the Directive 98/24/EC - risks related to chemical agents at work, leading factors were defined in working conditions in industrial and non-industrial sectors that impact employees' health and harmful physical and chemical agents in their surroundings (noise, vibration, electromagnetic radiation, chemical substances, etc.) [8,12,13].

Creating safe work environment is a priority for Georgia, as well as other countries [1,2,6,7,16,17,20,21]. WHO identified 6 compounds that have the most effect on air pollution and therefore on human health, weighted solid particles (PM), Sulphur Dioxide (SO2), Nitrogen dioxide ($NO_2$), Carbon monoxide (CO), Tropospheric ozone ($O_3$), and lead [19,20].

Nowadays, the priority of modern occupational medicine research is to identify the health effects of employees, the development of which is associated with the action of a complex of relatively low-intensity production factors, characterized by the decreased functional activity of the body and disruption of adaptation mechanisms.

Unfavorable parameters of working environment factors, as well as long-term and multiple effects on the body of the labor process cause straining of the body's adaptive mechanisms, changing and/or disrupting homeostatic parameters; develop the pre-nosological condition and pathological processes and, consequently, affect body activity and labor productivity.

Despite the fact, that many aspects of the working environment have been widely studied and related health risk factors also have been analyzed, an important area of employment dealing with the operation of urban and motor vehicles, in general, has been reviewed insufficiently. This circumstance has become especially relevant today, when a large part of the population of the country-side is concentrated in the capital, which, consequently, leads to an increase in the role of intercity transport, on the one hand, due to its mass use and on the other hand due to the increase in the number of people employed.

In modern megacities, including Tbilisi, motor transport is the leading form of intercity and long-distance transportation and, therefore, it is important. Transport is a major contributor to employees' health conditions [9,14,15,16], as well as a strong influencer on the population's social living conditions and ecology. Therefore, it's an important player among other factors that regulate Social Health [18,23,25].

Information regarding the heath conditions of individuals employed in the municipal transporting sector is scarce, and can not be easily applied when discussing the working conditions of people working on city transport in Tbilisi, because of the city's geographical peculiarities, unique climate, and pollution levels in the surrounding environment [9,10,8,14].

Identifying hygienic parameters of both the working and public environment of modern municipal transport ensures ecological safety of human health [7,10,15,22,24].

The factors that most impact employees during the working process are the levels of dust and toxic gases in the ear, they can induce occupational pathology caused by industrial air pollution but also contribute to other illnesses and affect a person's general ability to work.

The study aimed to observe the working conditions of individuals working on municipal transport, check the levels of dust and toxicity, and review from the hygienic point of view.

**Material and methods.** The levels of dust and chemical pollutants in the working environment of Tbilisi municipal transport workers were examined. Methods used in hygienic practice were applied to analyze air samples. In particular, for gravimetric determination of air pollutants, air samples were taken using electric aspirators and analytical aerosol filters.

In total, 108 tests were conducted to measure the concentration of dust in the air. 200 samples were collected with air analyzers (Elan CO/NO2, MiniRae2000, WASP XM-E-HCl, WASP XM-E-SO2).

Toxic gas concentrations have been analyzed. Concentrations of carbon monoxide, nitrogen dioxide, sulfur dioxide, hydrogen chloride, all hydrocarbons have been studied. The inspection was carried out in the city at the workplace of the drivers of the old (I) and new (II) model (type) buses with different operating characteristics and technical conditions - in the drivers' cabins and car service workshops, at 13:00, a total of 108 samples of dust content in the air, and 200 samples of various toxic substance content.

Normative documents were used to define toxicity levels in collected samples [4,5]. Data were analyzed using various statistical methods.

The arithmetic mean values and their margin of errors have been calculated; The reliability of the difference between the comparable values was assessed by the student's reliability coefficient (t, P).

**Results and discussion**. The toxicity levels in the surrounding environment of the municipal motor vehicle drivers, as well as technicians (welders, electricians, turners, tinsmiths, electric arc welders).

It was established that the toxicity of the air in the municipal transports and technical service establishments fluctuates between certain levels.

The highest dust levels were found in the working zone of the driver, with dust levels twice accepted levels (table 1). Working conditions at this specific zone were identified as 3.1 class. Workplaces in different service stations were also classified in the same group, with dust levels 1.6 times higher than normal. In total 5 workplaces were given level 3.1 classification.

According to the hygienic criteria, working conditions are divided into 4 classes: optimal, permissible, harmful, and dangerous. Harmful working conditions (3 classes) - are characterized by the presence of harmful production factors that exceed hygienic norms and adversely affect an employee or employee's, descendants. Harmful conditions are divided into 4 degrees of harm according to the degree of excess of hygienic norms and the expression of changes in the body of employees: 3.1; 3.2; 3.3 and 3.4) (6). However, type II vehicles are characterized by much better performance (t-3.23, P <0.001), although in this case, too, there are higher concentrations than PCL (permitted concentration limits).

Only the workplace of a tinsmith was classified as a level 2 acceptable hazard.

*Table 1. Dust levels in municipal transport and motor vehicle servicing facilities (mg/m³)*

| Workplace | Max Value | Min Value | Average Value | ±m | ±σ | permitted concentration limits (PCL) | X times Over PCL | Classification |
|---|---|---|---|---|---|---|---|---|
| Bus (I type) | 59 | 40 | 50.71 | 3.24 | 8.577 | 25 | 2.03 | 3.1 |
| Bus (II type) | 51 | 28 | 36.22 | 2.64 | 7.92 | 25 | 1.44 | 3.1 |
| Service Facility | 12.6 | 6.5 | 9.7 | 0.4 | 1.7 | 6 | 1.6 | 3.1 |

*Table 2 The concentration of toxic chemicals in the air of municipal transport (bus) and motor vehicle servicing facilities (mg/m³)*

| Workplace | Chemical | Danger Class | Max Value | Min Value | Average Value | ±m | ±σ | Permitted concentration limits (PCL) | X times Over permitted concentration limits | Hazard Class |
|---|---|---|---|---|---|---|---|---|---|---|
| Drivers Cabin | CO | 4 | 6.73 | 1.13 | 3.7 | 4.972 | 2.019 | 20 | - | 2 |
| | $NO_2$ | 3 | 0.186 | 0.029 | 0.093 | 0.149 | 0.06 | 2.0 | - | 2 |
| | $SO_2$ | 3 | 0.11 | 0.01 | 0.029 | 0.094 | 0.038 | 1.0 | - | 2 |
| | HCl | 2 | 0.04 | 0.01 | 0.016 | 0.078 | 0.032 | 5.0 | - | 2 |
| | Cn Hm | 4 | 0.2 | 0.1 | 0.126 | 0.120 | 0.049 | 300 | - | 2 |
| Welding shop Electric welding | CO | 4 | 28.5 | 18.4 | 25 | 1.0 | 3.1 | 20 | 1.3 | 3.1 |
| | $NO_2$ | 3 | 0.022 | 0.008 | 0.013 | 0.003 | 0.006 | 2.0 | - | 2 |
| | $SO_2$ | 3 | 0.069 | 0.009 | 0.039 | 0.012 | 0.37 | 1.0 | - | 2 |
| | HCl | 2 | 5.3 | 0.8 | 2.3 | 0.8 | 1.8 | 5.0 | - | 2 |
| | Cn Hm | 4 | 0.25 | 0.08 | 0.13 | 0.01 | 0.05 | 300 | - | 2 |
| Electric arc welding | CO | 4 | 45.5 | 18.8 | 30 | 4.4 | 10.6 | 20 | 1.5 | 3.1 |
| | $NO_2$ | 3 | 9.0 | 4.0 | 7.0 | 1.06 | 3.18 | 2.0 | 3.5 | 3.2 |
| | $SO_2$ | 3 | 0.43 | 0.12 | 0.26 | 0.04 | 0.1 | 1.0 | - | 2 |
| | HCl | 2 | 0.11 | 0.01 | 0.032 | 0.012 | 0.04 | 5.0 | - | 2 |
| | Cn Hm | 4 | 320 | 120 | 200.5 | 33.0 | 79.1 | 300 | - | 2 |
| Repair of radiators, soldering | CO | 4 | 28.4 | 18.5 | 20.5 | 1.6 | 3.9 | 20 | - | 2 |
| | $NO_2$ | 3 | 0.02 | 0.01 | 0.013 | 0.002 | 0.004 | 2.0 | - | 2 |
| | $SO_2$ | 3 | 0.25 | 0.08 | 0.13 | 0.01 | 0.05 | 1.0 | - | 2 |
| | HCl | 2 | 2 | 0.5 | 1 | 0.24 | 0.71 | 5.0 | - | 2 |
| | Cn Hm | 4 | 85.0 | 38.0 | 60.0 | 4.1 | 14.4 | 300 | - | 2 |
| Car battery servise station, mechanic | CO | 4 | 18.5 | 5.5 | 10.0 | 2.1 | 5.1 | 20 | - | 2 |
| | $NO_2$ | 3 | 0.4 | 0.18 | 0.23 | | | 2.0 | - | 2 |
| | $SO_2$ | 3 | 0.2 | 0.1 | 0.12 | 0.01 | 0.03 | 1.0 | - | 2 |
| | HCl | 2 | <0.01 | <0.01 | - | - | - | 5.0 | - | 2 |
| Mechanical service station, Turner | CO | 4 | 18.5 | 5.8 | 10.4 | 0.8 | 3.5 | 20 | - | 2 |
| | $NO_2$ | 3 | 0.2 | 0.1 | 0.12 | 0.011 | 0.034 | 2.0 | - | 2 |
| | $SO_2$ | 3 | 0.05 | 0.02 | 0.27 | 0.004 | 0.01 | 1.0 | - | 2 |
| | HCl | 2 | <0.01 | trace | - | - | - | 5.0 | - | |
| | Cn Hm | 4 | 93.5 | 58.3 | 75.0 | 5.8 | 13.9 | 300 | - | 2 |
| Tin-shop, Tinsmith | CO | 4 | 24.5 | 12.5 | 16.0 | 1.1 | 3.7 | 20 | - | 2 |
| | $NO_2$ | 3 | 0.38 | 0.11 | 0.23 | 0.08 | 0.1 | 2.0 | - | 2 |
| | $SO_2$ | 3 | 0.02 | 0.01 | 0.013 | 0.002 | 0.004 | 1.0 | - | 2 |
| | HCl | 2 | <0.01 | trace | - | - | - | 5.0 | - | 2 |
| | Cn Hm | 4 | 0.43 | 0.12 | 0.26 | 0.04 | 0.1 | 300 | - | 2 |

The study showed that different workplace environments have their specificities (Table 2).

The concentration of toxic agents was within acceptable parameters in most cases inspected. A few workplaces were distinguished as class 3. It should be noted that no class 3.3 or 3.4 hazard class workplaces were found during research.

From 6 workplaces inspected in motor vehicle service facilities only the working zone of the welder contained above acceptable levels of toxic chemicals in the air (hazard 3 class). Other zones had chemical toxicity levels within acceptable parameters and therefore were attributed as level 2 hazard class.

The research established that motor exhaust contains high levels of Sulfur Dioxide and Nitrogen Oxides and exposure to which increases the risk of coronary diseases [11,16]. Our study partially confirmed the research results of Limasset, Diebold da Hubert [10], investigating working conditions of a municipal vehicle driver in two major French cities and confirming that toxicity levels were within acceptable parameters.

We state, that even if the concentration of dust and toxic chemicals in the environment of municipal transport employees is lower than acceptable levels, long-time exposure to these agents affects the health of individuals and may cause subclinical health effects, even if the disease does not fully manifest. The effects will further increase because of the high-stress environment that is characteristic of this profession.

These effects should be taken into consideration when planning regular medical examinations and rejuvenating procedures for the employees.

Study results will serve as a basis for formulating directives on working conditions of municipal transport workers.

**REFERENCES**

1. Vepkhvadze N., Zurashvili B., Khorbaladze M., Kiladze N., Kugoti I., Kochoradze T. “General Hygienic Analysis of Atmospheric Air in Large Cities of Georgia According to Solid Weighted Particles” (2018-2019). Experimental & Clinical Medicine, 2020, N4, pp.74-76 (Georgian).
2. Vepkhvadze N., Tskhovrebadze N., Kochoradze T., Tskhovrebadze I., Kugoti I. “The Impact of Climate Change on the Health of the Population of Georgia.” Experimental & Clinical Medicine, 2020, N3, pp.15-19 (Georgian).
3. Kverenchkhiladze R., Saakadze V., Tsimakuridze M., Bakradze L. “Main Directions of Development of Occupational Medicine in Georgia at the Modern Stage” // Prophylactic medicine in the XXI century / Georgian Academy of Preventive Medicine / Collection of scientific works. V. III, Tbilisi: 2006-p. 111-116 (Georgian).
4. Technical Regulation on Permitted Limits of Concentration of Hazardous Substances in Working Zones (Government of Georgia, Resolution # 70, 2014).
5. Technical Regulation on Permitted Limits of Concentrations of Fibrogenic, Mixed Effect Aerosols, and Metals in Working Zone Air (Government of Georgia, Resolution # 67, 2014).
6. ”Hygienic Classification of Working Conditions According to the Factors of the Working Environment and Occupational Hazards and Dangers” - Order of the Minister of Labor, Health and Social Affairs of Georgia №147 / n, May 3, 2007.
7. National Environmental Agency of the Ministry of Environmental Protection and Agriculture of Georgia, “Brief Overview of Environmental Pollution in Georgia”, 2018, 2019.
8. Directive 98/24/EC - risks related to chemical agents at work.
9. Golinko V., Cheberyachko S., Deryugin O., Tretyak O., Dusmatova O. Assessment of the Risks of Occupational Diseases of the Passenger Bus Drivers // Saf. Health Work. 2020;11(4):543-549.
10. Limasset J.C., Diebold F., Hubert G., Exposure of urban bus drivers to traffic pollution // Sci. Total Environ. 1993, Jun 25;134(1-3):39-49.
11. Michaels D., Zoloth S., R. Mortality among urban bus drivers. // International Journal of Epidemiology, 1991, 20, 399-404.
12. Non-binding guide to practice for the application of directive 2003/10/EC of the European Parliament and the Council on the minimum safety and health requirements regarding the exposure of workers to the risks arising from physical agents (noise).
13. Non-binding guide to good practice with a view to the implementation of directive 2002/44/EC on the minimum safety and health requirements regarding the exposure of workers to the risks arising from physical agents (vibrations).
14. Nowakowicz-Dębek B., Pawlak H., Wlazło Ł., Maksym P. et all. Evaluating bioaerosol exposure among bus drivers in the public transport sector // J. Occup. Environ. Hyg. 2017, Nov;14(11): D169-D172.
15. Sreelakshmi Mohandas, Paul T Francis, P S Rakesh, P F Libin Antony. Assessment of respiratory morbidity among bus drivers and conductors of the state road transport corporation, Kochi, Kerala // J Family Med Prim Care. 2019 Dec 10;8(12):3887-3892.
16. Stern F. B., Halperin W. E., Hornung R. W., Ringenburg V. L., McCammon C. S. Heart disease mortality among bridge and tunnel officers exposed to carbon monoxide // American Journal of Epidemiology, 1988, 128, 1276-1288.
17. Valcke M., Bourgault M-H., Haddad S., Bouchard M., Gauvin D., Levallois Patrick. Deriving a drinking water guideline for a non-carcinogenic contaminant: the case of manganese. Int. J. J. Environ. Res. Public Health, 2018, 15 (7), 1293.
18. Wei-Te Wu, Su-Shan Tsai, Chung-Ching Wang et all. Professional Driver’s Job Stress and 8-year Risk of Cardiovascular Disease: The Taiwan Bus Driver Cohort Study // Epidemiology. 2019 Jul;30 Suppl 1:S39-S47.
19. WHO., Health for all in the 21st century, Geneva, 1998; WHO., Nitrates, Nitrites and N-nitroso compounds/Environmental Health Criteria 5, Geneva, 1977.
20. WHO. Towards good practice in health, environment and safety management in industrial and other enterprises, Copenhagen, WHO regional office for Europe, 1999.
21. Карелин А.О., Ломтев А.Ю., Волкодаева М.В., Еремин Г.Б. Совешенствование подходов к оценке воздействия антропогенного загрязнения атмосферного воздуха на население в целях управления рисками для здоровья. Гигиена и санитария. 2019;т.98;№1;с. 82-86.
22. Мельниченко П.И., Мелешенко В. Д., Остапович И.К., Ходыкина Т.М. Экология и профилактическая медицина: проблемы взаимодействия//Гигиена и санитария. 2019;98; 353-358.
23. Погонышева И.А., Погонышев Д.А. – Актуальные проблемы взаимосвязи окружающей среды и здоровья человека в странах Европейского Союза. обзор литературы//Гигиена и санитария, 2019; т. 98, №5:473-477.
24. Ретнёв В.М., Шляхецкий Н. С. Об определении понятий, необходимых при оценке вредного воздействия экологического фактора среды обытания// Научные чтения «Белые ночи-2003»/Материалы VII международных научных чтений Международной академиинаук экологии и безопасности жизнедеятельности, Изд-во МАНЭБ, 2003, с. 97-98.
25. Савилов Е.Д.,Брико Брико Н.И.,Колесников С.И. – Эпидемиологические аспекты экологических проблем современности// Гигиена и санитария, 2020; т. 99(2), №5:176-181.

**SUMMARY**

**HYGIENIC ASSESSMENT OF WORKPLACE ENVIRONMENTAL AIR POLLUTION OF TBILISI CITY MUNICIPAL TRANSPORT AND THEIR SERVICES**

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The study aim was to observe the working conditions of individuals working on municipal transport, check the levels of dust and toxicity, and review from the hygienic point of view. The levels of dust and chemical pollutants in the working environment of Tbilisi municipal transport workers were examined. Methods used in hygienic practice were applied to analyze air samples. test in total was conducted to measure the concentration of dust in the air and samples were collected with air analyzers. The toxicity levels in the surrounding environment of the municipal motor vehicle drivers, as well as technicians (welders, electricians, turners, tinsmiths, electric arc welding).

It was established that the toxicity of the air in the municipal transports and technical service establishments fluctuates between certain levels.

The highest dust levels were found in the working zone of the driver, with dust levels twice accepted levels. Working conditions at this specific zone were identified as 3.1 class. Workplaces in different service stations were also classified in the same group, with dust levels 1.6 times higher than normal. In total 5 workplaces were given level 3.1 classification. Only the workplace of a tinsmith was classified as a level 2 acceptable hazard.

The concentration of dust and toxic chemicals in the environment of municipal transport employees is lower than acceptable levels, but long-time exposure to these agents affects the health of individuals and may cause subclinical health effects, even if the disease does not fully manifest.

These effects should be taken into consideration when planning regular medical examinations and rejuvenating procedures for the employees.

**Keywords:** dust and chemical pollutants, Tbilisi municipal transport workers.

**РЕЗЮМЕ**

**ГИГИЕНИЧЕСКАЯ ОЦЕНКА ЗАГРЯЗНЕНИЯ ВОЗДУХА РАБОЧЕЙ СРЕДЫ СЛУЖАЩИХ, ЗАНЯТЫХ НА ТБИЛИССКОМ ГОРОДСКОМ ТРАНСПОРТЕ И НА МЕСТАХ ЕГО ОБСЛУЖИВАНИЯ**

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Создание безопасной для здоровья среды весьма актуально для Грузии, как и для других стран мира. Определение гигиенических параметров современного муниципального транспорта в плане как рабочей, так и общественной среды обеспечивает экологическую безопасность здоровья человека.

В течение рабочего процесса в комплексе профессиональных риск-факторов, действующих на организм, ведущими являются наличие, концентрация пыли и токсических газов в воздухе, что подразумевает не только риск развития профессиональной патологии, но и является способствующим фактором общей заболеваемости и влияет на работоспособность занятого персонала.

Целью исследования явилась гигиеническая оценка загрязнения воздуха рабочей среды служащих, занятых на Тбилисском городском транспорте и на местах его обслуживания (цех).

В рабочей среде муниципального транспорта исследовано наличие пыли и химических веществ в воздухе рабочей зоны. Анализ проб воздуха осуществлялся апробированными в гигиенической практике соответствующими методами.

Наличие пыли и химических веществ в воздухе изучено на рабочих местах водителей и обслуживающего персонала по разным профессиям в автомастерских цехах.

Результаты исследования показали, что самый высокий уровень пыли выявлен в воздухе рабочей зоны водителей, где условия труда оценены как класс 3.1 вредности. Условия на различных участках автомастерских цехов по уровню концентрации пыли в воздухе оценены как класс 3.1 вредности условий труда. По изученным показателям и по усреднённым величинам класс 3.3 и тем более, класс 3.4 вредности условий труда не выявлены.

Результаты исследования могут послужить основой для разработки превентивных мероприятий по оздоровлению состояния рабочей среды.

რეზიუმე

თბილისის საქალაქო ტრანსპორტსა და მის მომსახურებაზე დასაქმებულთა სამუშაო გარემოს ჰაერის დაბინძურების ჰიგიენური შეფასება

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თბილისის სახელმწიფო სამედიცინო უნივერსიტეტი, [1]გარემოს ჯანმრთელობის და პროფესიული მედიცინის დეპარტამენტი, [2]ფიზიოლოგიის დეპარტამენტი; [3]შრომის მედიცინისა და ეკოლოგიის სამეცნიერო კვლევითი ინსტიტუტი, თბილისი, საქართველო

ადამიანის ჯანმრთელობისთვის უსაფრთხო გარემოს უზრუნველყოფა საქართველოსთვის, ისევე, როგორც მსოფლიოს სხვა ქვეყნებისთვის, ძალზე აქტუალურია. თანამედროვე მუნიციპალური ტრანსპორტის ჰიგიენური პარამეტრების დადგენა როგორც სამუშაო, ისე საზოგადოებრივი გარემოს თვალსაზრისით უზრუნველყოფს ადამიანის ჯანმრთელობის ეკოლოგიურ უსაფრთხოებას.

შრომითი პროცესის დროს დასაქმებულის ორგანიზმზე მოქმედ პროფესიულ ფაქტორთა კომპლექსში წამყვანია ჰაერში მტვრისა და ტოქსიკური აირების შემცველობა, რაც წარმოადგენს არამარტო პროფესიული მტვრისმიერი პათოლოგიის განვითარების რისკს, არამედ საერთო ავადობის ხელშემწყობ ფაქტორს,რაც გავლენას ახდენს მომუშავეთა შრომისუნარიანობაზე.

კვლევის მიზანს წარმოადგენდა თბილისის საქალაქო ტრანსპორტზე და მის მომსახურებაზე დასაქმებულთა სამუშაო გარემოს ჰაერის მტვრითა და ტოქსიკური აირებით დაბინძურების მდგომარეობის ჰიგიენური შეფასება.

თბილისის მუნიციპალური ტრანსპორტის სამუშაო გარემოში შესწავლილია მტვრის და ქიმიური ნივთიერებების შემცველობა სამუშაო ზონის ჰაერში. ჰაერის ნიმუშების ანალიზისთვის გამოყენებულია ჰიგიენურ პრაქტიკაში აპრობირებული შესაბამისი მეთოდები. მტვრის და ტოქსიკური ნივთიერებების შემცველობა ჰაერში გამოკვლეულია როგორც ავტოტრანსპორტზე დასაქმებულთა (მძღოლები), ასევე, საშემკეთებლო საამქროებში სხვადასხვა პროფესიით მომუშავეთა სამუშაო ადგილებზე.

ჩატარებული კვლევის შედეგად მტვერის ყველაზე მაღალი დონე დაფიქსირდა მძღოლის სამუშაო ზონის ჰაერში; მოცემულ სამუშაო ადგილზე შრომის პირობები შეფასდა,როგორც მავნეობის 3.1 კლასი. პირობები საშემკეთებლო საამქროს სხვადასხვა უბანზე, ჰაერში მტვერის კონცენტრაციის დონის მიხედვით, შეფასდა შრომის პირობების მავნეობის 3.1 კლასით. შესწავლილი მაჩვენებლების მიხედვით, საშუალო სიდიდეებით, შრომის პირობების მავნეობის 3.3 და, მით უფრო - 3.4 კლასი არ გამოვლენილა.

კვლევის შედეგები საფუძვლად შესაძლოა დაედოს სამუშაო გარემოს მდგომარეობის გაჯანსაღებისკენ მიმართული პრევენციული ღონისძიებების შემუშავებას.

## CHEMICAL MODIFICATION OF BROMELAIN WITH DEXTRAN ALDEHYDE AND ITS POTENTIAL MEDICAL APPLICATION

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Bromelain is a proteolytic enzyme found in almost all parts of the Pineapple plant (*Ananas comosus* L. Merr.) including the stems, fruits and leaves, from which the stem and fruit contain the highest concentrations of enzyme. It is a mixture of different thiol endopeptidases and other components like phosphatases, glucosidase, peroxidases, cellulases, glycoproteins, carbohydrates, and several protease inhibitors. Bromelain has been categorized as stem bromelain (EC. 3.4.22.32) and fruit bromelain (EC.3.4.22.33) based on its source. The molecular weight of stem and fruit bromelain is 23.8 kDa and 33 kDa respectively [16].

Clinical studies have shown that bromelain may help in the treatment of several disorders. An *in* silico and in vitro study of the bromelain-phytochemical complex inhibition of phospholipase A2 has shown that bromelain possesses anti-inflammatory properties [20]. A combination of bromelain, trypsin, and rutin was compared to diclofenac in patients with osteoarthritis of the knee by Akhtar N. et al (2004). After six weeks, both treatments resulted in significant and similar reduction in the pain and inflammation [4]. Clinical trials have shown that oral bromelain (500 mg/day) can be effective in the reduction of pain at the donor site after FGG and may also enhance wound healing [19].

The antioxidant activity of crude bromelain was shown by Saptarini N. et al. [18]. Bromelain prevents or minimizes the severity of angina pectoris and transient ischemic attack (TIA). It is useful in the prevention and treatment of thrombophlebitis [13].

Pillai K. et al. [15] have studied anticancer properties of bromelain with therapeutic potential against malignant peritoneal mesothelioma. This work has revealed that the activity of chemotherapeutic drugs in combination with romelain is enhanced. Romano et al. [17] investigated the possible antiproliferative/ proapoptotic effects of bromelain in a human colorectal carcinoma cell line and its potential chemo-preventive effect on colon cancer. In addition, bromelain improves the absorption of antibiotics [16].

Proteolytic enzyme can be used to avoid this problem. Chemical modification of the protein molecules increases their stability [5] while decreasing antigenic, immunogenic and allergic effects. After chemical modifications of peanut proteins their allergenic potency was decreased as shown by [6].

Few studies have been published on modification of bromelain and previous work has only focused on changing the physical and chemical properties. Initial work in this field was published in 1975. Ota S. et al., carried out chemical modification of stem and fruit bromelain with 2-hydroxy-5-nitrobenzyl bromide, tetranitromethane, and hydrogen peroxide [14]. In another research the authors tried to obtain linear cross-linking of bromelain molecules. Modification was carried out with a bifunctional compound - glutaraldehyde (GTA), which reacts with the free amine groups of lysine. The degrees of covalent modification were 43% and 61%. Proteolytic activity was not changed and modified bromelain was more stable under heating [7]. Gupta P. and Saleemuddin M. [8] successfully performed oriented immobilization of stem bromelain via lone histidine on metal affinity support. In another study chemical modification of bromelain was carried out by using two reagents - Pyromellitic anhydride acid and Poly (maleic anhydride). The modification enhanced the stability and the optimum pH value shifted towards the alkaline. The thermal stability and the resistance to alkali and surfactants were increased by acylating the free amine groups of lysine [21].

Many water-soluble polymers are used for the chemical modification of enzymes. One such polymer is dextran. Dextran is a polysaccharide formed by poly-α-D-glucosides of microbial origin having glycosidic bonds predominantly C-1→C-6, as de-