Determination of Alpha Emitter in the Blood of the Smokers by using CR-39 ($SSNTD_S$)

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Abstract:

Solid state nuclear track detectors have been used to determine the distribution of various radionuclides in biological materials (smokers and nonsmokers blood persons) ; this is done by putting 10 CR-39 nuclear track detectors sheet in 5ml blood (each detector alone) sample in test tube and kept in cold region for 40 days. The CR-39 detectors then etched in 6.25N NaOH solution for 4hours at 60°C. Results showed that the mean track density in the blood of the smoker's persons which is (99.4), which is higher than the mean track density in the blood of the nonsmokers persons which is (78.56).

Keyword: Alpha Emitter, Blood Smokers, CR-39 detectors, track density.

تحديد مطلقات ألفا في دماء المدخنين باستخدام كاشف الاثر النووي CR-39

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الخلاصة:

تم استخدام كواشف الاثر النووي ذات الحالة الصلبة لتحديد توزيع النويدات المشعة المختلفة في المواد البيولوجية (مدخنون وغير مدخنين في الدم) ؛ تم ذلك عن طريق وضع ١٠ من كواشف الاثر النووي CR-39 في عينة دم بحجم ٥ مل (كل كاشف على حدة) في أنبوبة اختبار وحفظها في منطقة باردة لمدة ٤٠ يومًا. ثم تم قشط كواشف CR-39 في محلول NaOH 6.25N لمدة ٤ ساعات عند ٦٠ درجة مئوية. أظهرت النتائج أن متوسط كثافة الاثر في دم المدخن وهي (٩٩,٤) أعلى من متوسط كثافة الاثر في دم غير المدخنين وهي (٧٨,٥٦).

الكلمات المفتاحية : مطلقات الفا، دماء المدخنين ، كاشف ، CR-39 ، كثافة الاثر

Introduction:

Biomedical applications of nuclear track detectors form a rather broad and diverse field. Nuclear track detectors are used in dosimetry of various radiation types in radiobiology, in membrane and filters, in biological microchemistry and other application.Rn^{222} and its short lived

decay products Po^{218} , Pb^{214} ,Bi^{214} and Po^{214} represent the most significant contribution to the natural radiation[1] . Dependent on aerosol properties, inhaled daughter products are deposited on air way surface throughout the human respiratory tract by subsequent transfer to the blood, by clearance mechanisms the radionuclides are transported via the blood by circulation to the other organs of the body [2,3].

CR-39 Homopolymer

CR-39 detectors is made by the polymerization of the oxdi-2, 1- ethanediyl di-2-propenyl ester of carbonic acid. The monomer is allyl resin which means that is CH2=CH-CH2 . Because of the presence of the allyl functional groups, the monomer can't only polymerize but also cross-link which result in a thermoset plastic and not thermoplastic. [3,4,5] . The chemical etching process performed by immerses the irradiated detectors in suitable alkaline solvent. This solvent has a slightly ability to etch the bulk material, but it's prefer at the same time to etch the particle damage trails. Strong hydroxide, such as NaOH, is normally used as etching regent to enlarge the track enough to become visible under an optical microscope. The etching process can be affected in a complex path by a large number of variables including the exact composition of the sample and the type [6.7]. Concentration and the temperature of the etching orientation of the surface agitation of the etching, as well as the present of impurities in trace quantities may alter the etching behavior [5,6,7,8].

In this study which included 10 samples classified into two groups' smokers and nonsmokers. Smokers were consumed 20 cigarettes per day for 3-6 years

Methods and measurements:

The laboratory bloods were taken from smoker and nonsmoker persons to define the concentration of alpha particles in the blood which kept at low temperature .The solid state nuclear track detectors CR-39 (which obtained from pershore moulding LTD with a thickness of 500nm) were putting in 5ml blood samples in test tube for 40 days to reach the radio-equilibrium before prepared to etching procedures. CR-39 detectors were etched for 4 hours at a temperature of 60 ^{o}C in 6.25N NaOH. After etching the CR-39 detectors were scanned with an optical microscope under 100 x magnifications. The track density of alpha particles could be evaluated from following equation [6,7,9]:

ρ(track density) = number of tracks / area of field view

Results and discussion:

Table 1: alpha particles density in the nonsmoker person's blood

No.	Age	Average of the tracks	track density
1	**20**	**4.7**	**75.2**
2	**21**	**3.5**	**56**
3	**22**	**4.7**	**75.2**
4	**23**	**4.3**	**68.8**
5	**24**	**6.75**	**108**
mean			**78.56**

Table 2: alpha particles density in the smoker's person's blood

No.	Age	Average of the tracks	track density
1	19	4.18	66.8
2	20	6.6	105.6
3	21	4.9	78.4
4	22	6.4	102.4
5	23	9	144
mean			99.4

We can see from Table 1 shown the track density of alpha particles emitters in the nonsmokers person's blood and Table 2 shown the track density of alpha particles emitters in the smokers' person's blood , each table includes the number, the age, the average of alpha tracks, and density of the tracks.

It's clear that the average of the track density which reflects the mean alpha emitters emanated from the radionuclides present in the samples of the smoker's blood which is 78.56 tracks /mm^2 was higher than the mean track density in the nonsmoker's blood which is 99.4 tracks/mm^2, it's also clear that the highest value is detected in the smokers blood which is 144 tracks /mm^2 which is higher than the highest value detected in the nonsmokers blood which is 108 tracks /mm^2. The increasing in the track density is reflecting the increasing in the amount of alpha emitters present in the smoker's blood. Tobacco has minute quantities of some radioactive isotopes like (Pb-210, Po-210, Ra-226), which emanated as alpha particles during the burning of the cigarettes and deposited at the lung tissues during inhalation. Thus the lung cancer is increased among smokers [8].

Comparing with age of the studied persons it's obvious a relationship between the age of the person and the track density. This may be due to the fact that the radioactive isotopes is increased in the human being with age increasing because the intake of radioactive material during life from ingestion and inhalation [9,10], thus the risk of lung cancer increases with the length of smoking time and number of cigarettes. Figures 1and 2 showed the increasing in the track density relative to the age of the nonsmoker person's and smoker person's.

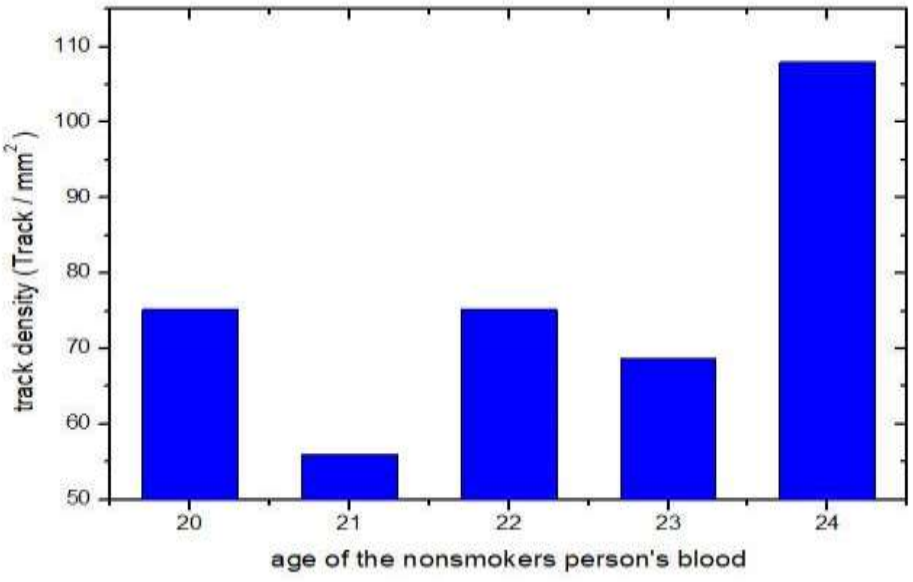

Figure 1: alpha particles density in the nonsmoker person's blood

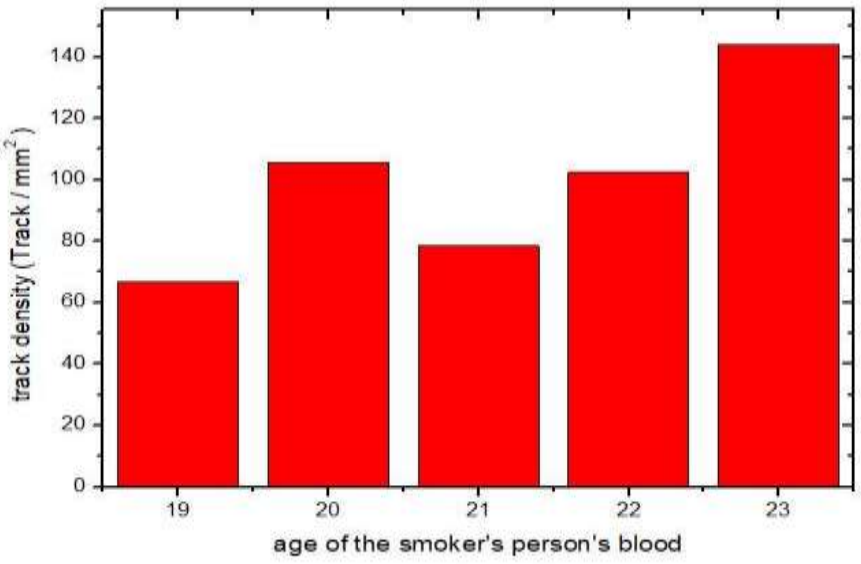

Figure 2: alpha particles density in the nonsmoker person's blood.

Conclusions:

It can be concluded from the previous results that:

1. The amounts of alpha particles in the smoker blood are more than that in the nonsmoker's blood person because smoke cigarettes having alpha particles.
2. There is a relationship between the person's age and the amount of alpha particles.

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