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ULTRA SOUNDS EFFECTS, RANGE 18 ÷ 45 KHz, ON HEARING PATHWAY OF ALBINO GUINEA PIGS

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ULTRA SOUNDS are the nimble vibrations with a very high frequency over 20 KHz, this means they can not be heard by the human ear.

It is clear the limit between sounds and ultra sounds varies according to the perceptive acuity of each animal with different behaviours of reaction that change according to the species. At present ultra sounds are widely used for different subjects such as: Mediciner, Engeneering, Ecology ect. but few are the studies that take into account a possible dangerous action on the organs. During the last 15 years the majority of researches have been aiming at the study of ultra sounds on mammalia considering the change of some parameters such as hypertension (Mainland 1964) or, on some occasion, using more sophisticated techniques to give an evaluation of the cortical activity (Adam et al 1973).

At present ultra sounds able to cause pathological phenomena are the ones with a very high frequency, over 100 Hz a second and with that implies strong vibration energies. We remember some phenomena such as the heating of the stimulated mean, especially if it consists of greasy materials, the fenomenan of cavitation that stresses the lesion of cells of living organes and the effects of chemical origin on depolarization of complex molecules such as the ones of starch and gelatine, the denaturation of proteins, the inactivation of some enzymes, the break of the aromatic amminoacids ring, the growth of oxidations of some organic compounds, the trasformation of some colloids from gelatine to salt and vice versa ect.

Materials and Methods

Two groups of eight Albino Guinea Pigs, each of both sexes, with a weight of about 300-350 gr. and with normal hearing according to the Preyer test, underwent an ultrasonic stimulation of 24 hours for 21 days with four periods of rest (for a total of 30 days). The animals were put into a cage and in anecoic environment with the aim of keeping an equal distance from the source (1 meter) to garantie a constant resonant power.

We used two generators of stimulus:

The first (A) was commercial (ES250), it had the following physical characteristics:

- A) Range of frequencies uttered 18 + 45 KHz.
- B) Sequence of sweep stimulation with modulation of $F = + 3$ KHz.
- C) Repetition time 1/4 sec.
- D) Acoustical pressure 105 dB SPL at 1 mt.

The second (B) (Generator C.S.R.B.) realized at the Study and Research Centre of Bioacoustic had the following physical characteristics:

- A) Range of frequencies uttered 18 + 45 KHz.
- B) Sequencies of stimulation that can be scheduled for single continuous frequencies.
- C) Acoustical pressure 105 dB SPL at 1 mt.

Both the generators had as Transducer Tweeters Piezoelectric Motorola with power spectrum as Fig. 1. The animals were studied with different generators so as to give an evaluation of possible psychoacoustical and morphological damages of the neuro sensorial epithelium both in continuous stimulation condition.

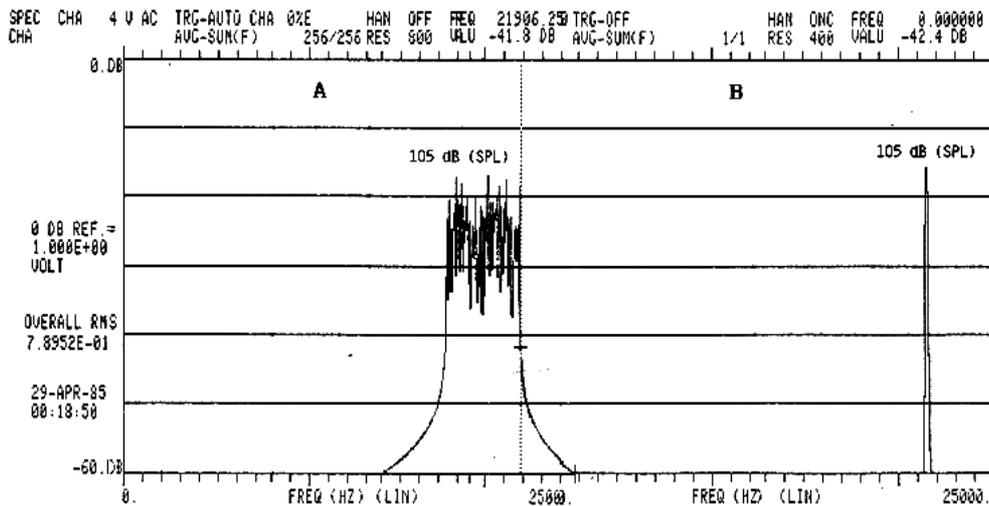
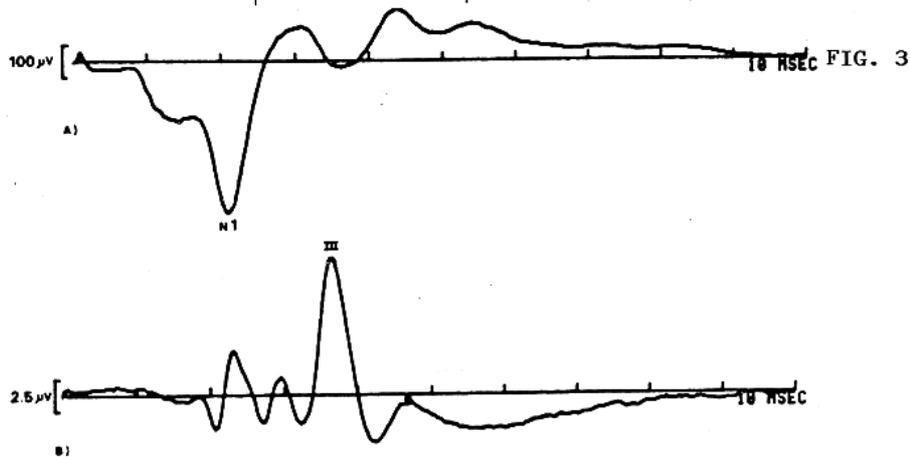
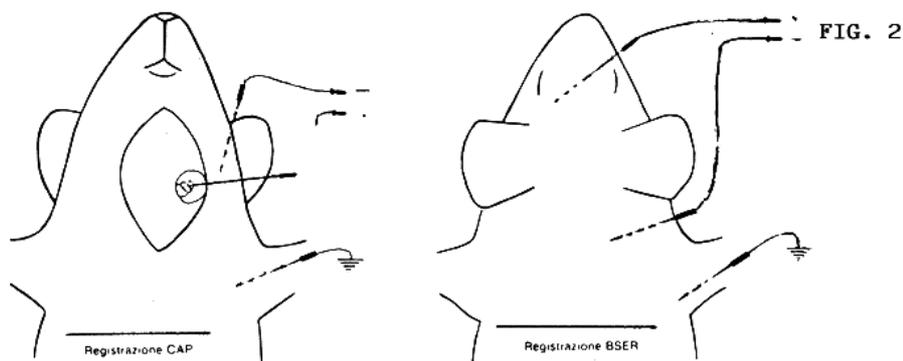


FIG. 1

During the experiment, each two weeks, the auditory functional character was valuated through out the observation of the Preyer Reflex evoked with noise stimulation (filtrated clicks) with a decreasing intensity from 110 dB SPL to levels of threshold.

The vestibular functional character was estimated measuring in seconds the time of post-rotary ocular after having made the animal roll for 10 rounds a turn each second.

A week after the last stimulation the animals were anaesthetized for the recording, through out electrodes with needles, of the BSER (Brain Stem Evoked Responses) and C.A.P. (Compund Action Potentials). Thanks to the vision of the constant body temperature on the monitor (Fig. 2-3). The animal was put into anecoic roomand faradized at 33 cm. from the loud-speaker that left out trains of clicks which lasted 100 msec of decreasing intensity starting from 110 dB SPL with a repetition frequency of 11 p.p.s.

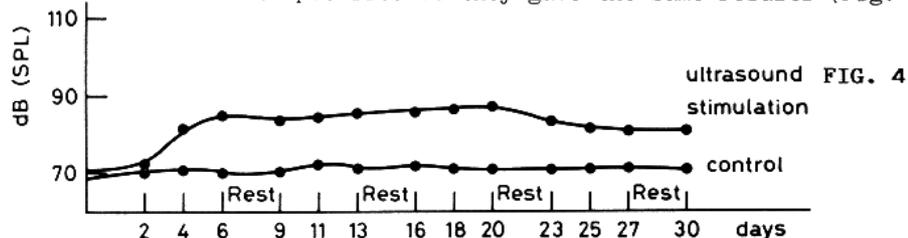


We evaluated the input-output latency functions of Auditory Evoked Potentials of the 1st and 3rd wave BSER. At the end of the experiment we took out the cochlea, the sensorial epithelium were perfused with osmium acid at 2% and spurr rosin inclusion was done into the cochlea with the Black Surface Preparation technique (Spoendlin H. and Brun J. P. 1974).

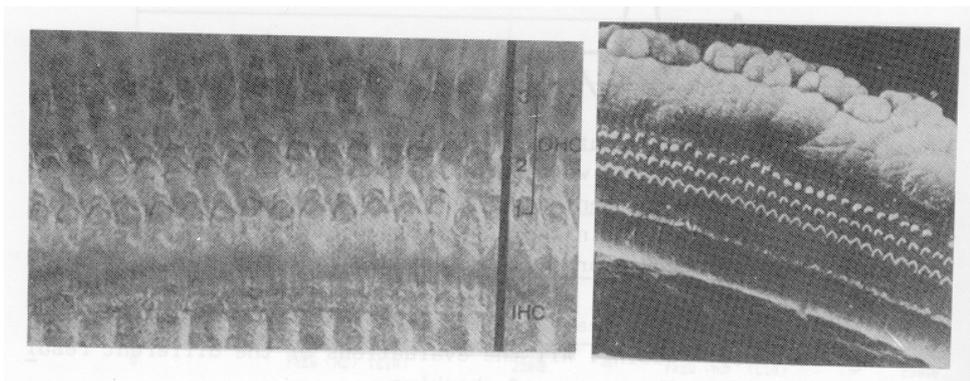
In the end we did the chemicals for the interferencial and electrical scanning microscopy reading. All the evaluations of the different results were addressed to the groupe of checking.

Results:

The exposure of Albino Guinea Pigs to ultra sounds with different kinds of eccitation stressed a more effective behaviuoral reaction (Flight effect) for eccitations with ES 2 (à instrument that's to say with a modulated signal from 18 + 45 KHz. F + 3 KHz as to C.S.R.B. With Preyer Pinna Reflex evaluation we can nottice that, starting from the 2nd day of eccitation to the 20th, the threshold increases in a way not relevant for statistics and it later falls down from 21st to 30th day. In the figure the relative auditory thresholds corresponding to different eccitations are not specified as they gave the same results (Fig. 4).



As for the study of the Post-Rotary-Nistagmy thresholds did not change in a relevant way so as to be considered important for statistics between the animals that underwent the ultra sounds stimulations and the groupe of checking. Even though the waves of width stray at high intensities of stimulation between the group of checking and the one of treated animals, the study of CAP (Composed Action Potentials) was not relevant for statistics. The phenomenon was underlined also for the "input-output latency" function. The function related to the BSER are not relevant for statistics even though they stray at high acoustics stimulation over 80 dB SPL. Latency is the most relevant parameter in the analysis of the BASER potentials, this is the reason why we studied its development in time as for the 1st and 2nd wave. On this occasion too the latency parameters have to be considered in the range of normality without statistical value. The going of the function T input-output latency has particular importance, it expresses the latency interval between the 1st and 3rd wave as this straiies the standards of normality. The phenomenon il difficult to explain it we leave out damages of nervous structures in the section cochlea-encephalic trunk. It is worth giving a deeper evaluation to this experiment if we use another method of research. Data of Interferential and electronic scanning microscopy put to light a morphological standard of neurosensorial epithelium as explained in Fig. 5A/B.



Conclusioni: The research done on Albino Guinea Pigs with different ultra sounds frequencies put to light that the animals behavioural techniques studied with the Preyer Reflex did coherent results in time. Such acoustical stimulation with frequency from 18 to 45 KHz both modulated and with fairly good frequencies having sound powers of 105 dB SPL, even though lasting for 30 days with four period of rest, did not bring about changes for the auditory organs, the vestibular apparatus, the encephalic trunk.

The ES 250 instruments, that gives modulated stimulus, is more useful for the bewilderment and escaping of the animal because it does not help the synchronization of specific frequencies related to the nerve fibre tuning waves of any sort of animal species Acoustical nerve. It is important now to make clear if these stimulation are dangerous for man's hearing organes even though the functional character remarks have been set in the range of audibility from 1 to 3 KHz. My knowledge leads me to make deeper researches for infrasounds ranges rather than ultra sounds.