North American Academic Research

Journal homepage: http://twasp.info/journal/home

Research Article

Railway noise- affecting the Humans and Microbial

Ma Jinsheng [1*], Asif Mahmood[1]

[1] *School of Mechanical Engineering and Automation, Beihang University, Beijing, China.*

[*]***Corresponding author***

mjs99@126.com

Accepted: *25 April , 2020;* ***Online***: *01 May, 2020*

DOI *: https://doi.org/10.5281/zenodo.3777231*

Abstract: *Railway is considered one of the cheap, eco-friendly and comfortable means of transportation. They are demolishing the natural sceneries, led to death or declining the wildlife inhabitants and producing an intolerable noise. The noise produced by railway is of high frequency and sound pressure level (SPL). The peaceful sound of the park and the high speed railway noise are recoded to evaluate their SPL by the sound spectrum curves. The sound pressure level (SPL) of the peaceful environment is around 42 dB and for the high speed train running at 300 km/h has a value of about 82 dB. The noise generated by high speed railway with high SPL produced inhibition phenomenon in the growth and the production of the microbial. Also, the exposure of railway noise disturbing the routine of human beings and caused many diseases. The impacts of the high speed railway noise exposure on the microbial can be described experimentally by using acoustic chamber. Low frequency sound exposure produces positive effects while higher frequency sounds (noise) exhibit inhibition and destructive phenomenon in the growth rate of the microbial. In literature, most of the authors studied on the effects of audible sound on the microbial, but there is not much work has done to investigate the effects of railway noise exposure on them. This article presents the impacts of noise generated by railway on the human and microbial.*

Keywords: *Noise Control; Railway noise; Cell Growth rate; Inhibition effect; Microbial Production.*

1. Introduction

If we don't want to see something, we can shut our eyes to exclude it but unfortunately in the case of sound exposure, we cannot shut our ears to stop the unwanted sounds. Our hearing system always works even when we are sleeping. The continuous exposure of variable noise to hearing is considered more hazardous than a constant noise. Sound is considered one of the universally physical disturbances present in the environment, to which different living organisms respond differently [1]. MATSUHASHI et al., [2] had indicated that like other organisms, the microbial also can produce, intellect, and respond to the exposure of sound. Human accomplishments such as urbanization, construction of buildings, transportation, railways, and mismanagements of natural assets have been enlarged and it causes adverse changes in the environment audibility, lands and aquatic animals [3-6]. Railway is somehow easy, comfortable, and harmless way of transportation but producing an irretrievable noise in the environment. The response of the human and microbial to uncontrolled noise emitted through railway is significantly different from the sound produced by nature itself.

There have been many types of literature describing the effect of sound exposure (either in the form of music or noise) on animals [7-8] plants and the microbes [9-11]. Formerly, it was presented in many experiments that sound stimuli the bacterial growth [12-13], their antibiotic tendency [14] and the quorum-sensing regulated pigment production [15- 16]. Shaobin Gu., et al., [39] presented that under the ordinary condition, the exposure of audible sound increased the growth rate of E. coli bacteria while shows an inhibition effects when subjected by sound in the harsh condition.

Ultrasound has the ability to reduce the growth rate of the bacterial production by aural cavitation while some bacteria such as Escherichia coli, Staphylococcus epidermidis and Pseudomonas aeruginosa, respond contrarily at certain frequencies [17-18]. William G. Pitt [19] suggested that, the exposure of ultrasound boosts the growth rates of prokaryotic and eukaryotic bacteria lying on the surfaces and in suspension. While, Koda S., et al [20] presents differently from [19] that, the exposure of ultrasound results in destroying or inactivation of the activities of the Escherichia coli bacteria in water and apple cider juice.

Xiao Ming Tan et al., [21] investigated that the noise generated by high speed train has a frequency range between 100 and 4000 Hz and the highest noise generated from the bogie area of the high speed train with a frequency range between 400 and 800 Hz. It is supposed that, at maximum speed the noise produced from bogie area and aerodynamic source of the high speed train has a value of 100 dB and 95 dB respectively. According to the ICE standard the outside noise for bogie area noise should be 82 dB (A) and for aerodynamics noise sources should not exceeds than 77 dB (A) [22]. Lee et al., [23] numerically examined the aerodynamic noise produced by different component of the pantograph of high speed train running at 400 km/h such as bottom frame, pan head area, the bulge area between upper and lower arm, and the whole pantograph area are in the frequency ranges 60-400 Hz, 600-800 Hz, 1000-2000 Hz, and 2000-5000 Hz respectively.

In literature, there were many authors who studied about the effects of audible sound on the growth and production of microbial, but many of them could not explain how sound stimuli them. From the literature, it is still not clear how and with what process sound influences the life cycle of microbes. The railways are radiating noise is very harmful for the survival of the human and microbial. In this article the impacts of noise generated by railway on the human and microbial are described experimentally. The sound of the peaceful environment and the high speed train noise are recorded and then analyzed in MATLAB to get their spectrum. Then these sounds are exposed to the microbes with the help of speaker to investigate the effects of railway noise on them.

2. Materials and methods

The sound of the natural environment and the high speed train are recorded by using Huawei Nova 4e Mobile phone. The sound of the natural environment is recoded for 32 seconds in the Beihang University Park, Beijing China. The noise of the high speed train moving with speed more than 300 km/h is recorded near Beijing, China. The sound was recorded at a horizontal distance of 7.5-10 m from the center-line of track. The recoded sounds are then analyzed by using MATLAB R2019b to get their spectrum in terms of time and frequency domains.

Souvik Banerjee, et al., performed an experiment to investigate the effects of sound on the growth of the E. coli bacteria. They used only an audible sounds for their experiment. We can follow their methodology to examine the effects of exposure of railway noise on the microbe's production.

An apparatus is used for this purpose is called acoustic chamber as shown in figure 1. The apparatus is consists of different components such as Speaker, Glass Chamber, Movable Sample Handler, Sound absorbing material layer, and Function Generator (amplifier). The function generator is used to generate and amplify the sound similar to the sound produced by the train with same frequency and sound pressure level. A speaker is used for the purpose of exposure of sound on the sample plate inside the chamber. The collected microbes were put on the plates and then placed on the moveable sample handler for directing the exposure of sound from the speaker onto the sample plate. The distance between the speaker and the sample is set according to the requirements. This distance can be changed accordingly by sliding the sample handler up or down to examine the influence of distance during the exposure of sound. A control system is introduced and set as a reference. All the above-mentioned procedures are carried out for the control system but the function generator and speaker are not connected with power supply and hence no sound exposure occurred.

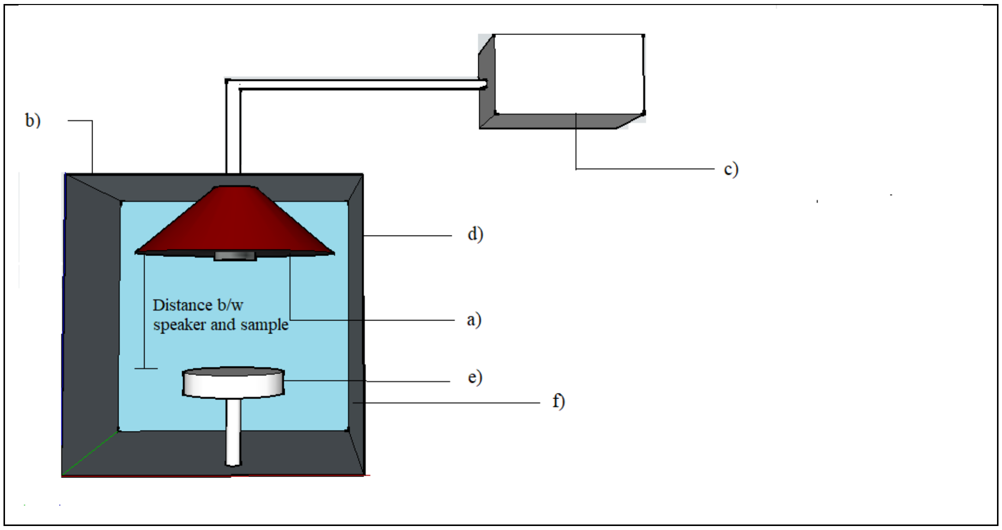

Figure 1 Experimental apparatus for investigating the stimulation effect of train noise ; a) – Speaker; b) – Cover lid; c) – Function Generator; d) – Glass chamber; e) – Movable Sample Handler; f) – interior sound absorbing material

Furthermore, the growth rate of the microbes in the exposure of sound is compared with the control system to evaluate the effects of train noise on them. The impacts of sound exposure on the growth of the microbes and their statistical analysis can be calculated from the equations (1-5). The acoustic chamber is sealed and packed tightly to evade the sound leakage. In order to avoid the reverberation effects and interference phenomena occurrence during sound exposure, the interior walls of the acoustic chamber are covered with a layer of sound absorbing material as shown in figure 1. This sound absorbing layer absorbs the sound that are not directing on the sample directly and hence the chance of sound reflection is minimum.

2.1 Measurement of biomass and Growth rate

The cell mass of E. coli can be evaluated by optical density and the optical density is measured by spectrophotometer. The specific growth rate μ of the microorganism (E. coli) can be calculated as follows (GU, et al., 2016).

$$\mu = \frac{\Delta W}{W \times \Delta t} \qquad (1)$$

Where W is the initial cell mass, μ is the specific growth rate, ΔW is the addition or reduction in the growth of the cell mass in time Δt,

The time Δt for doubling the growth rate of the microbes can be defined as

$$W\ (t + \Delta t) = 2\ W\ (t) \qquad (2)$$

$$\Delta t = ln2/\mu \qquad (3)$$

2.2 Kinetic modeling and statistical analysis

The germination time was fit by the following model (Peleg and Normand, 2013)

$$P(t) = P_{asym}\{1 - \exp.[-(t/t_a)^m]\} \quad (4)$$

P_{asym}, t_a, and m represents final germination level, time for reaching 63.2% of the asymptotic value, and shape factor of the germination curve, respectively. The germination speed, k can be defined as

$$k = P_{asym}\, m \left(1 - \frac{1}{m}\right)^{\left(1-\frac{1}{m}\right)} \mathrm{Exp}\left(1 - \frac{1}{m}\right) \quad (5)$$

3. Results and discussion

Railways are the primary elements of the country's landscape regional structure and oblige as the main provider of interstate cargo and commuter transportation. The impact of the sound waves produced by railway on the ecosystem, especially on humans and microbial are very harmful.

The figure 2 shows the spectrum of the sound in the peaceful environment. The sound pressure level of the sound varies in between 30 and 41dB. The maximum value of the SPL is 41.32 dB as marked in figure 2. This sound loudness has no negative effects on the health of the human beings and on the growth rate and colonial formation of the microbial.

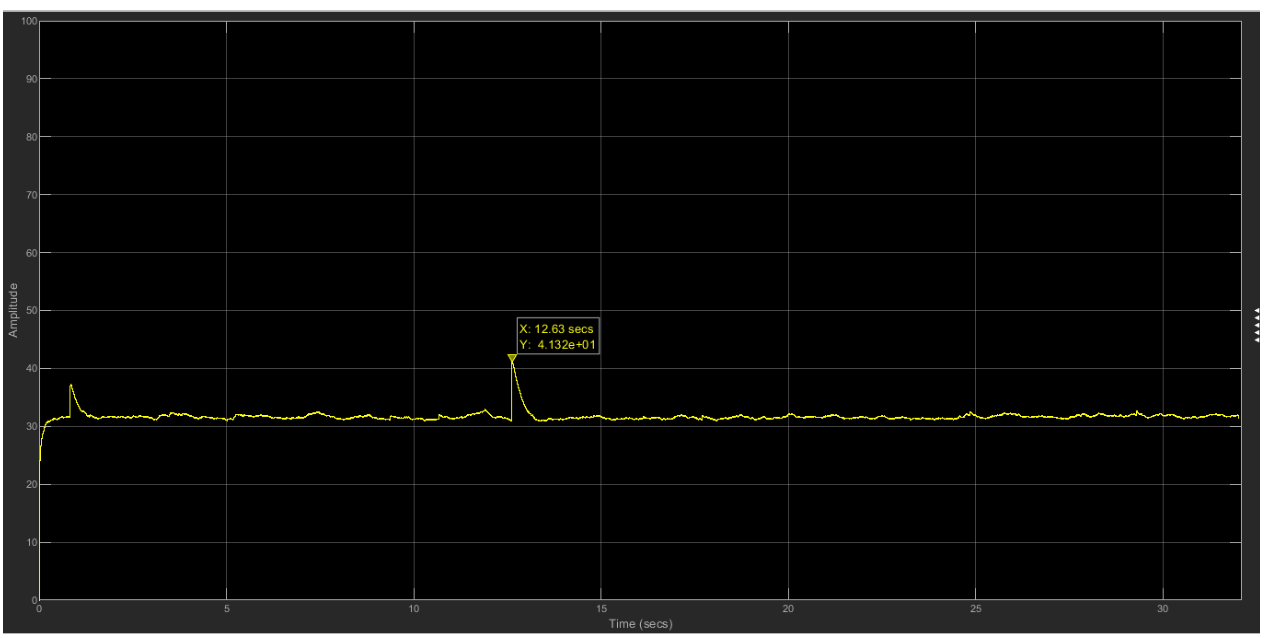

Figure 2. The spectrum of the sound in natural environment

The spectrum of the noise generated by the high speed train is shown in the figure 3 and 4. Figure 3 shows the spectrum of the high speed train noise in frequency domain. In the figure 3 it is shown that the most of the noise is generated by the sounds within frequency range of 20-4000 Hz.

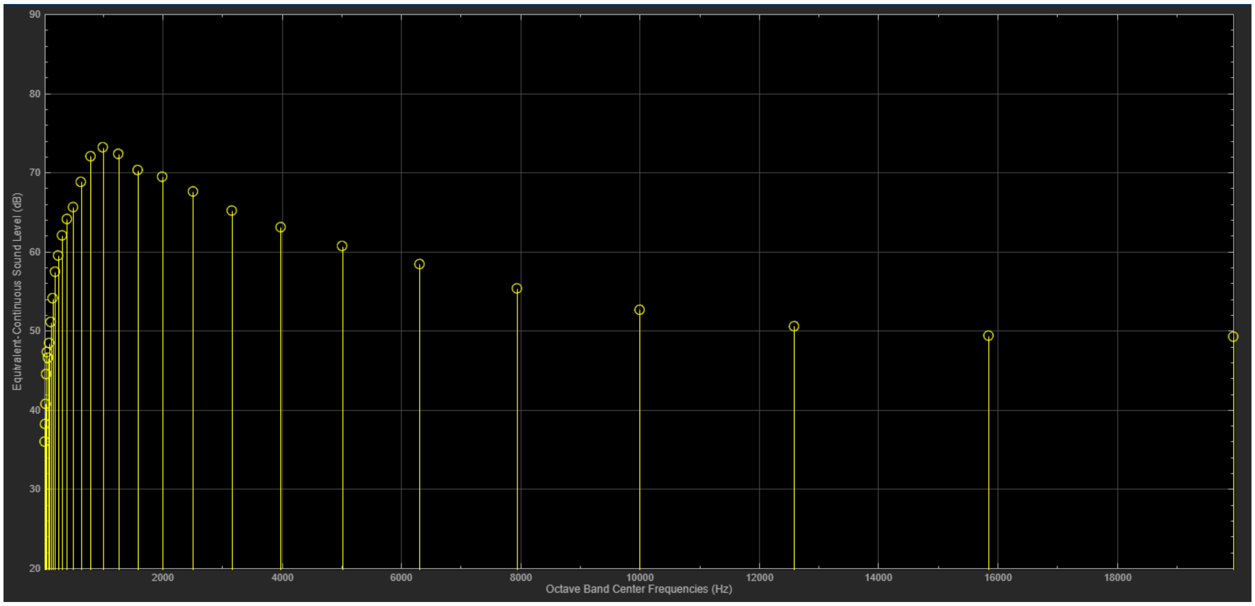

Figure 3. The spectrum of the high speed train noise in frequency domains

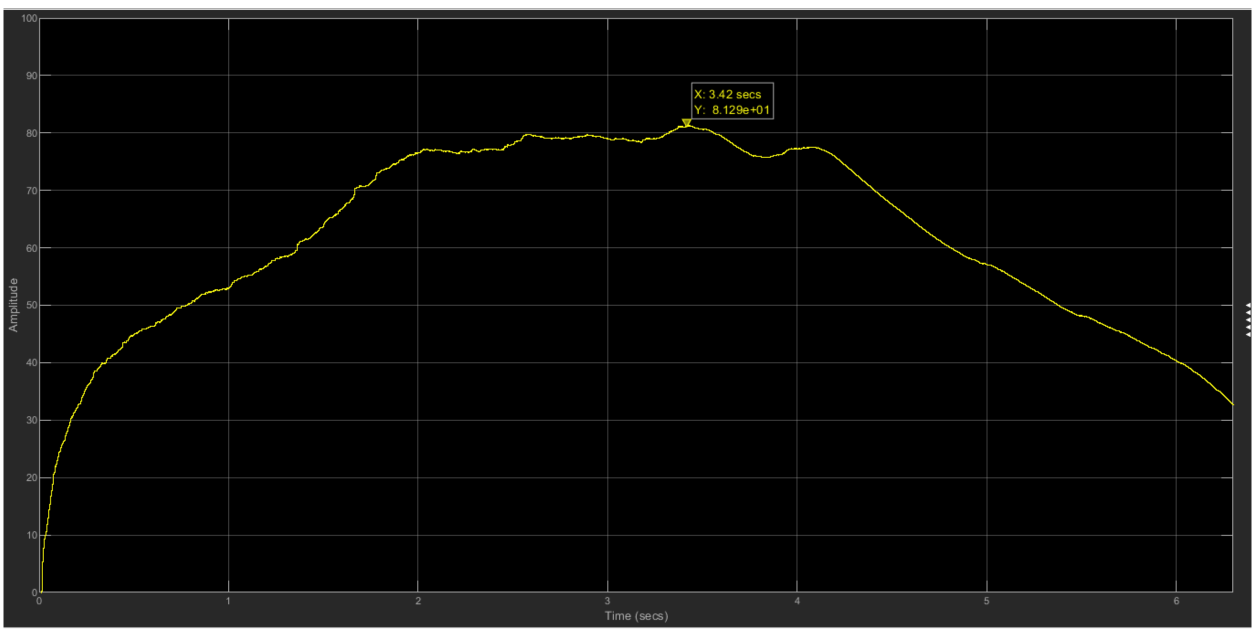

Figure 4. The spectrum of the high speed train noise in time domain

The sound with frequency range of 800-1200 Hz producing louder sounds. This noise is produced by bogie area as presented by Xiao Ming Tan et al., in [21]. The maximum SPL is shown by the sound with frequency 1000 Hz as shown in the figure 3. The figure 4 displays the spectrum of the high speed train noise in time domain. From figure 4 it is shown that the SPL of the train noise varies from 75 to 81.29 dB. The maximum value of SPL is shown 81.29 dB. This is different from the figure 3. The reason is that, in case of the frequency domain, the SPL of the noise is shown at every frequency separately while in the time domain it is showing the SPL for all the frequencies altogether in a single curve. So the SPL has maximum value 81.29 dB in case of time domain and 76 dB in frequency domains.

3.1 Impacts of noise on human

Noise pollution is considered the third leading hazard after air and water pollution. According to the current estimates of World Health Organization, the exposure of traffic and train noise is influencing more than 1.5 million healthy peoples every year in Western Europe. Continual exposure to loud intensity of train noise results in the injury to our eardrums and reduces the sensitivity of ear to sounds. The noise generated by the railway is combination of low as well as high frequency sounds, and sound pressure level. Railway noise exposure give rise to sleeping trouble, heart diseases, impaired blood circulatory function, digestive obsession, anxiety, mental malfunctioning and enlarged the drug usage in people living across the rail road [26]. German Environment Agency showed that, 44% population in Europe is influenced by the following noise producing sources such as Airplane, Railways, Road Traffic, Industries, and neighboring noises [27]. From [28-29], it was examined that the risk of heart failure has been increased for those inhabitants living nearby the busy roads and railways. Every addition of 10 dB sounds will increase the stroke rate by 1.14% and the chance of heart attack by 1.12% [30-31]. In Netherland, a study [32] revealed that the reported cases of the sleeping disorder has been increased from 18% to 23% between the years 1998 and 2003. Muzlet et al., [33], studied that once the exposure of noise has stopped, although the human's ears stop responding to the noise but their cardiovascular responding continuously the same way as before. Gautier et al. [34] examined that different Europeans high speed trains running at a speed between 250-350 km/h radiating noise of SPL ranges from 85.5 to 97 dB. In Canada the SPL of the train noise at the stations reaches up to 85 dB while other time the SPL declined to 43-55 dB [35]. In Japan the SPL of the train at a distance of 200 from the track will be 64 dB in the fields and increased up to 65.7 dB in the cities and at a distance of 50 m from the track this sound pressure level crossed the Japanese permitted standard 70 dB [36-37]. A typical conversation has a loudness level of 50-60 dB that is not harmful for the human ear. The sound with SPL in between 70 and 90 dB causes severe hearing problems and above 90 dB caused permanent hearing loss. By the exposure of high frequency sounds prone to the human body and cause numerous diseases. It would be better to stay away from such a high frequency noise generated by the railways for the safety of human.

3.2 Impacts of noise on microbial

The microbial are considered a basic element for life and main contributor for the development of the ecosystem and bionetwork. In the response of noise exposure, their biological and ecological behavior will be disturbed and long term exposure may affect their growth rate and production.

Souvik Banerjee, et al., [38] examined that the exposure of 432 Hz audible sound enhanced the growth and the antibiotic susceptibility of the E. coli as compared to the control system with no sound exposure while a decline was shown in the response of the sound with 4000 Hz.

The Escherichia coli is a typical bacteria present in the human's small intestine and plays significant role in food digestion. The measured results of the sound exposure on E. coli bacteria are tabulated in the table 1.

Table.1 Effect of sound on bacterial growth and antibiotic susceptibility [37]

Plates under Observation	No. Of Colonies	Zones Of Inhibition
Control Plate	39 (9 big and 30 small)	18 mm
Plate under 432 Hz	46 (8 big and 38 small)	20 mm
Plate under 4 KHz	06 (2 big and 4 small)	17 mm

The control plate is not affected by any sound and the total number of colonies in the control plate are 39 as shown in table 1. When the plate is exposed by a sound of frequency 432 Hz, it enhanced the colony forming ability and the number of colonies are reached to 46 that are even greater than control plate. The third plate with exposure of sound of frequency of 4000 Hz show a very slow growth and able to produce only 6 colonies, clearly showed that, the sound with frequency greater than 1000 Hz caused an inhibition in the growth of E. coli bacteria. The antibiotic capability of the plate with no sound exposure has 18mm zones of inhibition. To investigate the effects of sound exposure on the antibiotic capability of the E. coli bacteria, we compare the zones of inhibition of the sound exposed plates to the plate with subjecting no sound. The plate with exposure of 432 Hz sound booted up the inhibition zones up to 20 mm, which means this sound exposure enhanced the antibiotic capability of the E. coli bacteria. Whereas in case of 4000 Hz sound the inhibition zones has a value of about 17 mm that is minimum from the both cases. It shows that when the bacteria are subjected to sounds of higher frequency or noise, their growth and antibiotic capability goes decreases significantly.

GU. Shaobin, et al. [39] studied the effects of audible sound on the Escherichia coli under ordinary and osmatic environmental conditions. The results of this experiment are not different from the previous study [38], sound exposure in the normal condition brought stimulation effects on the growth rate of Escherichia coli while osmatic condition (by addition of sugar or salt) caused inhibition effects of the E. coli culture medium.

The exposure of sound in the normal condition stimulate the growth rate of the E. coli bacteria than the control as shown in figure 5. During the exposure of sound with frequencies 1000, 5000 and 10000 Hz and in the ordinary condition enhanced the relative colony forming efficiency up to 41%, 30% and 31% respectively as compared to control system. When these sounds are subjected on the bacteria in the harsh condition by addition of sodium chloride by 2%, their colonial forming ability decreased the relative colony forming efficiency as compared to the system with no sound exposure as shown in the figure 6.

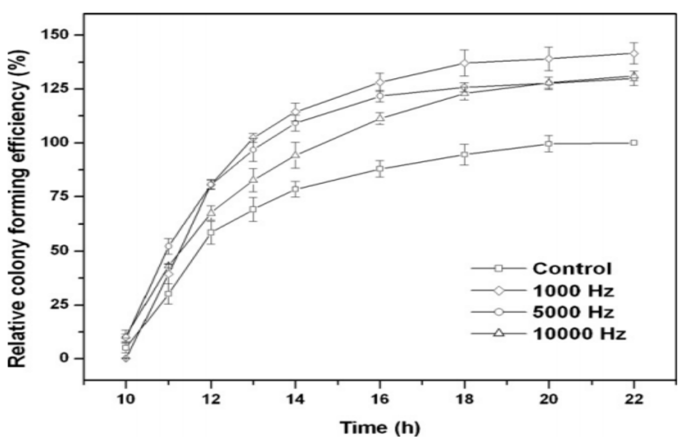

Figure 5. The influence of audible sound stimulation on E. coli growth under normal culture conditions.

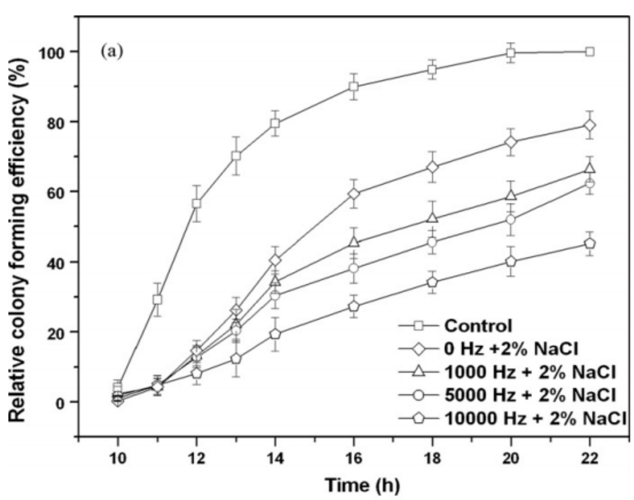

Figure 6. The influence of audible sound stimulation on responses of E. coli to salt stress

[40] Investigates the effects of audible sounds of frequencies 5000, 10000, and 15000 Hz on the growth of the bacteria Aspergillus Spp. experimentally. All three frequencies enhance the colonies formation as compared to the control (no sound exposure) and the sound with frequency 5000 Hz encourage the growth rate the most. These results are totally different from the studies [38-39].

[41] Investigated the effects of audible sound in the form of Indian music with frequency range (172-581 Hz) and (86-839 Hz) on the six different microorganisms (Chromobacterium violaceum, Serratia marcescens, Xanthomonas campestris, Brevibacillus parabrevis, Lactobacillus Plantarum and Saccharomyces cerevisiae). The results showed that the sound in the frequency range (172-581 Hz) increased the growth of all the microorganisms except Serratia marcescens. The second sound frequency 86-839 Hz influenced differently than first one. The growth rate and the pigment (prodigiosin) production of all the four microbes increases except Chromobacterium violaceum and Serratia marcescens. It is also noted that Chromobacterium violaceum responded differently when exposed to different music frequencies.

To investigate the influence of the sound pressure level, a sound of 300 Hz with different loudness levels 70-89.5 dB was set for the experiment, and the effects of growth and pigment (violacein) production of the Chromo bacterium violaceum was investigated [42]. It was found that the growth of the Chromo bacterium violaceum was affected significantly for all the sound intensities 70-89.5 dB. The higher the loudness of sound exposure the higher it affects pigment production.

The author in [43] studied the effects on the production in bacterial colonies of E. coli bacteria by exposure of two very different physical parameters the extremely low frequency electromagnetic fields and mechanical vibration. To investigate the effects relative to the frequency (2, 4, 6, 8 10 Hz) for mechanical vibration of amplitude (8mm) and intensity of electromagnetic fields (0.4 m T) were selected for both cases when the microbial are in their cluster medium during the introduction and when the culture media prior exposed by extremely low frequency electromagnetic fields and mechanical vibration before the addition of the bacteria. The result shows that, 4 and 8 Hz extremely low frequency electromagnetic fields and mechanical vibration show different biological effects on the production of bacteria than others. 4 Hz frequency exposure affects the cell culture directly while the 8 Hz affected the cell production in the above-mentioned both cases.

[44] Studied, the exposure of the mechanical vibration at infrasound frequency (2, 4, 6, 8, 10 Hz) on the growth of the bacteria with and without a medium. The results are not different from the

study [43], the mechanical vibrations at 4, 8 and 10 show inhibition phenomenon while at 2 and 6 Hz has the stimulation effects in the growth of the E. coli K-12. By how and what method or mechanism the mechanical vibration affects the microbial is still not clear. Infrasound with certain frequency causes inhibition in the growth of the E. coli. The results of the exposure of mechanical vibration on the growth of the E. coli K-12 are shown in the figure 7.

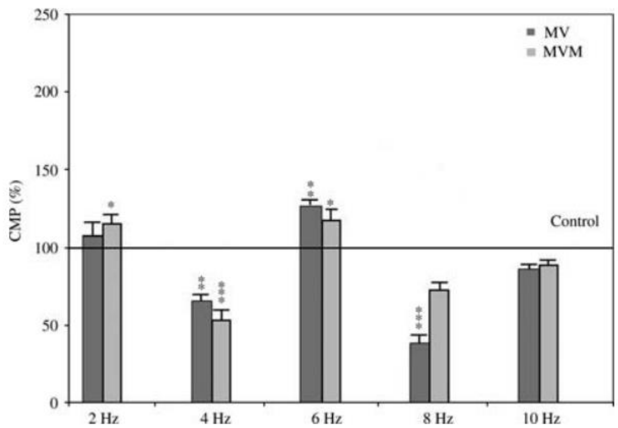

Figure 7. Frequency-dependent effect of MV treatment on the bacterial growth (CPM (%)). In the graph the bacteria culture treated with culture media marked as MV and beforehand treated culture media marked as MVM.

4. Conclusion and future recommendation

The railway noise is daring for both human beings and the survival of the microorganisms. It is concluded that all the sound exposure affect the production rate of the microbial, either it enhance the growth rate or decrease it. Sounds at low frequency show positive effects whereas at high frequency or sounds exposure in osmatic condition produced inhibition occurrence in the growth the microbial. The higher the frequency and the loudness of sound exposure the higher it shows inhibition effects in the growth rate of the microorganisms. The ultra and infrasound enhanced the inhibition phenomena in the growth rate of bacteria at certain frequency. In our analysis the noise generated by high speed railway has SPL of 81.29 dB that is almost 12 dB more than Japanese permitted standards. This high intensity noise is lying in the range of severe hearing loss for human’s ear and cause numerous diseases. This louder sound reduced the growing ability of the microorganisms and caused inhibition effects. While the natural sound are of low frequency sounds with SPL of about 42 dB. This low frequency sounds has no negative effects on the humans neither on the growth rate and proliferation of the microbial. There is not much literature that described the impacts of railway noise on the growth and survival of the microbial. Although a few presents the effects of audible sound on microorganisms, much work still remains to be examined.

This paper has initiated a new study area to investigate the impacts of railway noise on the microbial alongside the railway track. It is recommended for future work that the noise emitted by the railway should be reduced to a certain limit. The dominant noise generated by the railway consists of rolling noise, aerodynamics noise, and the structural vibration. There are many methods to control or reduce the railway noise. The aerodynamic noise of the railways can be reduced by constructing the cover across the pantograph, constructing the barrier across the railway track. The rolling noise of the railways can be controlled by reducing the friction between the rail and the wheel of the train and by attaching damping material on the side of the rail, or on the surface of the wheel of the train. The vibrations of the railway can be controlled by adjusting the alignment between the wheel and the railway line and also by reducing the roughness between them. By covering the interior walls and the floor of the cabin with sound absorbing materials, the interior noise can be reduced to some extent. In future any one or combination of two or more abovementioned methods can be used to reduce the railway noise to a certain level. By reducing the railway noise, we can save the humanity and other living organisms living across the railway lines. For future we recommend a new study method to investigate the impacts of railway noise on the growth rate and production of the microbial and also there is need to work more to control the noise radiated by the railway.

References

[1] Vijay Kothari et.al 2018, Influence of a Mono-Frequency Sound on Bacteria can be a Function of the Sound-Level, Indian Journal of Science and Technology, February 2018.

[2] MATSUHASHI, et al., 1998, Production of sound waves by bacterial cells and the response of bacterial cells to sound. The Journal of General and Applied Microbiology, 44(1), 49-55.

[3] Jasny M., 1999, sounding the depths: supertankers, sonar, and the rise of undersea noise. Natural Resources Defense Council, New York.

[4] McDonald MA, et al., 2006, Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicholas Island, California. J Acoust Soc Am 120:711–718.

[5] Watts RD, Compton RW, et al., 2007, Roadless space of the conterminous United States. Science 316:736–738.

[6] Barber JR, Crooks KR, Fristrup KM, 2009, the costs of chronic noise exposure for terrestrial organisms. Trends Ecol Evol 25:180–189.

[7] Marten K, Marler P., 1977, Sound transmission and its significance for animal vocalization.

Behavioral Ecology and Sociobiology; 2(3):271–90.
[8] Chanda ML, Levitin DJ., 2013, the neurochemistry of music. Trends in Cognitive Sciences; 17(4):179–93. PMid: 23541122.
[9] Aggio RBM, Obolonkin V, Villas-Boas SG., 2012, sonic vibration affects the metabolism of yeast cells growing in liquid culture: A metabolomic study. Metabolomics. 2012; 8(4):670–8.
[10] Shah A, Raval A, Kothari V., 2016, Sound stimulation can influence microbial growth and production of certain key metabolites. Journal Micro Biology Bio Tech. Food Science. 2016; 5(4):330-4.
[11] HASSANIEN, REDA H.E., et al., 2014. Effect of acoustic frequency technology on the growth of strawberry in solar greenhouse. 18th world congress of CIGR, Beijing.
[12] Sarvaiya, N. and Kothari, V., 2015, Effect of audible sound in form of music on microbial growth and production of certain important metabolites. Microbiol, 84(2), 227-235.
[13] Shah, A., Raval, A. and Kothari, V., 2016, Sound stimulation can influence microbial growth and production of certain key metabolites. J. Microbiol. Biotechnol. Food Sci., 5(4), 330.
[14] Sarvaiya, N. and Kothari, V., 2017, Audible Sound in Form of Music Can Influence Microbial Growth, Metabolism and Antibiotic Susceptibility. J. Appl. Biotechnol. Bioeng. 2(6), 00048.
[15] Kothari, V., Joshi, C., Patel, P., et al., 2018, Influence of a mono-frequency sound on bacteria can be a function of the sound-level. Indian J. Sci. Technol, 11(4).
[16] Kothari, V., Sharma, S., Padia, D., 2017, Recent research advances on Chromobacterium violaceum. Asian Pac. J. Trop. Dis., 10(8), 744-752.
[17] Joyce, E., et al., 2003, the development and evaluation of ultrasound for the treatment of bacterial suspensions. A study of frequency, power and sonification time on cultured bacillus species. Ultrasonic Son chemistry, 10(6):315-318.
[18] Pitt, W.G. and Ross, S.A., 2003, Ultrasound Increases the Rate of Bacterial Cell Growth. Biotechnology Progress, 19(3):1038-1044.
[19] William G. Pitt and S. Aaron Ross, 2003, Ultrasound Increases the growth rate of bacterial cell growth, *Biotechnol Prog*., 19(3): 1038–1044.
[20] Koda S, Miyamoto M, et al., 2009, Inactivation of Escherichia coli and Streptococcus mutans by ultrasound at 500 kHz. Ultrason Sonochem. 2009;16: 655-659.
[21] Xiao-Ming Tan et al., 2018, Characteristics and Mechanism Analysis of Aerodynamic Noise Sources for High-Speed Train in Tunnel, Hindawi Complexity, Volume 2018, Article ID 5858415, 19 pages
[22] Y.J Lee, 1996, Transactions on the Built Environment vol 18,WIT Press, ISSN 1743-3509.
[23] S. A. Lee, et al., 2015The aero-acoustic analysis for each part of double arm pantograph of high speed train," Journal of Computational Fluids Engineering, vol. 20, no. 2, pp. 61–66.
[24] W. Babisch, 2002, the noise/stress concept, risk assessment and research needs," Noise & Health, vol. 4, no. 16, pp. 1–11.
[25] Fritschi L, Brown AL, Kim R, Schwela DH, Kephalopoulos S., 2011. Burden of disease from environmental noise, The WHO European centre for environment and health. Geneva: WHO Regional Office for Europe, 7–11.

[26]. Babisch WF, Beule B, Schust M, et al., 2005, Traffic noise and risk of myocardial infarction. Epidemiology,16:33–40.
[27] Umweltbundesamt, 2014.
[28]. Grazuleviciene R, Lekaviciute J, Mozgeris G, et al., 2004 Traffic noise emissions and myocardial infarction risk. Pol J Environ Stud, 13:737–41.
[29] Sorensen M, Andersen ZJ, Nordsborg RB, et al., 2012, Road traffic noise and incident myocardial infarction: a prospective cohort study. PLoS ONE,7:e39283
[30] Słrensen M, Hvidberg M, et al., 2011, Road traffic noise and stroke: a prospective cohort study. European Heart Journal 32(6)
[31] Słrensen M, Andersen ZJ, et al., 2012, Road traffic noise and incident myocardial infarction: a prospective cohort study. PLoS ONE 7(6):e39283
[32] Franssen E., et al., 2003, Hinder door milieufactoren en de beoordeling van de leefomgeving in Nederland Inventarisatie verstoringen. TNO, 2004.
[33] Muzet, A., 1983, Research on noise-disturbed sleep since 1978. In: Rossi, G., ed. Proceedings of the Fourth International Congress on Noise as a Public Health Problem, Vol. 2, Milan, Centro Ricerche e Studi Amplifon.
[34] Gautier, P. E., et al., 2008, High speed trains external noise: A review of measurements and source models for the TGV case up to 360 km/h. In Proceedings of the 8th world congress on railway research (pp. 1-1).
[35] CTA., 2015, Railway noise measurement and reporting methodology. Retrieved February 3, 2016.
[36] Matsumoto, et al., 2005, Environmental noise in Middle East region of Kochi Prefecture [Japan]. Transactions of the Japanese Society of Irrigation, Drainage and Reclamation Engineering (Japan).
[37] Kanda, H., Tsuda, H., Ichikawa, K., & Yoshida, S., 2007, Environmental noise reduction of Tokaido Shinkansen and future prospect. In B. S. Werning, D. Thompson, P. E. Gautier, C. Hanson, B. Hemsworth, J. Nelson, T. Maeda, & P. Vos (Eds.), Noise and vibration mitigation for rail transportation systems (pp. 1–8). Berlin, Heidelberg: Springer.
[38] Souvik Banerjee, et al., 2018, Effect of Different Sound Frequencies on the Growth and Antibiotic Susceptibility of Escherichia coli Int.J.Curr.Microbiol.App.Sci, 7(3): 1931-1939
[39] Gu Shaobin, et al., 2010, a pilot study of the effect of audible sound on the growth of E. coli, Colloids and Surfaces B: Bio interfaces 78, 367–371.
[40] Poopathy Muthu Karippen, 2009, Experimental Investigation on the Effects of Audible Sound to the Growth of Aspergillus Spp, modern Applied Sciences, vol.3, No. 4.
[41] Abheelasha Shah, et al., 2015, sound stimulation can influence microbials growth and production of certain key metabolites, J Microbiol Biotech Food Sci / Shah et al. 2016 : 5 (4) 330-334.
[42] Vijay Kothari, et al., 2018, Influence of a mono-frequency sound on bacteria can be a function of the sound-level, Indian Journal of Science and Technology, Vol 11(4).

[43] Varsik Martirosyan, 2012, The Effects of Physical Factors on Bacterial Cell Proliferation, Journal of low frequency noise, vibration and active control, Vol. 31 No. 4, 247 – 256.
[44] Varsik Martirosyan, et al., 2012, the study of the effects of mechanical vibration at infrasound frequency on [3H]-thymidine incorporation into DNA of E. coli K-12, Electromagnetic Biology and Medicine, Early Online: 1–8.

Asif Mahmood, a Pakistani international student at Beihang Univeristy, Beijing, China. I am doing masters in mechanical engineering and my research area is noise control.

Acknowledgments
All praises and thanks be to the ALLAH Almighty. Much Appreciation to my supervisor Professor Ma Jinsheng and my group members for their guidance and recommendations.

Conflicts of Interest

There are no conflicts to declare.