International Journal of New Technology and Research (IJNTR)
ISSN:2454-4116, Volume-4, Issue-1, January 2018 Pages 42-44

Bacteria or Caketeria?!!?

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Abstract— **Background. The present study is done to confirm the transfer of bacteria when birthday candles are blown.**

Materials & Methods. The study has been carried out in the 2017. The candles were blown on sterile foil and the samples were collected in sterile swab and cultured in blood agar plates.

Result. Our study shows a 100% increase in the bacterial count comparing a sterile foil sheet containing blown candles.

Conclusion. The ceremony of blowing out candles in a birthday cake is proved to transfer bacteria to a greater extent. Probability of the risk of spread of respiratory illness is 100%. Hence this study stands as an evidence proving the spread of bacteria aerosolized from the respiratory tract. Precautions should be taken when a person coughs, sneezes and nowadays even when the person blows his or her birthday cakes!

Index Terms— **Birthday cakes, candle blowing, bioaerosols.**

I. INTRODUCTION

The tradition of blowing out candles on birthday cake is being followed in many countries. Some say that the practice began in ancient Greece related to bringing cakes with lit candles to the temples. Another ancient tradition says that the smoke from the blown candles carry their wishes to the heaven. A written account reported of birthday candles matching the age of Count Ludwig Von Zinzendorf being presented at the Count's birthday celebration in Germany in 1700's (Frey, 1753).

Ironically when the candles on the birthday cake are blown even though the smoke carries wishes to heaven , which is the good part but the bad part is that the aerosols from the person blowing the candle spreads bacteria from his or her oral microbial flora.

Bacteria are an unavoidable part of life present in and almost everything human contact. Whether a commensal or a pathogen its important to know about its transfer as illness related to pathogenic bacteria are a major health problem in today's society. Poor air hygiene and bioaerosols can have adverse effects on human health (Douwes, Thorne, Pearce & Heederik., 2003; Xu et al., 2011).

Respiratory droplets expelled by coughing and sneezing are sources of normal human flora, as well as pathogenic bacteria (Obeng, 2008; 1970; Houk, 1980)and viruses (Loosli, Hertweck, & Hockwald, 1970).The respiratory tract can be colonized with pathogenic organisms that can then be aerosolized in the breath of an infected individual (Couch, Knight, Gerone, Cate, Douglas, 1969; Knight, 1973).The spread of respiratory diseases including SARS (Yu et al., 2004) and H1N1 avian influenza (Baker et al., 2010) have been attributed to oral airborne transmission. In fact, influenza virus particles were detected in the exhaled breath of infected individuals through coughing, breathing and talking (Fabian et al., 2008; Stelzer-Braid et al., 2009; Huynh, Oliver, Stelzer, Rawlinson & Tovey, 2008; Lindsley et al., 2010). When respiratory droplets are released, they may spread infection directly fromperson-to-personorbycontamination of surfaces then touched by others (Obeng, 2008).

In fact, exhaled breath contained 693 to 6,293 CFU of bacteria/ml (Xu et al., 2012 and Qian, Hospodsky, Yamamoto, Nazaroff & Peccia., 2012) reported that human occupants are significant contributors to indoor air bacteria and that humans emit bacteria at a rate of about 37 million gene copies per person per hour. Hence when a person exhales forcibly, like blowing out candles, bacteria and viruses are aerosolized from the respiratory tract.

The purpose of this research was to confirm the bacterial transfer from top of a cake when blowing out the candles on a birthday. The data from our investigation may help raise awareness of possible health risks associated with birthday celebrations and encourage others to take steps toward preventing the spread of bacteria and preventing respiratory tract infections.

II. MATERIALS AND METHODS

A sterile foil sheet was spread on a circular base and 15 small birthday candles were placed on it under aseptic conditions. 5 test subjects were asked to smell and consume spicy foods to stimulate a meal- dessert sequence. After lighting the candles the test subjects were asked to blow the candles until they were fully extinguished. Control samples were provided for the test. Using a sterile swab, samples were collected from the foil (blown and not- blown) and it was lawn cultured on blood agar plates for approximate estimation of the microbial load. The plates were then incubated at 37°C for 24 hours and the results were observed.

III. Results and Discussion

The result of our study shows that blowing out candles resulted in 100% increase in the microbial load from the foil in which the candles were blown when compared to the foil that did not have candles. Studies on airborne droplet size from the oral cavity are found as early as 1899 (Flugge, 1899) and by several others before the mid 20thcentury (Hutchison, 1901; Winslow, 1910; Strausz, 1922; Lange & Nowoselsky, 1925; Hamburger, 1944; Duguid, 1946). One study reported that 90% of bacteria-carrying droplets remaining airborne for 30 minutes in still air and that some smaller droplets remained for up to 30 hours (Duquid, 1946). More recently,

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Wan et al. (2014) established that up to over 2,000 moisture particles were released per breath, all less than 5 um in diameter.

Bioaerosols are very important as their size is very small and they transfer bacteria and viruses while a person blows, coughs or sneezes, particle droplets generated by breathing, blowing and coughing. The average size of expelled particles generated by coughing and speaking was found to be much larger (13.5 um for coughing and 16.0 um diameter for speaking) by measurement at the mouth opening thus minimizing the effect of evaporation on droplet (particle) size (Chao et al., 2008). The size of droplets in expelled air is large enough to carry bacteria as well as viruses. Normal respiratory aerosols can include *Staphylococcus* spp., *Streptococcus* spp., *Corynebacterium* spp., *Haemophilus* spp., and *Neisseria*spp. (Madigan,Martinko, Dunlap, & Clark, 2009). Madigan et al. (2009) also found certain pathogenic species, such as *Streptococcus pneumonie* and *Staphylococcus aureus*, may cause illness when spread through surface contamination via oral aerosols.

Considering contagious diseases such as influenza, some researchers have concluded that airborne transmission is a likely pathway (Weder & Stilianakis, 2008; Wein & Atkinson, 2009). Fabian et al. (2008) and Stelzer-Braid et al. (2009) detected viral influenza in the exhaled breath of infected patients. Fabian et al. (2008) reported that 60% of patients with influenza A had detectable levels of the virus in exhaled breath with 87% of exhaled particles less than 1 um in diameter. In another study, Lindsley et al. (2010) reported that 81% of influenza patients had influenza RNA in their breath and that 65% of the influenza was found in aerosol particles 4 um in diameter or smaller. Verifying that bacterial cells as well as viruses are carried on human bioaerosols, (Fennelly et al 2004) reported that 25% of tuberculosis patients exhaled from 3-633 CFU per cough of *Mycobacterium tuberculosis* in expelled air particles.

The ceremony of blowing out candles in a birthday cake is proved to transfer bacteria to a greater extent. The person blowing the candle could be healthy but the question is what if he or she is infected? Probability of the risk of spread of respiratory illness is 100%. Hence this study stands as evidence proving the spread of bacteria aerosolized from the respiratory tract. Precautions should be taken when a person coughs, sneezes and nowadays even when the person blows his or her birthday cakes!

REFERENCES

[1] Paul Dawson, Inyee Han, Danielle Lynn , Jenevieve Lackey, Johnson Baker & Rose Martinez-Dawson . Bacterial transfer associated with blowing out candles on a birthday cake. Journal of Food Research; Vol. 6, No. 4; 2017

[2] Brankston, G., Gitterman, L., Hirji, Z., Lemieux, C.,&Gardam, M. (2007).Transmission of influenza A in human beings. *The Lancet Infectious Diseases,7*,257-265.https://doi.org/10.1016/S1473-3099(07)70029-4

[3] Bright,K. R., Boone,S. A.,& Gerba,C. P. (2010). Occurrenceof Bacteriaand Viruses on Elementary Classroom Surfacesand the Potential Roleof Classroom Hygiene inthe Spreadof Infectious Diseases.*Journal of School Nursing,26*(1), 33-42. https://doi.org/10.1177/1059840509354383

[4] Chao,C.Y.H., Wan,M.P., Morawska,L., Johnson,G.R., Ristovski,Z.D., …Katoshevski, D.(2009).Characterization of expiration air jets and droplet size distributions immediately at the mouth opening.*J Aerosol Sci.,40*(2),122-133.https://doi.org/10.1016/j.jaerosci.2008.10.003

[5] Couch, R., Knight, V., Gerone, P., Cate, T., & Douglas, R. (1969). Factors influencing response of volunteers to inoculation with Coxsackie virus A type 21. *American Review of Respiratory Disease, 99*, 24-30. http://www.atsjournals.org/doi/abs/10.1164/arrd.1969.99.1.24#readcube-epdf

[6] Douwes, J., Thorne, P., Pearce, N., & Heederik, D. (2003). Bioaerosol health effects and exposure assessment: Progress and prospects. *Annals of Occupationanl Hygiene, 3*, 187-200. https://doi.org/10.1093/annhyg/meg032

[7] Duguid, J.P. (1946). The size and the duration of air-carriage of respiratory droplets and droplet nuclei. *Epidemiology and Infection,44*(6), 471-479 https://doi.org/10.1017/S0022172400019288

[8] Fabian,P., McDevitt,J.J., DeHaan,W.H., Fung, R.O.P., Cowling,B.J., Chan, K.H., Leung, G.M.,& Milton, D.K. Influenza virus in human exhaled breath: an observational study. *PLoS ONE,3*,e2691. https://doi.org/10.1371/journal.pone.0002691

[9] Fennelly, K.P., Martyny, J.W., Fulton, K.E., Orme, I.M., Cave, D.M.,&Heifets, L.B. et al. (2004).Cough-generated aerosols of Mycobacterium tuberculosis: a new method to study infectiousness. *American Journal of Respiratory and Critical Care Medicine,169*(5),604-609.http://dx/doi.org/10.1164/rccm.200308-1101OC

[10] Flugge,C. (1899).Die Verbreitung der Phthise durch staubförmiges Sputum und durch beim Husten verspritzte Tröpfchen. *Zeitschrift fur Hygiene und Infektionskrankheiten,30*(1), 107-124. http://dx/.doi.org/10.1007/BF02198683

[11] Frey, A. (1753) A True and Authentic Account of Andrwe Frey. https://books.google.com/books?id=VIoUAAAAQAAJ&pg=PA15&hl=en#v=onepage&q&f=false

[12] Hamburger, M. (1944). Studies on the transmission of hemolytic Streptococcus infections: I Cross infection in army hospital wards. *Journal of Infectious Diseases,75*(1), 58-70. https://doi.org/10.1093/infdis/75.1.58

[13] Houk, V. N. (1980) Spread of tuberculosis via recirculated air in a naval vessel: the Byrd study. *Annals of the New York Academy of Sciences, 353*, 10-24. https://doi.org/10.1111/j.1749-6632.1980.tb18901.x

[14] Hutchison, R. F. (1901). Die Verbreitung von Keimen durch gewöhnliche Luftströme. *Zeitschrift fur Hygiene und Infektionskrankheiten,36*(1), 223-253. https://doi.org/10.1007/BF02141226

[15] Knight, V. (1973). Airborne transmission and pulmonary deposition of respiratory viruses. In: Hers JF, Winkles KC, editors. Airborne transmission and airborne infections. VIth Int. Symp. on Aerobiology. New York, NY: Wiley, pp. 175-182.

[16] Lange, B., & Nowoselsky, W. (1925). Experimentelle Untersuchungen über die Bedeutung der Staubinfektion bei der Tuberkulose. *Medical Microbiology and Immunology,104*(1-2), 286-307. https://doi.org/10.1007/BF02175004

[17] Lindsley, W. G., Blachere, F. M., Thewlis, R. E., Vishnu, A., Davis, K. A., Cao, G., & Palmer, J. E. (2010) Measurements of airborne influenza virus in aerosol particles from human coughs. PLoS ONE 5: e15100. https://doi.org/10.1371/journal.pone.0015100.

[18] Loosli, C., Hertweck, M., & Hockwald, R. (1970) Airborne influenza PR8-A virus infections in actively immunized mice. *Arch Envir Hlth, 21*, 332-346. https://doi.org/10.1080/00039896.1970.10667248

[19] Madigan, M.T., Martinko, J. M.,Dunlap, P.V., & Clark, D. P. (2009). Brock: Biology of Microorganisms, 12thed. San Francisco: Pearson. 1061 p.

[20] Obeng, C. S. (2008). Personal Cleanliness Activities in Preschool Classrooms. *Early Childhood Education Journal,36*, 93-99.http://doi.org/10.1007/s.10643-008.0253.4.

[21] Qian,J., Hospodsky,D., Yamamoto,N., Nazaroff,W.W., & Peccia,J.(2012) Sizeresolved emission rates of airborne bacteria and fungi in an occupied classroom. Indoor Air, http://doi.org/10.1111/j.1600-0668.2012.00769.
[22] SAS (2010). Statistical Analysis Institute User's Guide :Basics, 9.1 ed.,SAS Institute Inc. Cary, NC.
[23] Stelzer-Braid,S., Oliver,B.G., Blazey,A.J., Argent,E., Newsome,T.P., Rawlinson, W.D.,& Tovey, E.R. (2009).Exhalation of respiratory viruses by breathing, coughing, and talking. *Journal of Medical Virology,81*,1674-1679. http://doi.org/10.1002/jmv.21556
[24] Strausz, W. (1922). Versuche über beim Sprechen verschleuderte Tröpfchen.*Zeitschrift fur Hygiene und Infektionskrankheiten,96*(1), 27-47 https://doi.org/10.1007/BF02183834
[25] Tellier, R. (2009) Aerosol transmission of influeza A virus: a review of new studies Journal of the Royal Society Interface. Published online 1-8. http://doi.org/10.1098/rsif.2009.0302.focus
[26] Wan, G.H., Wu, C.L., Chen, Y.F., Huang, S.H., Wang, Y.L., & Chen, C.W. (2014) Particle Size Concentration Distribution and Influences on Exhaled Breath Particles in Mechanically Ventilated Patients. *PLoS ONE,9*(1),e87088. http://doi:10.1371/journal.pone.0087088
[27] Weber, T.P.,&Stilianakis, N.I. (2008) Inactivation of influenza A viruses in the environment and modes of transmission: a critical review. *Journal of Infection,57*,361-373. https://doi.org/10.1016/j.jinf.2008.08.013
[28] Wein, L.M.,&Atkinson, M.P. (2009) Assessing infection control measures for pandemic influenza. *RiskAnalysis,29*,949-962. http://doi.org/10.1111/j.1539-6924.2009.01232.x
[29] Winslow, C.E.A.(1910).Aninvestigationoftheextentofthebacterialpollution oftheatmospherebymouthspray.*TheJournalofInfectiousDiseases, 7*(1),17-37.http://dx/doi.org/10.1093/infdis/7.1.17
[30] Xu, Z., Wu, Y., Shen, F., Chen, Q., Tan, M., & Yao, M. (2011) Bioaerosol science, technology, and engineering: past, present, and future. *Aerosol Science and Technology, 45*, 1337-1349. https://doi.org/10.1080/02786826.2011.593591
[31] Xu, Z., Shen, F., Li, X, Wu, Y., Chen, Q., Jie, X., & Yao, M. (2012). Molecular and microscopic analysis of bacteria and viruses in exhaled breath collected using a simple impaction and condensing method. *Plos One, 7*(7), 1-8. Published online www.plosone.org
[32] Yu, I. T., Li, Y., Wong, T. W., Tam, W., Phil, M., Chan, A. T., Lee, J., Leung, D., & Ho, T. (2004) Evidence of airborne transmission of the severe acute respiratory syndrome virus. *New England Journal of Medicine, 351*, 1731-1739. https://doi.org/10.1056/NEJMoa032867

Figure 1: Growth of bioaerosols from the foil in which the candles blown

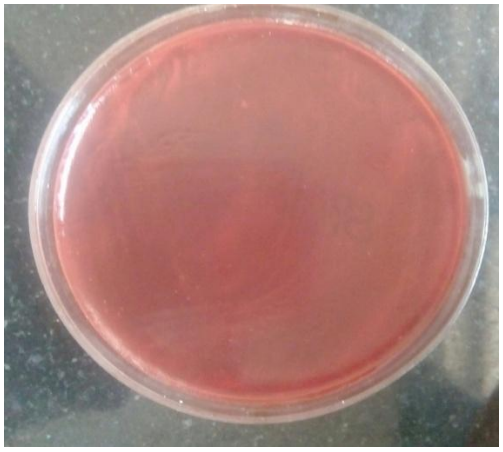

Figure 2: No growth - Swab taken from foil in which the candles not blown