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BACTERIAL CONTAMINATION OF BROKEN AND SHELLED EGGS SOLD IN SOROTI MUNICIPAL, SOROTI DISTRICT

BY

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A DESERTATION TO BE SUBMITTED TO THE FACULTY OF AGRICULTURE AND ANIMAL SCIENCES, ANIMAL DEPARTMENT, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD
OF A BACHELORS DEGREE IN ANIMAL PRODUCTION AND MANAGEMENT

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Declaration

I BAHAYA FRANCIS KASIGAIRE declares that this research was carried out by me with the guide of my laboratory supervisor Mr. Muyinda Robert, my Academic supervisor Dr. Ekou Justine and from review of other research journals.

Dedication

I dedicate this research to myself and, I also dedicate this report to my family and friends

Approval

This research was conducted under the guidance of my supervisor and presented in a defense panel for approval

Approved by

Dr. EKOU JUSTINE

Date .....

Sign.....

Acknowledgement

I take this opportunity to thank my academic supervisor for the guidance; I also thank Mr. Muyinda Robert for the effort and guidance in my experimental work. My sincere appreciation and thanks goes to all the management staff, lecturers and stake holders of Busitema University Arapai Campus

List of abbreviations

FDA: Food and Drug Authority

CFU: Colony Forming Units

FAO: Food and Agricultural Organization

WHO: World Health Organization

MAAIF: Ministry Of Agriculture Animal Industry and Fisheries

UBOS: Uganda Bureau of Statistics

NAOH: Sodium Hydroxide

HCL: Hydrochloric acid

E.T.C: And others

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Abstract

Eggs are highly demanded due to the fact that eggs are nutritious and readily available as cheap source of proteins. Contamination of table eggs with pathogenic bacteria is a major problem worldwide resulting into foodborne illnesses and intoxication. Although there is knowledge about bacterial contamination of cracked and un-cracked table eggs worldwide, virtually nothing is known about bacterial contamination of cracked and un-cracked table eggs in Soroti municipal. Therefore the aim of this research was to determine the microbial quality of cracked and un-cracked table eggs sold in Soroti municipal. 1ml of egg content sample was serially diluted, 1ml of the 3rd dilution poured on nutrient agar and cultured by incubating at temperatures of 37±2 ^{0}c for 24 hrs in hot air oven, bacteria colonies were counted and bacteria concentration calculated, different bacteria colonies were extracted, gram stained and observed under the light microscope using 100x magnification objective for characterization according to cell morphology.

The mean bacterial concentrations (load) were 40177.8 and 61089 colony forming units and colony forming unit per ml of cracked and un-cracked egg content respectively, there was a significant difference in the level of contamination between the cracked and un-cracked table eggs (p-value=0.008). There were six identified bacterial species; salmonellae, pseudomonas, bacillus, coliform, streptococci and staphylococci. All these bacteria were isolated from both cracked and un-cracked table eggs although there was significant difference in species prevalence between cracked and un-cracked egg samples (p-value=0.0024). Cracked table eggs sold in Soroti municipal are more contaminated than un-cracked eggs. Both having pathogenic bacteria such as salmonella and coli-forms; therefore pose a risk of causing foodborne infection and intoxication to the public. The public should boil their eggs before eating them and be educated on the dangers of eating raw and undercooked cracked eggs

Chapter one

Introduction

Egg are highly demanded due to the fact that eggs are nutritious and readily available cheap source of protein(Miranda et al., 2015)., one large egg providing about 6.5g of proteins and they are also a significant source of iron, riboflavin, folate and vitamin B12, D and E(Sophie, Guyot, & Nys, 2019)

China is the largest producer and consumer of poultry eggs in world, followed by United States of America and Russia(Food and Agriculture Organization of the United Nations [FAO], 2015)

The total poultry population in Uganda was projected to be about 32.6 million birds for 2006-2007 compared to 23.5 million in 2002,with chicken forming the main poultry type and the eastern region comprising of the highest number of poultry birds(Umut, 2017). recent studies give an estimate of 37.4 million chicken birds in Uganda (FAO, 2012.;MAAIF and UBOS, 2009). Egg production in Uganda has increased in the past five years and a rate of 2.8 percent increase from 882.6 million eggs produced in 2016 to 907.1 million in 2017 was noticed(UBOS, 2018).

There is no information on consumption rate of egg in Soroti and Uganda, however according to Jaffe, (2016), productivity is always influenced by the demand for a particular product.

Despite the increasing egg production and consumption rates, food borne diseases remain a challenge globally, with higher incidence rate in developing countries (Kirk et al., 2015; Grace, 2015). Food borne diseases are among the widespread public health problem, yet only a small proportion of these illnesses come to the notice of health services, and even fewer are investigated (Venter, 2000). In 2010, the World Health Organization's Food borne Disease Burden Epidemiology Reference Group estimated 582 million cases of food borne diseases and 351 000 associated deaths worldwide (Zelalem, 2017). Affecting mostly elderly people, children aged less than 5 years, pregnant women, and individuals with low immune systems(Lund & O'Brien, 2011;WHO, 2019).

Humans acquire and suffer from food borne illnesses or become intoxicated via the oral route after eating food or drinking water contaminated with food borne or waterborne causing microbes respectively or their toxins(Moua, 2006). The common bacterial microbes associated

Reference

Abdela, W. (2014). *Sources and distribution of Salmonella serotypes isolated from food animals , slaughterhouse personnel and retail meat products in Ethiopia :* (November 2002), 1997–2002. https://doi.org/10.4314/ejhd.v17i1.9782

Ackers, M., Mahon, B. E., Leahy, E., Goode, B., Damrow, T., Hayes, P. S., … Slutsker, L. (2008). An Outbreak of Escherichia coli O157:H7 Infections Associated with Leaf Lettuce Consumption . *The Journal of Infectious Diseases*, *177*(6), 1588–1593. https://doi.org/10.1086/515323

Ahmed, A. (1986). *Antibacterial Properties of an Egg*.

Al-Bahry S.N., Mahmoud I.Y., Al-Musharafi S.K., Al-Ali, M. A. (2012). Penetration of Spoilage and Food Poisoning Bacteria Into Fresh Chicken Egg : a Public Health Concern. *Global Journal of Bio-Science & Biotechnology*, *1*(1), 33–39.

Al-Obaidi, F. A., Al-Shadeedi, S. M. J., & Al-Dalawi, R. H. (2011). Quality, chemical and microbial characteristics of table eggs at retail stores in Baghdad. *International Journal of Poultry Science*, *10*(5), 381–385. https://doi.org/10.3923/ijps.2011.381.385

Amer, M. M. (2016). *A study on bacterial contamination of table eggs sold for consumption in Sana âĆ™ a city Sana ' a city . Introduction The poultry sector investment in Yemen is estimated to be more than 2 milliards farms produce about 50 % of the table eggs . with producing*. (February 2015).

Atoyebi, O., Adetunji, V., Babalobi, O., & Atoyebi, T. (2018). Isolation of Escherichia coli O157:H7 in table eggs from selected farms in Ibadan: Efficacy of Lactobacillus rhamnosus GG probiotic for its control. *International Journal of Infectious Diseases*, *73*, 57. https://doi.org/10.1016/j.ijid.2018.04.3554

Bahobail, A. A. S., Hassan, S. A., & El-deeb, B. A. (2012). *Microbial quality and content aflatoxins of commercially available eggs in Taif , Saudi Arabia*. *6*(13), 3337–3342. https://doi.org/10.5897/AJMR12.229

Baker, C. (1974). MICRO , BIOLOGY Of EGGS. *Journal Milk Food Technology*, *37*(5), 265–268.

Barrow, P. A., & Lovell, M. A. (2007). *Experimental infection of egg □ laying hens with Salmonella enteritidis phage type 4 Salmonella enteritidis phage type 4. 9457.* https://doi.org/10.1080/03079459108418769

Becker, K., Heilmann, C., & Peters, G. (2014). Coagulase-negative staphylococci. *Clinical Microbiology Reviews*, *27*(4), 870–926. https://doi.org/10.1128/CMR.00109-13

Ben-David, A., & Davidson, C. E. (2014). Estimation method for serial dilution experiments. *Journal of Microbiological Methods*, *107*, 214–221. https://doi.org/10.1016/j.mimet.2014.08.023

Berang. (1999). *BACTERIAL PENETRATION OF THE EGGSHELL AND SHELL MEMBRANES OF THE CHICKEN HATCHING EGG : A REVIEW.*

Berrang. (1999). *Berrang et al. 1999. Bacterial penetration of the eggshell and shell membranes of the chicken hatching egg-a review.*

Bisholo, K. Z., Ghuman, S., & Haffejee, F. (2018). Food-borne disease prevalence in rural villages in the Eastern Cape, South Africa. *African Journal of Primary Health Care & Family Medicine*, *10*(1), 1–5. https://doi.org/10.4102/phcfm.v10i1.1796

BOARD. (1992). *Anestesia en el paciente séptico con distrés respiratorio* (pp. 47–60). pp. 47–60.

Botteldoorn, N., Heyndrickx, M., Rijpens, N., Grijspeerdt, K., & Herman, L. (2003). *Salmonella on pig carcasses : positive pigs and cross contamination in the slaughterhouse*. 891–903. https://doi.org/10.1046/j.1365-2672.2003.02042.x

Cader, S., Goburdhun, D., & Neetoo, H. (2014). Assessment of the Microbial Safety and Quality of Eggs from Small and Large-Scale Hen Breeders. *JWPR Journal of World's Poultry Research J. World's Poult. Res*, *4*(4), 75–81. Retrieved from http://jwpr.science-line.com/

Cader, S. et al. (2014). *Assessment of the Microbial Safety and Quality of Eggs from Small and Large-Scale Hen Breeders*. *4*(4), 75–81.

CDC. (2013). *Signs and Symptoms Diagnosis Treatment Transmission*. 2011–2013.

Cohen, T. C. and P. S. (2015). *HHS Public Access*. *3*(3). https://doi.org/10.1128/microbiolspec.MBP-0006-2014.Commensal

Commission, E., The, O. O. F., Committee, S., Veterinary, O. N., & Relating, M. (2000). *ON FOOD-BORNE ZOONOSES*. (April).

Cooke, E. M. (1985). Escherichia coli – an overview. *Journal of Hygiene*, *95*(3), 523–530. https://doi.org/10.1017/S022217240006065X

Cox, N. A., Berrang, M. E., & Cason, J. A. (2000). Salmonella penetration of egg shells and proliferation in broiler hatching eggs - A review. *Poultry Science*, *79*(11), 1571–1574. https://doi.org/10.1093/ps/79.11.1571

De Jong, B., & Ekdahl, K. (2006). The comparative burden of salmonellosis in the European Union member states, associated and candidate countries. *BMC Public Health*, *6*(February). https://doi.org/10.1186/1471-2458-6-4

De Silva, S. A. S. D., Kanugala, K. A. N. P., & Weerakkody, N. S. (2016). Microbiological Quality of Raw Milk and Effect on Quality by Implementing Good Management Practices. *Procedia Food Science*, *6*(Icsusl 2015), 92–96. https://doi.org/10.1016/j.profoo.2016.02.019

Drinan, L. (2016). Escherichia coli infections. *Nursing Standard*, *25*(8), 59–60. https://doi.org/10.7748/ns.25.8.59.s50

ElMasry, R., Torky, H., & ElGebaly, L. (2016). Sequence Analysis of Pathogenic Staphylococcus Aureus Isolated from Different Sources. *Alexandria Journal of Veterinary Sciences*, *51*(2), 1. https://doi.org/10.5455/ajvs.202784

FAO. (n.d.). *Livestock production systems spotlight*.

Farrokh, C., Jordan, K., Auvray, F., Glass, K., Oppegaard, H., Raynaud, S., … Cerf, O. (2013). Review of Shiga-toxin-producing Escherichia coli (STEC) and their significance in dairy production. *International Journal of Food Microbiology*, *162*(2), 190–212. https://doi.org/10.1016/j.ijfoodmicro.2012.08.008

FDA. (2013). *FC2013-010.pdf*.

Fluit, A. C. (2005). *Towards more virulent and antibiotic-resistant Salmonella ? 43*, 1–11. https://doi.org/10.1016/j.femsim.2004.10.007

Folorunsho, O., & Charles, A. (2017). Effect of rinses on microbial quality of commercially available eggs and its components before processing from Ilorin in western Nigeria. *Bitlis Eren University Journal of Science and Technology*, *3*(2), 44–44. https://doi.org/10.17678/beuscitech.47130

Food and Agriculture Organization of the United Nations [FAO]. (2015). *EGG Facts*. (March), 2015. Retrieved from http://www.fao.org/assets/infographics/FAO-Infographic-egg-facts-en.pdf

Gantois, I., Ducatelle, R., Pasmans, F., Haesebrouck, F., Gast, R., Humphrey, T. J., & Van Immerseel, F. (2009). Mechanisms of egg contamination by Salmonella Enteritidis: Review article. *FEMS Microbiology Reviews*, *33*(4), 718–738. https://doi.org/10.1111/j.1574-6976.2008.00161.x

Giedrys-kalemba, S., Jursa-kulesza, J., & Travelling, P. (2015). *Learn more about Staphylococcus Staphylococcus Autovaccines in Individual Therapy of Staphylococcal Infections*.

Grace, D. (2015). Food safety in low and middle income countries. *International Journal of Environmental Research and Public Health*, *12*(9), 10490–10507. https://doi.org/10.3390/ijerph120910490

Guyot, N., Rehault-Godbert, S., Slugocki, C., Harichaux, G., Labas, V., Helloin, E., & Nys, Y. (2016). Characterization of egg white antibacterial properties during the first half of incubation: A comparative study between embryonated and unfertilized eggs. *Poultry Science*, *95*(12), 2956–2970. https://doi.org/10.3382/ps/pew271

Habib, F., Rind, R., Durani, N., Latif Bhutto, A., Buriro, R. S., Tunio, A., … Shoaib, M. (2015). Morphological and Cultural Characterization of Staphylococcus Aureus Isolated from Different Animal Species. *Journal of Applied, Environmental and Biological Sciences*, *5*(2), 15–26.

Hanning, I., Pendleton, S., Souza, D. D., Kit, R. P. C. R., Settles, M. L., Of, W. H. O. E., …

Gerritsen, A. (2014). *33 M Llion*. (September), 1–9.

Harris, L. G., Foster, S. J., Richards, R. G., Lambert, P., Stickler, D., & Eley, A. (2002). An introduction to Staphylococcus aureus, and techniques for identifyingand quantifying S. aureus adhesins in relation to adhesion to biomaterials:Review. *European Cells and Materials*, *4*, 39–60. https://doi.org/10.22203/eCM.v004a04

Ift, T., & Status, S. (2004). *Bacteria Associated with Foodborne Diseases*. *7*(August), 1–25.

Jafari, A., Mm, A., & Bouzari, S. (2012). *Escherichia coli : a brief review of diarrheagenic pathotypes and their role in diarrheal diseases in Iran*. *4*(3), 102–117.

Jaffe, A. B. (2016). *Demand and Supply Influences in R & D Intensity and Productivity Growth Author (s): Adam B . Jaffe Source : The Review of Economics and Statistics , Vol . 70 , No . 3 (Aug ., 1988), pp . 431-437 Published by : MIT Press Stable URL : http://www.jstor.o*. *3*(3), 431–437.

Janmaat, A., & Morton, R. (2006). *Infectious Diseases of Poultry*. (June), 1–6.

Jeanmonod, D. J., Rebecca, Suzuki, K. et al., Hrabovsky, M., Mariana Furio Franco Bernardes, M. P., & Lilian Cristina Pereira and Daniel Junqueira Dorta. (2018). We are IntechOpen , the world â€™ s leading publisher of Open Access books Built by scientists , for scientists TOP 1 % Control of a Proportional Hydraulic System. *Intech Open*, *2*, 64. https://doi.org/10.5772/32009

Kabir, A., Miah, S., & Islam, A. (2018). Factors influencing eating behavior and dietary intake among resident students in a public university in Bangladesh: A qualitative study. *PLoS ONE*, *13*(6), 1–17. https://doi.org/10.1371/journal.pone.0198801

KAPER, J. P. N. A. J. B., & Center. (2002). Diarrheagenic Escherichia coli Strains. *Bacterial Pathogenesis*, *11*(1), 407–421. https://doi.org/file://Z:\References\Text Files\00000004472.txt

Katouli, M. (2010). Population structure of gut Escherichia coli and its role in development of extra-intestinal infections. *Iranian Journal of Microbiology*, *2*(2), 59–72.

Kim, A. C. J., Emery, D. A., Rinke, H., Nagaraja, K. V, Halvorson, D. A., Kim, C. J., … Rinke,

H. (2019). *Effect of Time and Temperature on Growth of Salmonella enteritidis in Experimentally Inoculated Eggs Published by : American Association of Avian Pathologists Stable URL : https://www.jstor.org/stable/1591153 on Growth of Salmonella enteritidis Effect of*. *33*(4), 735–742.

Kim, S. (2010). Salmonella serovars from foodborne and waterborne diseases in Korea, 1998-2007: Total isolates decreasing versus rare serovars emerging. *Journal of Korean Medical Science*, *25*(12), 1693–1699. https://doi.org/10.3346/jkms.2010.25.12.1693

Kirk, M. D., Pires, S. M., Black, R. E., Caipo, M., Crump, J. A., Devleesschauwer, B., … Angulo, F. J. (2015). Correction: World Health Organization Estimates of the Global and Regional Disease Burden of 22 Foodborne Bacterial, Protozoal, and Viral Diseases, 2010: A Data Synthesis (PLoS Med, (2015), 12, 12). *PLoS Medicine*, *12*(12), 1–21. https://doi.org/10.1371/journal.pmed.1001940

KORNACKI, J. L., & MARTH, E. H. (2016). Foodborne Illness Caused by Escherichia coli: A Review. *Journal of Food Protection*, *45*(11), 1051–1067. https://doi.org/10.4315/0362-028x-45.11.1051

Le, L., Rosa, D., Gracia, A., Barranco, D., & Rallo, L. (2008). *Fatty acid composition of advanced olive*. *1926*(April), 1921–1926. https://doi.org/10.1002/jsfa

Lin, J., Lin, D., Xu, P., Zhang, T., Ou, Q., Bai, C., & Yao, Z. (2016). Non-hospital environment contamination with Staphylococcus aureus and methicillin-resistant Staphylococcus aureus: proportion meta-analysis and features of antibiotic resistance and molecular genetics. *Environmental Research*, *150*, 528–540. https://doi.org/10.1016/j.envres.2016.06.040

Lund, B. M., & O'Brien, S. J. (2011). The Occurrence and Prevention of Foodborne Disease in Vulnerable People. *Foodborne Pathogens and Disease*, *8*(9), 961–973. https://doi.org/10.1089/fpd.2011.0860

Lutful Kabir, S. M. (2010). Avian colibacillosis and salmonellosis: A closer look at epidemiology, pathogenesis, diagnosis, control and public health concerns. *International Journal of Environmental Research and Public Health*, *7*(1), 89–114. https://doi.org/10.3390/ijerph7010089

M. OKAMURA, S. KIKUCHI, A. SUZUKI, H. TACHIZAKI, K. T. A. M. N. (2008). *Effect of fixed or changing temperatures during prolonged storage on the growth of Salmonella enterica serovar Enteritidis inoculated artificially into shell eggs*. 1210–1216. https://doi.org/10.1017/S0950268807009612

MAAIF and UBOS. (2009). The national livestock census: A summary report of the national livestock census. *Uganda Bureau Of Statistics*, *May*, 1–34. https://doi.org/10.5267/j.msl.2012.06.001

Marin, C., & Lainez, M. (2009). Salmonella detection in feces during broiler rearing and after live transport to the slaughterhouse. *Poultry Science*, *88*(9), 1999–2005. https://doi.org/10.3382/ps.2009-00040

Martins, P. D., de Almeida, T. T., Basso, A. P., de Moura, T. M., Frazzon, J., Tondo, E. C., & Frazzon, A. P. G. (2013). Coagulase-Positive Staphylococci Isolated from Chicken Meat: Pathogenic Potential and Vancomycin Resistance. *Foodborne Pathogens and Disease*, *10*(9), 771–776. https://doi.org/10.1089/fpd.2013.1492

Masalha, M., Borovok, I., Schreiber, R., Aharonowitz, Y., & Cohen, G. (2001). Analysis of transcription of the Staphylococcus aureus aerobic class Ib and anaerobic class III ribonucleotide reductase genes in response to oxygen. *Journal of Bacteriology*, *183*(24), 7260–7272. https://doi.org/10.1128/JB.183.24.7260-7272.2001

Miliane Moreira Soares de Souza1, S. de M. de O. C., Ingrid Annes Pereira2, L. de C. S., 3, Pribul, B. R., & Coelho, 1 and Irene da Silva. (2000). *We are IntechOpen , the world ' s leading publisher of Open Access books Built by scientists , for scientists TOP 1 %*.

Miranda, J. M., Anton, X., Redondo-valbuena, C., Roca-saavedra, P., Rodriguez, J. A., Lamas, A., … Cepeda, A. (2015). *Egg and Egg-Derived Foods: Effects on Human Health and Use as Functional Foods*. 706–729. https://doi.org/10.3390/nu7010706

MSD. (2013). *I mp or tant pou l tr y di seas e s*.

Okoro, C. S., Musonda, I., & Agumba, J. (2017). Evaluating the Influence of Nutrition Determinants on Construction Workers' Food Choices. *American Journal of Men's Health*, *11*(6), 1713–1727. https://doi.org/10.1177/1557988315625775

Paião, F. G., Arisitides, L. G. A., Murate, L. S., Vilas-Bôas, G. T., Vilas-Boas, L. A., & Shimokomaki, M. (2013). Detection of Salmonella spp, Salmonella Enteritidis and Typhimurium in naturally infected broiler chickens by a multiplex PCR-based assay. *Brazilian Journal of Microbiology*, *44*(1), 37–41. https://doi.org/10.1590/S1517-83822013005000002

Perez, M. A. (2006). Food Preparation, Practices, and Safety In The Hmong Community by Miguel A. Perez, Ph.D., Long Julah Moua, M.P.H., and Helda Pinzon-Perez, Ph.D. Hmong Studies Journal, 2006, 7:1-24. *Health (San Francisco)*, 1–24.

Roudsari, A. H., Vedadhir, A., Amiri, P., Kalantari, N., Omidvar, N., Eini-Zinab, H., & Sadati, S. M. H. (2017). Psycho-socio-cultural determinants of food choice: A qualitative study on adults in social and cultural context. *Iranian Journal of Psychiatry*, *12*(4), 238–247.

Safaei, H. G. (2011). *The prevalence of bacterial contamination of table eggs from retails markets by Salmonella spp ., Listeria monocytogenes , Campylobacter jejuni and Escherichia coli in Shahrekord , Iran. 4*, 249–253.

Samiullah, Chousalkar, K. K., Roberts, J. R., Sexton, M., May, D., & Kiermeier, A. (2013). Effects of egg shell quality and washing on Salmonella Infantis penetration. *International Journal of Food Microbiology*, *165*(2), 77–83. https://doi.org/10.1016/j.ijfoodmicro.2013.05.002

Schroeder, J. M. and C. M. (2011). Чувствительность Бактерий Вида Escherichia Coli К Комплексному Фаговому Биопрепарату. *Lib.Ugsha.Ru*, (8), 1–11.

Sophie, R., Guyot, N., & Nys, Y. (2019). *The Golden Egg : Nutritional Value , Bioactivities , and Emerging Benefits for Human Health*. 1–26. https://doi.org/10.3390/nu11030684

Spitzer, H. (2015). *An Analysis of Bacterial Contamination of Chicken Eggs and Antimicrobial Resistance An Analysis of Bacterial Contamination of Chicken Eggs and Antimicrobial Resistance*.

Standards, F. (2014). *Food Standards Australia New Zealand - Annual Report 2013-2014*.

Svobodová, J., & Tůmová, E. (2014). Factors affecting microbial contamination of market eggs:

A review. *Scientia Agriculturae Bohemica*, *45*(4), 226–237. https://doi.org/10.1515/sab-2015-0003

Tajkarimi, M. (1943). *Mehrdad Tajkarimi 1*. 1–8.

Toltzis, P. (2018). *Staphylococcaceae Learn more about Staphylococcaceae Staphylococcus epidermidis and Other Coagulase-Negative Staphylococci Staphylococcal Infections*.

UBOS. (2018). *Statistical Abstract 2018*. Retrieved from www.ubos.org.

Umut, T. N. (2017). Technology and the Virtues: a philosophical guide to a future worth wanting. *İnsan & Toplum Dergisi (The Journal of Human & Society)*, *7*(2). https://doi.org/10.12658/human.society.7.14.d0145

UNDP. (2014). *SOROTI District*. (June).

Urahn, S. K., Eskin, S., & Hoelzer, K. (2016). *Emerging Pathogens in Meat and Poultry The Pew Charitable Trusts Safe food project*.

USDA. (2016). *Biology of Eggs Objectives Egg Composition*. 1–14.

Vabe, M., & Hansen, H. (2014). The Relationship between Food Preferences and Food Choice : A Theoretical. *International Journal of Business and Social Science*, *5*(7), 145–157. https://doi.org/10.1016/B978-044451091-4/50017-0

Venter, T. Van De. (2000). *Emerging food-borne diseases: a global responsibility*.

Virginia, D., Semedo, G., Vinicius, F., & Castro, S. (2018). *Salmonella spp . in the fish production chain : a review. 2015*.

Welch, R. A. (2006). *The Genu s Escherichia*. 60–71.

WHO. (2015). WHO African Region. *WHO Estimates of the Global Burden of Foodborne Diseases*, 1.

WHO. (2019). *Diarrhoeal disease*. (May 2017), 2017–2020.

Zelalem, S. (2017). *Thesis Ref No._____ ASSESSMENT OF THE CONTAMINATION OF BEEF WITH*.