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Densities of Muzekah and Dead Chicken

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Abstract*— Halal meat products have two billion consumers worldwide, and which are growing annually by more than 20%. However, there is no intelligence device or a specific mechanism available for consumers to check whether the meat is Muzekah or not? Seven hundred years ago it was stated that"if a municipal employee has doubts over the meat whether it is Halal or not, he should test it in water; Halal meat (Muzekah) sinks in water whereas non-halal meat (meat of deceased animal) floats over water. He should also cast a piece of the meat on hot coal, and if it sticks to the coal then it is Halal (Muzekah), and if it did not stick then it is from a deceased animal. The aim of this study is to validate this statement by analyzing why the Muzekah meat sinks in water and sticks onto the hot coals, in order to identify a suitable detecting mechanism that can differentiate between the meats produced by Muzekah and other methods of slaughtering. The density, water holding capacity (WHC) and aerobic plate counts (APC) were measured and used to validate and justify the statement. We have measured the average densities of chickens that were killed by three different methods: Muzekah, which means slaughtered within the fulfillment of Islamic requirements; Slaughtering (SWP), which means slaughtered without pronouncing the name of Allah, and Dead, which means died without slaughtering. Chicken meats obtained from these three methods of killings and commercially available chicken meats from local company in KSA have showed significant variations in the average densities. It was found that the Muzekah meat and fresh fish have higher average densities than water. Thus both of them sink in water. The substance sinks in the liquid if it is denser than the liquid. It was also found that Muzekah meats have low WHC compared to other types of meat with significant values. While higher WHC is observed in the meat of dead chicken and causes it to absorb the heat of the hot coal and puts it off without sticking to it. While Muzekah meat has low WHC and thus does not put off the hot coal, but instead sticks to it. On the other hand, the low APC of Muzekah meat means that it is clean, healthy and dense, and thus it sinks in water. The obtained results significantly validated, confirmed and supported the statement about the sinking ability of Muzekah meat. This sinking ability is innovative and a simple detecting mechanism that can differentiate between Muzekah meat and meats slaughtered using other methods and will serve the demands of Muslim communities and humanity in general.

Index Terms—**Muzekah, Slaughtered, Dead, Chicken, Densit .**

I. INTRODUCTION

Islamic communities significantly distrust the safety and validity of imported meat in the markets, whether it has been slaughtered within the fulfillment of Islamic requirements **(Muzekah)** or not. The demand for Muzekah meat is very high and yet, there is no simple scientific method to help consumers to differentiate between Muzekah and non-slaughtered (Dead) meat in the market [1-4]. Muzekah means cutting the carotid and the jugular blood vein by cutting the neck up to the spinal cord and then leaving the animal to die. This method is used for birds, cattle, sheep and goats, whereby the animal is laid down on its right side and the blood carrying arteries and veins are cut. The practice of Muzekah in Islam has always been to apply a sharp blade to the neck of the animal. There are many conditions for Halal Slaughtering (Muzekah) as mentioned in [1-8]. The perceptions of risk towards animal meat vary with time and depend on the consumers groups [5-9]. It is prohibited for Muslim to eat any of the followings: any animal that died before performing the **Muzekah** slaughtering, the blood and flesh of swine, meat which has been invoked other than the name of Allah, in addition to any meat contaminated or mixed with non-Halal meat. On the other hand, Muslims are allowed to eat seafood without slaughtering and the **Muzekah** meat of lawful animals. Studies have shown that Halal slaughtered meat (**Muzekah**), but not other conventional methods used in many countries, protects consumers from many food-borne diseases [5-10]. It is well recognized as one of the main reasons for the popularity of Halal products even among non-Muslim consumers. Moreover, the way of Muzekah slaughtering process is of significant importance for human health, safety and quality of the meat. Globally, the Halal market that spans from food to finance and tourism is worth USD 3 trillion. According to the latest estimated report, Halal products have two billion consumers worldwide, and which are growing annually by more than 20% [11]. However, there is no intelligence device or a specific mechanism available for consumers to check whether the meat is **Muzekah** or not? In addition to that there are few scientific published reports on this important area [1-6].

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Muhammad Al-Qurashi, Ziauddin, deceased in 1307 C. E. (729 A. H.), stated that "if a municipal employee has doubts over the meat whether it is Halal or not, he should test it in water; Halal meat (**Muzekah**) sinks in water whereas non-halal meat (meat of deceased animal) floats over water. He should also cast a piece of the meat on hot coal, and if it sticks to the coal then it is Halal **(Muzekah**), and if it did not stick then it is from a deceased animal. This is similar to eggs, which sink in water if they are good, whereas float if they are spoiled" [1]. The aim of this study is to validate this statement by analyzing why the **Muzekah** meat sinks in water and sticks onto the hot coals, in order to identify a suitable detecting mechanism that can differentiate between the meats produced by **Muzekah** and other methods of slaughtering. The density, water holding capacity (WHC) and aerobic plate counts (APC) were measured and used to validate and justify the statement.

Density is a measure of the "compactness" of matter within a substance and is defined as the mass per unit volume [12-13]. Its standard metric unit is (kg/m^3). The volume of any solid object, irregular or regularly shaped, can be measured by liquid displacement method. The solid is submerged in a liquid in which it is not soluble, and the volume of the displaced liquid is measured. The bulk density averages of chicken's bone, skins and breasts were reported as 881, 1113 and 1121 kg/m^3, respectively [14]. While the densities of fresh fish 1045 kg/m^3, seawater 1025 kg/m^3, pure water 1000 kg/m^3, pork 970 kg/m^3 and for blood 620 kg/m^3 [14-15]. The specific heat of water c_{water} = 4186 J/(kg K) is the largest among all common materials. It means that water can give off or take in large quantity of heat with little change in temperature [16].

Water holding capacity (WHC) of raw and cooked meat has been related to some important organoleptic properties such as juiciness and tenderness [17]. Change in WHC of muscle homogenates has been shown to be closely related to the pH, and to be a sensitive indicator of variations in the charges and structure of muscle proteins. An efficacious way of preventing food-borne human diseases is to monitor the microbiological quality of poultry meat and meat products during production, storage and distribution. Epidemiological reports suggest that poultry meat is still the primary cause of human food poisoning [18]. The micro flora of poultry might be transferred from the primary production sites to production lines, and further, by subsequent contamination [19]. Micro flora of crude chicken meat is heterogeneous and originates from slaughtering premises, operators' hands, equipment and outfit, in addition to water and air [20-22].

II. MATERIALS AND METHODS

A. Collection of samples

The aim of this study is to validate Ziauddin's statement by analyzing why the **Muzekah** meat sinks in water and sticks onto the hot coals, in order to identify a suitable detecting mechanism that can differentiate between the meats produced by **Muzekah** and other methods of slaughtering. The density, water holding capacity (WHC) and aerobic plate counts (APC) were measured and used to validate and justify the statement. To achieve the aims, one-month-old chickens (n = 9) were obtained from a commercial hatchery. The chickens were hydroid strains and their weights ranged between 1.5-1.75 kg. Each chicken was kept immediately after slaughtering in a sterilized container, and transported under aseptic conditions to the Laboratory at the Faculty of Science, University of Hail.

B. Methods of slaughtering

i. Muzekah method

The chicken was put in a chicken killing cone. The head was pulled out through the end of the cone, and then the artery was cut just below the jaw line. The chicken was left to bleed out until the reflexes stopped, and then washed off to remove dirt.

ii. Slaughtering without pronouncing (SWP) the name of Allah method:

Without performing in the name of Allah, and without adhering to the conditions of the **Muzekah** method, the chicken was put in the jaw line. The chicken was left to bleed out until the reflexes stopped, and then washed off to remove feathers and dirt.

ii. Dead method:

In order to keep all the amount of blood within the meat, the chicken was put in a plastic bag, and sealed until the chicken could not breathe, suffocated and died out.

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C. Preparation of meat samples

Poultry meat samples were prepared for analysis, which included: **Muzekah,** Slaughtered (SWP) and dead chicken meat and chicken meat from local company. All the chicken meats were chilled immediately within two hours of slaughtering to 5 °C to insure the prompt removal of the animal heat and preserve the wholesomeness of the products. Each meat sample was divided in two parts, one part was packed, sealed, chilled, and kept as a reference. The other part was chilled for 24 hours and then used for analysis.

D. Measurement of density

Density is defined as the mass per unit volume.

$$\rho = \frac{m}{V} \quad (1)$$

Where ρ is the density, m is the mass and V is the volume [11-12].

Archimedes' Principle states that "An object immersed in liquid, fully or partially, experiences an upward buoyant force. The magnitude of this force is equal to the weight of the volume of liquid displaced by the object."

$$F_B = \rho_F g V \quad (2)$$

Where F_B is the buoyant force on the object, the acceleration due to gravity g = 9.82 m/s^2, ρ_F is the density of the fluid, and V is the volume of the object immersed in a fluid which equals the volume of the displaced fluid. It is possible to use Archimedes principle to determine the density of an object without even determining its volume. According to Archimedes principle

$$F_B = W - W_a \quad (3)$$

Where W is the actual weight of the object measured in air ($W = mg$), and W_a is the apparent weight while the object is immersed in a fluid. Comparison between equations (2) and (3) allows us to write

$$F_B = \rho_F g V = W - W_a \quad (4)$$

Solving this equation for the volume of the object "

$$V = \frac{W - W_a}{g \rho_F} \quad (5)$$

Substituting it into the definition of density (1) we arrive (after simplification) to:

$$\rho = \left[\frac{W}{W - W_a}\right] \rho_F \quad (6)$$

Thus Archimedes principle was used to measure the density of chicken.

The spring balance was set on the Zero scale. The chicken meat was hanged first from the string. The balance was read the same as when the chicken meat was placed on top of the pan. The mass was multiplied by the acceleration due to gravity to get the actual weight W, and then the data was recorded. While the chicken meat was still hanging from the balance, the chicken meat was submerged in a beaker of water so that the entire meat was under water but was not touching the sides or bottom of the beaker. The reading on the scale was recorded and multiplied by gravity to get the apparent weight W_a, then the density of the chicken meat was calculated.

E. Aerobic plate count

Aerobic plate count (APC) was carried out on total plate count agar. The medium was autoclaved and maintained at 46ºC. Samples were serially diluted and an aliquot of 1 ml of each of the serial dilutions was transferred to the petri dishes (4 inch in diameter) and molten agar (15-20 ml) was poured on it. Plates were gently swirled to uniformly mix the sample and incubated at 37ºC for 48 hours. After incubation APC was determined from appropriate plates. Characteristic colonies appearing on the respective selective agar media were counted, multiplied by the dilution factor and expressed as colony forming units per ml c.f.u/ml.

F. Water holding capacity (WHC)

The samples were wrapped with a nylon net and 3-pieces of filter paper. The wrapped samples were centrifuged at 3000Xg for 20 min. The percentage ratio of sample weight difference between, before, and after centrifugation, to sample weight before centrifugation provided free water content. The difference between moisture content and free water content was described as the water holding capacity index.

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III. RESULTS AND DISCUSSIONS

Fig. 1 shows the densities of **Muzekah**, from left to the right, Saudi company chicken, Fish, Seawater, Slaughtered (SWP) chicken, water, dead chicken, pork, calculated average density of **Muzekah** and blood and finally blood. It can be clearly seen that the **Muzekah**, Saudi Company meats and fresh fish have higher densities than seawater. That means the three of them would sink deeply in both seawater as well as pure water. This result is in full agreement with Ziauddin's statement [1].

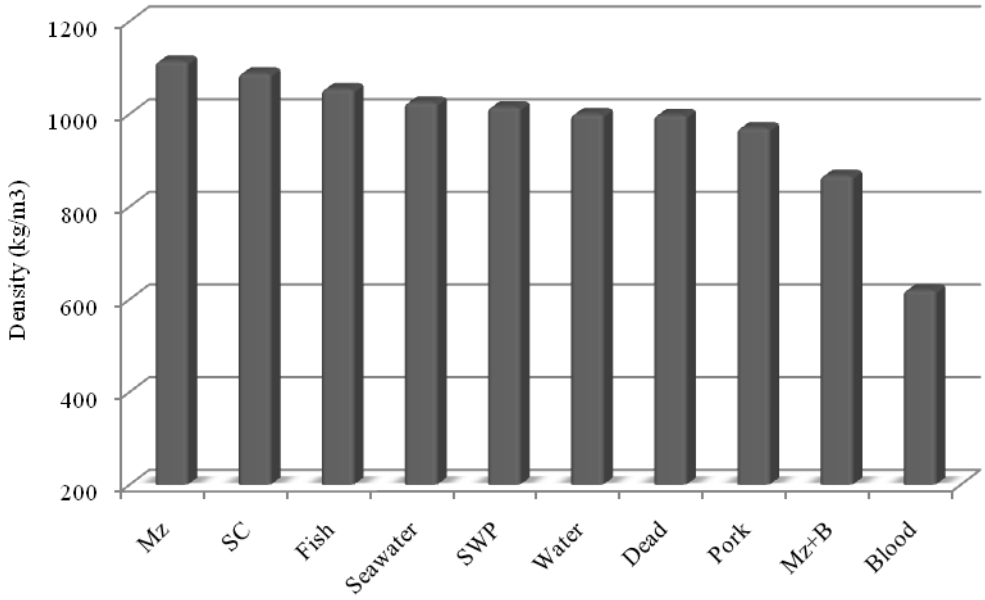

Fig 1: Densities of Different Types of Meats.

On the other hand the SWP meat shows less density than the seawater and more than pure water. That means it floats in seawater and sinks in pure water, which was not mentioned in the statement [1]. While the dead chicken meat shows less density than pure water, which means it floats. It was reported that the densities of pork and blood were 970 and 620 kg/m^3, respectively [13-14] both less than the density of pure water (1000 kg/m^3). It is well known that, it is forbidden for Muslims to eat the meat of dead animals, the flesh of swine and blood. The three of them have densities less than the density of pure water and float on it. This is a simple method for Muslims to differentiate between allowed and forbidden fresh meats by immersing them in pure or seawater, where if they sink means they are fresh and permissible to eat, whereas if they float, they are not permissible for him to eat.

Fig. 2 shows the results of aerobic plate counts (APC). The microbial counts of **Muzekah** meat were followed by Saudi company meat (SC), SWP meat and the dead chicken meat. The higher APC for the dead chicken meat was more than 6 log10 CFU/cm^2, which indicates highly contaminated meat, thus containing a growth of different types of bacteria and synthesis of gasses that increased the volume and reduced the density of dead meat, and thus it floated.

Low APC of **Muzekah** meat means that it is clean, healthy and dense. Thus the **Muzekah** meat sinks in water, which supports the statement.

WHC of **Muzekah**, SC Saudi local company, SWP, dead chicken are shown in Fig. 3. It is clearly shown that the **Muzekah** meat has low WHC compared to the other types of meat. While higher WHC was observed in the meat of dead chicken. Water has the largest SHC among all common materials. It means that water can give off or take in large quantity of heat with little change in temperature. Thus, the higher WHC of dead chicken meat causes it to absorb the heat of the hot coal and off it and does not stick on it. While the **Muzekah** meat has low WHC, which means it is not able to put off the hot coal but instead it sticks on it.

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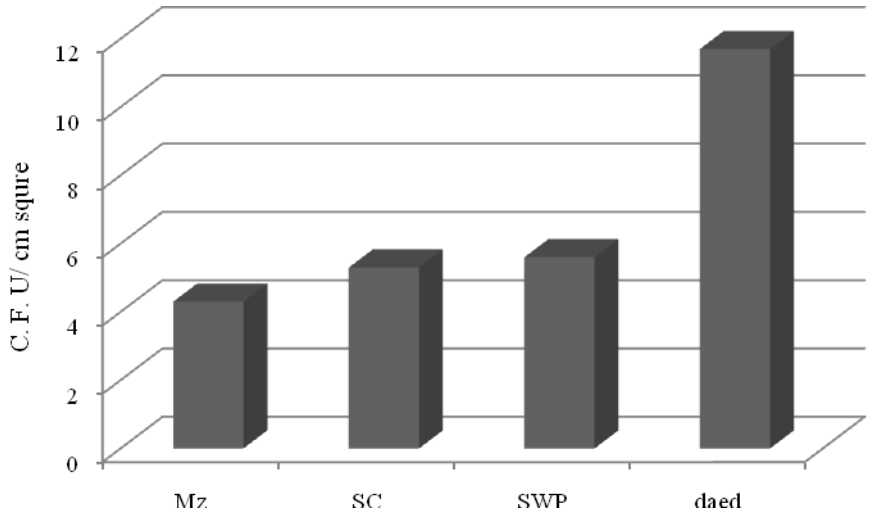

Fig 2: Aerobic Plate counts of different meat types by log10 CFU/cm^2.

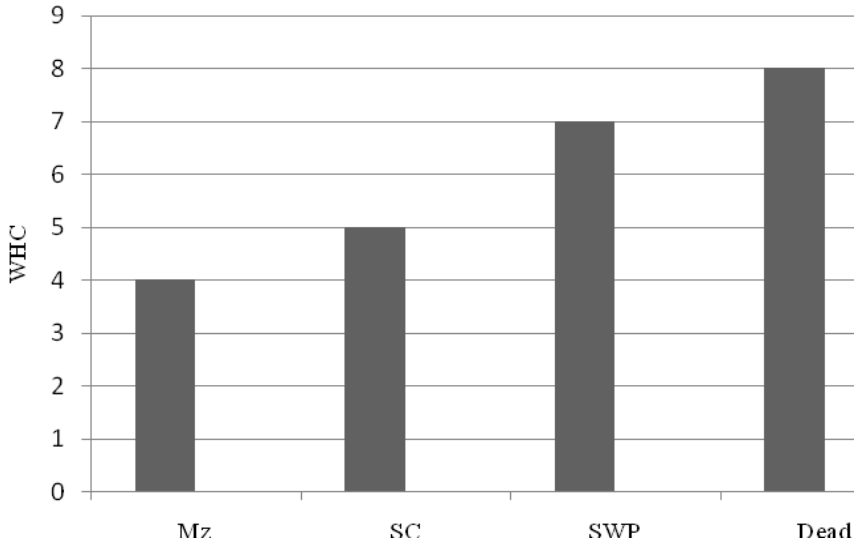

Fig 3: Water holding capacity (WHC) of different meat types.

In addition to that, low WHC in **Muzekah** meat decreases the volume and increases the density. Thus the **Muzekah** meat sinks. Both results support the Ziauddin's statement [1]. Thus the sinking ability of **Muzekah** meat seems to be a suitable and simple detecting mechanism that can differentiate between it and other methods of slaughtering.

IV. CONCLUSION

It is well known that, there is no intelligence device or a specific mechanism available for consumers to check whether the meat is **Muzekah** or not? The aim of this study is to validate Ziauddin's statement by analyzing why the **Muzekah** meat sinks in water and sticks onto the hot coals, in order to identify a suitable detecting mechanism that can differentiate between the meats produced by **Muzekah** and other methods of slaughtering. It is found that the **Muzekah** meat and fresh fish have higher average densities than seawater. Thus both of them sink in water. It is also found that, **Muzekah** meat has low WHC compared to other types of meat with significant values. While higher WHC is observed in the meat of dead chickens. Thus, the higher WHC of dead chicken meat makes it to

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absorb the heat of hot coal and thereby dramatically reduces the surface temperature of coal and does not stick on it. While **Muzekah** meat has low WHC and does not reduce the surface heat of hot coal dramatically but instead sticks on it. The higher APC of the dead chicken indicates highly contaminated meat, with growth of bacteria and synthesis of gasses that increased the volume and reduced the density and enhanced the floating. While low APC of **Muzekah** meat means that it is clean, healthy and dense and have sinking ability in water. Hopefully, the aim of this study is achieved. The obtained results have validated, confirmed and supported Ziauddin's statement and the sinking ability of **Muzekah** meat. This sinking ability is an innovative and simple detecting mechanism that can differentiate between **Muzekah** meat and meats of other methods of slaughtering, and will serve the demands of Muslim communities and humanity in general.

ACKNOWLEDGMENT

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CAREER INTERESTS

Knowledge is given to guide the mankind to perform and utilize the natural resources for best worshiping Allah S. W. T. Thus I do love to share the knowledge and expertise with others and hence develop new ideas. Academic and research are my first preferences. Would like to contribute to the development of science and technology and to apply them for the benefit of mankind not limited to the followings:

Material science, solid-state physics, glass-materials, nanotechnology, sensors and semiconductor devices for Halal Meat technology.

Education

Nov 2001	**PhD.**	University of Technology Malaysia, *Specialization*: Solid State Physics *Thesis title*: "**Studies of Tin Antimony Selenium-Based Chalcogenide Glasses**".
March 1998	**M. Sc.**	University of Technology Malaysia, *Specialization:* Solid State Physics *Thesis title*: "**Studies of Amorphous Thin Films of Tin Antimony Selenium-System**".

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Feb. 1991	**B. Sc.**	University of Khartoum, Sudan (Science and Education-Physics (Honour).

Occupation

Position	Major Activities
Associate Prof., Physics Department, Faculty of Science, Hail University, Sept. 2009 to date.	○ Leader of Halal Meat Research Group. PI of Research Project CO-I for one project. ○ Chairman of Metals and Chalcogenides Nanostructures' Group (MCNG), UOH **CO**-I of two projects. ○ Vice Dean for Development and Quality Assurance Nov 2009- Jan 2013. ○ Acting Head of Physics Dept. May-Nov. 2010. ○ Committee Member of the Departments' Program Revision Committee ○ Committee Member of Physics Dept. Program Committee. ○ Taught the following courses: ○ Solid State Physics I & II ○ General Physics I & II ○ Heat & Thermodynamics
Senior Lecturer August 2003-2009 EEE-Program, University of Technology PETRONAS,(UTP) Malaysia	○ Member of Nano-technology Research group and contribute in constructing tits Laboratory at UTP. ○ Member of Computer Systems Engineering group, UTP. ○ Leader of Halal Meat Research Group. ○ Supervised M. S. and final-year students' projects. ○ Supervised Engineering Team Projects. ○ Teach Physics I-II ○ Peer review member of Journal of Material Science, USA. Kulwer-Publisher. ○ Peer review member of Journal of Non-Crystalline Solids, USA, Elsevier-Publisher. ○ Published and submitted papers for publication. ○ Conducted tutorial and laboratory ○ Attended several seminars organized by the faculty, ○ Member of the Department Exam Committee ○ Member of the football team of the EEE.

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Assistant Professor

(Nov. 2001-August 2003)

Faculty of Science,

University of Kordofan, Sudan

- A coordinator of Post Graduate Program,
- Supervised final year projects.
- Participated in several co-curriculum activities,
- Handled various administrative tasks.
- Member of University Senate, academic board of Faculty of Natural Resources and Environmental Studies and Faculty of Education.
- Participated in establishing the Physics labs.
- Taught the following courses:
  - Solid State Physics I and II
  - Quantum Physics II and I.
  - General Physics-I-II
  - Theory of Relativity
  - Sound and Waves
  - Classical Mechanics

Researcher

August 1998-Nov 2001 University Technology Malaysia

- Conducted literature review about chalcogenide glasses materials.
- Experimental setup for sample preparations.
- Developed a theoretical model using Excel.
- Designed especial electrical furnace for sample preparation.
- Data collection and analysis using XRD, SEM, IR, DTA, Raman Spectroscopy, UV-Spectroscopy, X-ray guide tube (XGT) and EDX.
- Published a Ph.D. thesis entitled “Studies of Tin Antimony Selenium-Based Chalcogenide Glasses”.
- Assisted master and final years student in managing and writing their dissertations.
- Supervised labs for first and second year students.
- Attended several seminars and published many papers.

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Master Student 96-1998 University Technology Malaysia	○ Research assistant (March-May 1998) ○ Conducted literature review about amorphous thin films ○ Experimental setup for the sample preparation using solid-state reaction techniques. ○ Data collection and analysis using XRD, EDX, SEM, I-V characteristic, ○ Published M. Sc. thesis entitled "Studies of Amorphous Thin Films of Tin Antimony Selenium-System". ○ Attended several seminars and published many papers.
Teaching Assistant (July 1991-Dec. 1995) U. of Kordofan, Sudan	○ Taught the following courses: ▪ Optics ▪ General Physics-I-II ▪ Sound and Waves ○ Prepared the lab experiment and the lab sheets for Physics I & II. ○ Supervised Lab. experiments. ○ Manger of National Student Welfare Fund, North Kordofan State, Sudan, within the university.
Tutor and Teacher (1989-1990) Faculty of Education, U. of Khartoum, Sudan Teacher Islamic African Center, Khartoum	○ Prepared the lab experiment and the lab sheets for physics II & I. ○ Supervised Lab experiments. ○ Taught the Physics course at Islamic African Center (3-Months).

Languages

Arabic (fluent) and English (fluent)

Awards

1. **Excellence Performance award** from University of Technology PETRONAS; for services for a year 18/8/2008-17/8/2009.
2. Awarded a **Silver Medal** in International, invention, innovation and technology exhibition (ITEX 08), 9-11th May 2008, Kula Lumpur, Malaysia.
3. Awarded a **Bronze Medal** in an Invention Exhibition and Competition, The Prestigious INNOVA EUREKA, 22–25th November 2007, Brussels, Belgium

Computer Skills

Microsoft Offices, Linux and MATLAB

Research's Grants:

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- Characterization study of Muzekah, Slaughtered and Died Chicken Meat. Research Project Proposal- 15-AGR3422-58, (RS-2.0 Millions) submitted to NSTIP on Feb. 2015.
- Characterisation Properties of Muzekah, Slaughtered and Died Chicken Meat Products. Research Project Proposal- 15-AGR3457-58(RS-2.0 Millions) submitted to NSTIP on Feb. 2015.
- Metal-Borates Nanowires for Mechanically Strengthening Materials. Research Project Proposal- 14-NAN2682-58, (RS-2.0 Millions) submitted to NSTIP on Oct. 2014.
- Characterization of Meat Slaughtered In Islamic Method (HALAL-MEAT). Ministry of Science and Education Malaysia (MOSTI); Fund approved of (RM 360000.00); 2008-2009.
- Characterization properties of fish and slaughtered and not slaughtered meat. Short Term Project; UTP-Internal Fund of RM 20000.00; 2008.
- Capacitive Air Bubble Detector Operated at Different Frequencies for Application in Hemodialysis. Short Term Project; UTP-Internal Fund of RM 20000.00; 2007.

Supervision:

1. 3-Master Degrees.
2. 15 Final year projects
3. 10-Engineering team projects.

Journals' Reviewer:

1. Journal of Material Science, Kulwer-Publisher.
2. Journal of Non-Crystalline Solids, Elsevier-Publisher.
3. Journal of Solid State Sciences, Elsevier-Publisher
4. Journal of Physics: Condensed Matter, Institute of Physics (IOP) Publisher.
5. Journal of Physica Status Solidi, **Wiley InterScience**-Publisher.
6. Technical Advisory Panel , ICFAS 2012; http://www.utp.edu.my/icfas2012/index.php?option=com_content&view=article&id=60&Itemid=63

Workshops and Training

1. Certified Expert Total Quality Management, Canada Global Centre Consulting and Training; Jan 2013.
2. Certified Educational Specialist in TQM; The Arab Academy for Training Science; Jan 2013.
3. Training Program in Total Quality Management, University of Hail 3-4 Dec. 2012.
4. Statistical Data Processing using the Program of SPSS; University of Hail 2-3 Feb. 2011.
5. Strategies for Effective Teaching University of Hail 12-13 Jan 2011
6. E-Science fund workshop a Hands-on- Approach organized by UTP in the period 15-16 January 2009
7. Effective Education delivery, organized by UTP in the period 12-13 August 2006.
8. UTP Team Building Program, organized by UTP in the period 19-23 July 04
9. Active Media Innovation course, Matlab for Image Processing, 4-7-November 2003
10. Final year Project Supervisory Skills, UTP, 15 October 2003.

Publications

1. Journal Papers

1. Ibrahim, S. M., Abdelgadir, M. A. Sulieman,A. E. and Adam. A. B., (2014). Influence of *Halal* and Non-Halal Slaughtering on the Quality Characteristics of Broiler Chicken Burger. International J. of Food Science and Nutrition Engineering, 4(5): 113-117.

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2. E.M. Elssfah, Adam, A. B, A.Wahab, M.A.Hussein and A. Awatif. (2014). A simple route for the synthesis single-crystalline $Mg_2B_2O_5$ nanowire bundles. Elixir Condensed Matter Phys. 73, 26146-26149.
3. A. B. Adam and N. Nasukha. (2011). "Analysis of Dielectric Constants of Slaughtered and Non-Slaughtered Chicken". IEEE- 978-1-4577-0069-9/11.
4. Mohmmad, R. Ibrahim, T., Begam, M. and Adam, A. B., (2010). Capacitive Discrimination of Slaughtered and Non-slaughtered Sheep and Goat Meat. Intelligent and Advanced Systems (ICIAS), ISBN 1424466237, pp. 1–5.
5. Mawahib Gafare Abdalrahman Ahmed, Abdallah Belal Adam, John Ojur Dennis, Gail Sylvia Steele. (2009) "**Capacitor Device for Air Bubbles Monitoring".** International Journal of Electrical & Computer Sciences IJECS Vol: 9 No: 10
6. Abdallah Belal Adam (2009). "Infrared and Raman Studies on $Sn_xSb_5Se_{95-x}$ Chalcogenide Glasses". J. King Saud Univ. Vol. 21, Science (2); 111-115.
7. A. B. Adam, S. Sakrani & Y. Wahab, Y. (2008) "Structural studies of Sn_x-Sb_{15}-Se_{85-x} chalcogenide glasses. High performance structures and materials, **IV**. Ed. W.P. De Wilde, and C.A. Brebbia, WIT-press. Page 10.
8. A. B. Adam, Sakrani, Samsudi and Wahab, Y. (2006) *Sn-Sb-Se crystalline phases formed by melt-quenching technique.* Journal of Materials Science, 41 (17). pp. 5797-5801. ISSN 1573-4803
9. A. B. Adam; Sakrani, Samsudi and Wahab, Y. (2005) *Glass-formation region of ternary Sn-Sb-Se-based chalcogenide glasses.* Journal of Materials Science, 40 (7). pp. 1571-1576. ISSN 1573-4803
10. Abdallah Belal Adam, Samsudi Sakrani and Yussof Wahab (2002). "Infrared and Raman Studies on $Sn_xSb_{10}Se_{90-x}$ Chalcogenide Semiconductor" Solid State Science and Technology, 10 (1 &2), 139-144.
11. Yussof Wahab, Abdallah Belal Adamand and Samsudi Sakrani (2002). "Investigation on the Properties of $Sn_xSb_{10}Se_{90-x}$ Chalcogenide Semiconductor". Solid State Science and Technology, 10 (1 &2) 60-67.
12. Abdalla Belal Adam, Samsudi Sakrani, and Yussof Wahab, FTIR studies of Sn-Sb-Se chalcogenide semiconductors, J. Solid State Sc. & Tech., Vol. 4 No. 1 (2001) 30-37.
13. Abdallah Belal Adam (2001) Studies of ternary tin-antimony-selenium-based chalcogenide glasses". PhD-Thesis. Universiti Teknologi Malaysia. http://eprints.utm.my/6809.
14. Abdallah Belal Adam, Samsudi Sakrani and Yussof Wahab (2000). "Extension of Philips model in predicting glass-formation area of Sn-Sb-Se- Chalcogenide Semiconductors. ACXRI-2000, 300-306.
15. Abdallah Belal Adam, Samsudi Sakrani and Yussof Wahab (2000). "FTIR Studies on Sn_x-Sb_{20}-Se_{80-x} Glassy Semiconductors." J. Solid St. Sci. and Technol. Letters, 8 (1 &2) 42-50.
16. Abdallah Belal Adam, Samsudi Sakrani and Yussof Wahab (1998). "Switching Properties in $Sn_{46.5}$-$Sb_{8.0}$-$Se_{45.5}$ and Sn_{12}-Sb_{837}-Se_{51}." J. of Solid State Science and Technology. 6(1), 78-83.
17. Samsudi Sakrani, Abdallah Belal Adam and Yussof Wahab (1997). "Effect of Antimony Addition on Properties of Thin Films of Sn-Sb-Se System. J. of Solid State Science and Technology. 5(1), 1-6.

2- Conference Papers

.A. B. Adam. "Halal Meat Authenticity, New Analytical Methods in Differentiation Between Halal and non-Halal Meat". Dubai International Food safety conference 9-11 Nov. 2014.

1. A. B. Adam and Mohmmad, R. A. (2012). "Physical methods to differentiate between meats of animal died before or after slaughtering". 1st Int. Conference on Halal Food Control and Exhibition; 12-15 Feb. 2012, InterContinental Hotel-Riyadh; Saudi Arabia.

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2. Mawahib Gafare Abdalrahman, Abdallah Belal Adam and John Ojur Dennis. Capacitive Air Bubble Detector Operated at Different Frequencies for Application in Hemodialysis. The international conference on electronics and electrical engineering (ICEEE), (WCSET 2009: World Congress on Science, Engineering and Technology). February 25-27, 2009. Penang, Malaysia.
3. Mawahib Gafare, Abdallah Belal Adam and John Ojour Dennis, (2008). Capacitive detector for detecting air bubble in moving blood for artificial kidney. Proceeding of the 3rd International Symposium on Biomedical Engineering/ the 1st Biomedical Engineering International Convergence (ISBME& BMEiCON 2008); page 332-337.
4. Mawahib Gafare, Abdallah Belal Adam and John Ojour Dennis, (2008). Capacitive Air Bubble Detector Operated At 30 Khz For Application in Hemodialysis.' International conference on Mathematic and Natural science (2008).27-28 October 2008, Bandung, Indonesia.
5. Mawahib Gafare Abdalrahman, Abdallah Belal Adam, John Ojur Dennis. "Detection of Air Bubbles in Artificial Kidney using Capacitive Detector at a Frequency of 2MHz". National Postgraduate Conference on Engineering Science and Technology (NPC) 31 March 2008, Malaysia.
6. Mawahib Gafare Abdalrahman, Abdallah Belal Adam and John Ojur Dennis, "A Capacitive Device for the Detection of Air Bubbles in Fluids" Student Conference on Research and Development (SCOReD 2008) IEEE. November 26-27, 2008. UNIVERSITI TEKNOLOGI MALAYSIA, Johor Bahru, Malaysia.
7. Samsudi Sakrani, Abdallah Belal Adam, Putut Marwoto, and Yussof Wahab and Bakar Ismail (1999). "Amorphous Thin Films Solar Cells." Paper presented during a Seminar on Construction, Materials and Environmental Technology, University Technology Malaysia, 3-4 Feb. 1999.
8. Putut Marwoto, Samsudi Sakrani, Bakar Ismail, Abdallah Belal Adam and Yussof Wahab (1998). "Design of MEPVCD System for Preparation Thin Films amorphous Silicon." Paper presented during the XV Regional Seminar on Solid State Science and Technology, 13-15 Dec. 1998, Hotel Seri Malayisa, Began Lalang Sepang Selangor, Malaysia.
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10. Abdallah Belal Adam, Samsudi Sakrani (1997). "Thin Films of Sn-Sb-Se System Prepared by Solid State Amorphisation Reaction." Paper presented at Seminar of Postgraduate Students, Physics Department, Faculty of Science, University of Technology Malaysia, 22-23 Sep. 1997.