Study of Characteristics of Contaminants during Eggs Hatching Using Incubator

by

Amnah Bashirah Mansor

Dissertation submitted in partial fulfillment of

the requirements for the

Bachelor of Engineering (Hons)

(Mechanical Engineering)

MAY 2013

Universiti Teknologi PETRONAS

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the

Mechanical Engineering Programme

Universiti Teknologi PETRONAS

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BACHELOR OF ENGINEERING (Hons)

(MECHANICAL ENGINEERING)

Approved by,

_____

(Ir. Dr. Masri bin Baharom)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2013

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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AMNAH BASHIRAH MANSOR

ABSTRACT

This project investigates the contaminant materials that are present during eggs hatching using an incubator which can spoil the hatching of eggs. 16 numbers of eggs were used in the experiment and they were manually turned to ensure equal heat distribution. The temperature is maintained using a temperature controller. This study will focused on the monitoring on the physical changes of the water used by observing the condition of the water, collecting data on the temperature, relative humidity and also checked on the pH value of the water every day. Then when the contaminant is obviously appears, the sample will be taken for the lab testing under microscope to view the structure of the contaminated tiny crystal, testing using Scanning Electron Microscope (SEM) to obtain the characteristics of the contaminants and test on the composition to figure out the contaminants material.

ACKNOWLEDGEMENTS

First and foremost, I would like to praise Allah the Almighty for awarding me the opportunity to complete my Final Year Project (FYP) for eight months during my final year studies. Without His aid, I would never be able to do my FYP, yet alone stand against the challenges faced during the project completion period. Special appreciation to:-

Ir. Dr. Masri bin Baharom

Head of Department/Associate Professor, Department of Mechanical Engineering

cum my supervisor

Universiti Teknologi PETRONAS

Also, I would like to deliver a great gratitude to all lecturers; technician and all personnel who have help me a lot in completion the project. My appreciation also goes to:-

Dr. Setyamartana Parman

Senior Lecturer, Department of Mechanical Engineering cum my internal examiner

Universiti Teknologi PETRONAS

Finally, I would like to thank my beloved family and friends who have been giving me inspiration and courage throughout this course in order to complete my Final Year Project.

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LIST OF SYMBOLS AND ABBREVIATIONS

FYP 2	Final Year Project 2
SEM	Scanning Electron Microscope
XRD	X-ray Diffraction
GC-MS	Gas Chromatography-Mass Spectrometry
FTIR	Fourier Transform Infrared Spectroscopy
RH	Relative Humidity

CHAPTER 1

INTRODUCTION

1.1.PROJECT BACKGROUND

Chicken meat has become one of the important sources of protein in Malaysia due to the high price other alternatives such as fish, beef, and others. Because of this, poultry industry has become one of the sectors that must be enhanced in order to cater for the needs of population. Since chicken come from eggs and natural hatching by hen is very limited, effective ways to hatch the chicken eggs must be improved in order to improve production. Therefore, instead of using natural hatching under a broody hen, incubators are used for eggs hatching process. The incubator conditions needed for the incubation process have been previously studied, and it is easier to monitor the condition of the egg and make sure that the eggs are not ruined during the process. The incubator imitates the real hatching process by providing heat from light bulbs and humidity from water, placed underneath the eggs tray. However during the monitoring of egg hatching process, there are contaminants found at the surface or water which is a very tiny crystal like, which composition is not known.

1.2.PROBLEM STATEMENT

When another batch of eggs are hatched in the same incubator without changing the contaminated water, some of the fertile eggs are found to spoil and do not hatch based on experienced. The contaminants are found to form on the surface of water. It is questionable on where the contaminants come from; whether it is some kind of calcium formation from the egg shell or form something else.

1.3.OBJECTIVE

The objectives of this project are:

- To study the characteristic of water used in eggs hatching process.
- To determine the characteristics and properties of the contaminated crystal-like found at the surface of water when egg hatching process take place.

1.4.SCOPE OF STUDY

This project is basically the study of the characteristics of contaminants during eggs hatching using incubator. To complete this study, the incubator is used for the egg hatching to be done. Chicken eggs will be used for this project and it basically will take 21 days to complete the egg hatching process. Upon completing the process, the composition of water used will be monitored everyday by measure the temperature and humidity level inside the incubator and also test the pH value of the water. After obvious appearance of the crystal-like contaminant at the surface of the water the picture and also the sample will be taken for the lab testing analysis. The testing will be done using digital microscope, Scanning Electron Microscope (SEM) to examine the structure overview of the contaminants and X-ray diffraction (XRD), Gas Chromatography-Mass Spectrometry (GC-MS) and Fourier Transform Infrared Spectroscopy (FTIR) to test the composition of the contaminants. A simple testing on the appearance of calcium carbonate are done using vinegar which react with calcium carbonate. At the end the contaminants should be decided as calcium formation or the bacterial formation.

1.5.RELEVANCY OF THE PROJECT

Egg hatching process may be thought as non-engineering; however, in actual the process involve engineering knowledge especially in the analysis to determine the physical changes in the water used for the egg hatching process. The study is basically about what is the composition and structure of the contaminants that appear at the water surface after the hatching process completed and why the water needs to be changed after each complete egg hatching cycle. The contaminants found at the surface of the water will be tested and analyze to know whether the formation of calcium occur there.

1.6.FEASIBILITY OF THE PROJECT

This study is conducted in two semesters of final year project equivalent to eight months of study. The first semester is spend and dedicated by the author with studying various relevant material such as journal papers and research papers that has something related to the project. The estimated cost of carrying out the project is also within the limit provided by the university. Some of the materials and equipment for the study such as incubators is provided and planned test and experiment are also available at the university laboratory and can be outsourced easily from other university. The author will use and implement, where possible, all acquired knowledge to make this project a success. The first egg hatching process started on 11th March 2013. From the experiment, the author got a clear view on the study that will be done. For FYP 2, the second egg hatching process experiment is done in June 2013. The sample of the crystal-like contaminant is taken for the lab testing on the structure and its composition. All the required data and result is expected to be ready prior to submission of the final report.

CHAPTER 2

LITERATURE REVIEW

2.1.EGGS HATCHING PROCESS

From article in The Poultry Club of Great Britain,[1] it stated that hen eggs take 21 days to hatch, duck and turkey eggs 28 days, most goose eggs 28 - 30 days and Muscovy eggs 35 days. Melvin L. Hamre [2] explained in his article that the requirement for the incubation process is to maintain the temperature in the 99-102° F temperature range (100-101° F., if possible). Place the thermometer to measure the temperature at a level at or slightly above where the center of the egg will be. For the humidity, the moisture level in the incubator should be about 50 to 55 percent relative humidity, with an increase to about 65 percent for the last three days of incubation. Moisture is provided by a pan of water under the egg tray. The water surface should be at least half as large as the surface of the egg tray. The eggs need to be turned at least two times per day to make sure all the eggs received equal temperature distribution throughout the process. The eggs must not be turned for the last three days because the eggs are preparing to hatch. From article in the GouldianFinch.Info, [3] the figure below shows the infertile and fertile eggs. Without changing the water after one complete hatching process, the other eggs put will not hatched and become infertile.

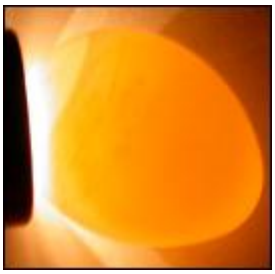


Figure2.1: Infertile

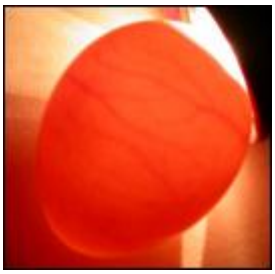


Figure2.2: Fertile

Figure2.3: Fertile

2.2.FORMATION OF CALCIUM CARBONATE

When the eggs hatching process reaches two weeks, there is contaminant found in the surface of the water, a very tiny-crystal like which is to believe that it was the calcium formation from the vaporization of the egg shell to the water below it due to the heat apply to it. The calcium carbonate deposits will lead to the formation of stalactite and stalagmite. From article in Net Industries, [4] it stated that calcium carbonate, $CaCO_3$, is one of the most common compounds on Earth, making up about 7% of Earth's crust. It occurs in a wide variety of mineral forms, including limestone, marble, travertine, and chalk. Calcium carbonate also occurs combined with magnesium as the mineral dolomite, $CaMg(CO_3)_2$. Stalactites and stalagmites in caves are made of calcium carbonate. A variety of animal products are also made primarily of calcium carbonate, notably coral, sea shells, egg shells, and pearls.

Encyclopedia Britannica Facts matter [5], explained that stalactites are formed through calcium carbonate deposits made by mineral rich water dripping through the ceiling onto the cave floor surface. The water evaporates leaving the calcium carbonate behind. This deposits form a stalactite like an icicle hanging from the cave roof. A stalagmite appears like an inverted stalactite, rising from the floor. From the study of this project, there is possibility on formation of calcium at the surface of the water due to evaporation of the water to the egg shell and producing calcium carbonate deposits. This is said so because the egg shell contain calcium carbonate and it dissolve in various acids. Therefore, the tiny crystal found at the surface of water after the eggs hatched could be calcium formation from the egg shell. The Figure 4 below shows the formation of stalactite and stalagmite in the caves which could be the same concept with this project study which is the calcium carbonate formation.

Figure2.4: Stalactite and Stalagmite formation

2.3.EGGS SHELL DISINFECTION

To provide the cleanliness and to reduce the bacterial at the egg shell before undergo egg hatching process, disinfection of the shell can be done. From article in PubMed, [6] Quaternary ammonium Hatching Egg Sanitizer Spray (HES Spray) can be used in disinfecting broiler hatching eggs. It will result in significant reductions in the total aerobic counts on the egg surface of 98.1% and 99.9%, respectively, within 30 min of application.

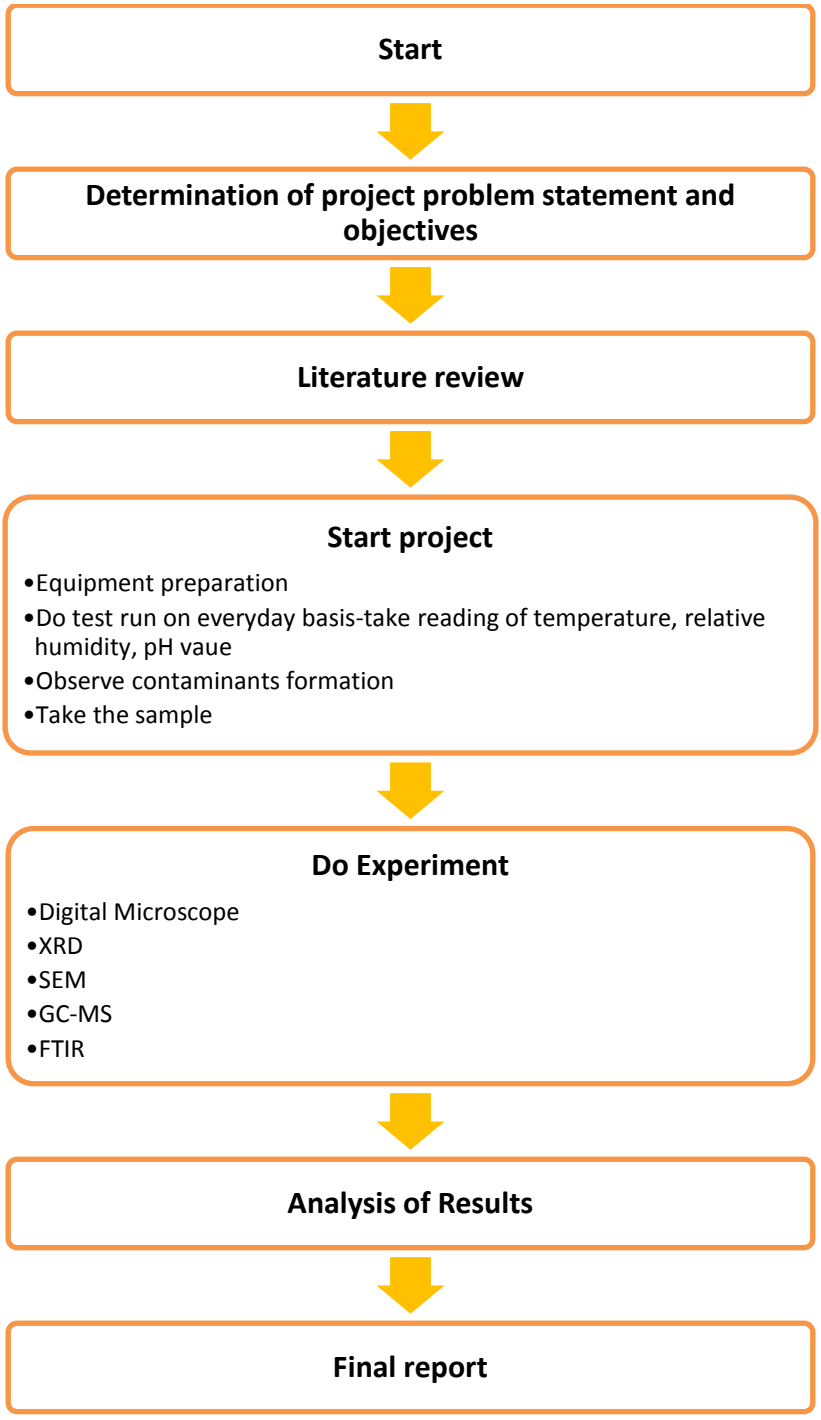
From article in PubMed, [7] Hydrogen peroxide can be used as an alternative hatching egg disinfectant. It is used to disinfect broiler hatching eggshell surfaces and to maintain hatching potential. Under pure culture conditions, 50% H2O2 yielded over a 6 log kill in 30s of three potential eggshell bacterial contaminants. Level of contaminated eggs and "early-dead" embryos were significantly reduced in the H2O2-treated eggs. H2O2 actually improved the hatching potential of fertile broiler eggs compared with hatchability of untreated eggs.

For this study, when the egg shell is already disinfected, and the bacterial is reduced up to 99%, the possibility of bacterial formation at the surface of water is not more than 1%. Therefore the focused to study the composition of the crystal contaminant found at the water surface is more reliable.

CHAPTER 3

METHODOLOGY

3.1.PROJECT ACTIVITIES



3.2.RESEARCH METHODOLOGY

Incubator Working Principle

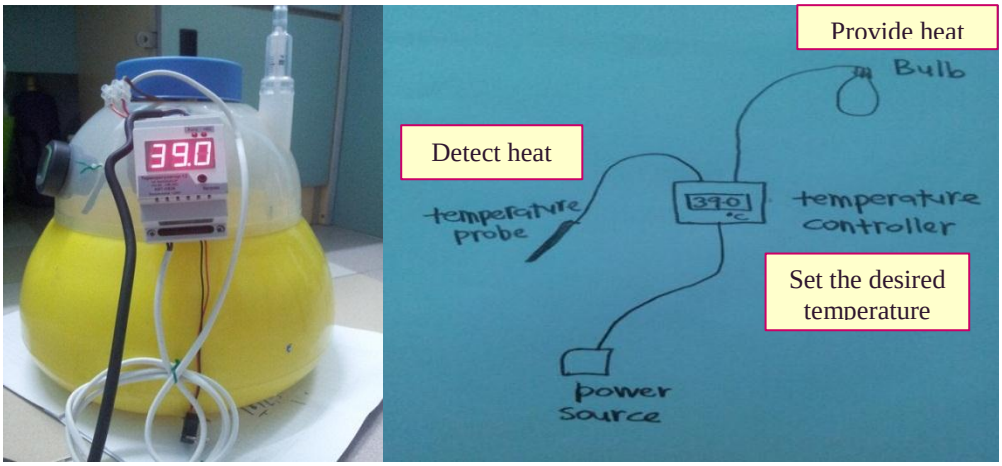


Figure3.1: Incubator's mechanism

Figure 3.1 above shows the working principle of the incubator which provides same condition to fulfill the requirements that imitates the real hatching process. It consists of the bulb that provide heat to the eggs, temperature probe that detect the heat from the bulb, the temperature controller used to set the desired temperature and power source that provide electric to the equipment.

The temperature controller is used to set the temperature at 39 ºC. Then it will send the signal to the bulb to provide heat and raise the temperature to the set temperature. The temperature probe will detect the heat inside the incubator and sent the signal to the temperature controller to read the temperature. Then the bulb will continuously lights on and off to maintain the desired temperature.

Eggs hatching equipment preparation

Temperature calibration

Put water in the water pan

Mark the eggs

Place raw eggs in egg tray

Place the bulb above the eggs

Monitor the relative humidity

Figure3.2: Equipment preparation

Figure 3.2 above shows the equipment set up for the hatching process. The research need to be done to know the egg hatching process requirement before the study on the water composition can be done. The hen eggs are chosen for this project because it takes the shortest time for one complete hatching process to take place. Eggs hatching process for chicken will take about 21 days to be complete. Throughout the project, the equipment for egg hatching will be placed in the author's room at the hostel due to requirement to observe and turn the eggs at least two times per day. Upon setting up the equipment, calibration of equipment must be done to make sure that the temperature is in the 99-102° F temperature range which equal to about 39°C (100-101° F., if possible). Place the thermometer at a level or slightly above the center of the eggs to measure the temperature. The temperatures outside the 97-103°F range need to be avoided because it can kill the embryos. Therefore, the temperature inside the incubator must be monitored every day to make sure there is no abnormalities occur.

Put the water in the pan under the egg tray at least half as large as the surface of the egg tray and then placed the raw chicken eggs in the egg tray inside the incubator which can be occupied by maximum of 16 eggs. Before that, mark the eggs with an X and an O to differentiate when turning the eggs. The moisture level in the incubator should be about 50 to 55 percent relative humidity, with an increase to about 65 percent for the last 3 days of incubation. Moisture is provided by a pan of water under the egg tray and the bulb will provide enough heat for the incubation process to take place while the hygrometer is to measure the humidity inside the incubator by using relative humidity. The eggs need to be turned two times every day basically in the morning and at night to make sure the eggs received equal heat, moisture and it will not stick to the egg shell. The incubator needs to be put away from direct sunlight to prevent overheating. To monitor the condition of the water used, the reading of the temperature, relative humidity and also the pH value is taken every day. The appearance of the contaminants was monitored and observed every day and the egg candling is done to examine the eggs fertility.

Figure 3.3 below shows the egg candling at day 7. There is black spot inside the egg which shows that the egg is fertile. From the eggs candling, non-fertile or ruined eggs will be removed immediately to prevent smelly odor.

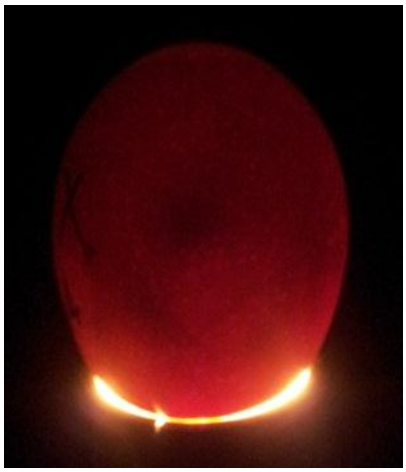


Figure3.3: Egg candling day 7

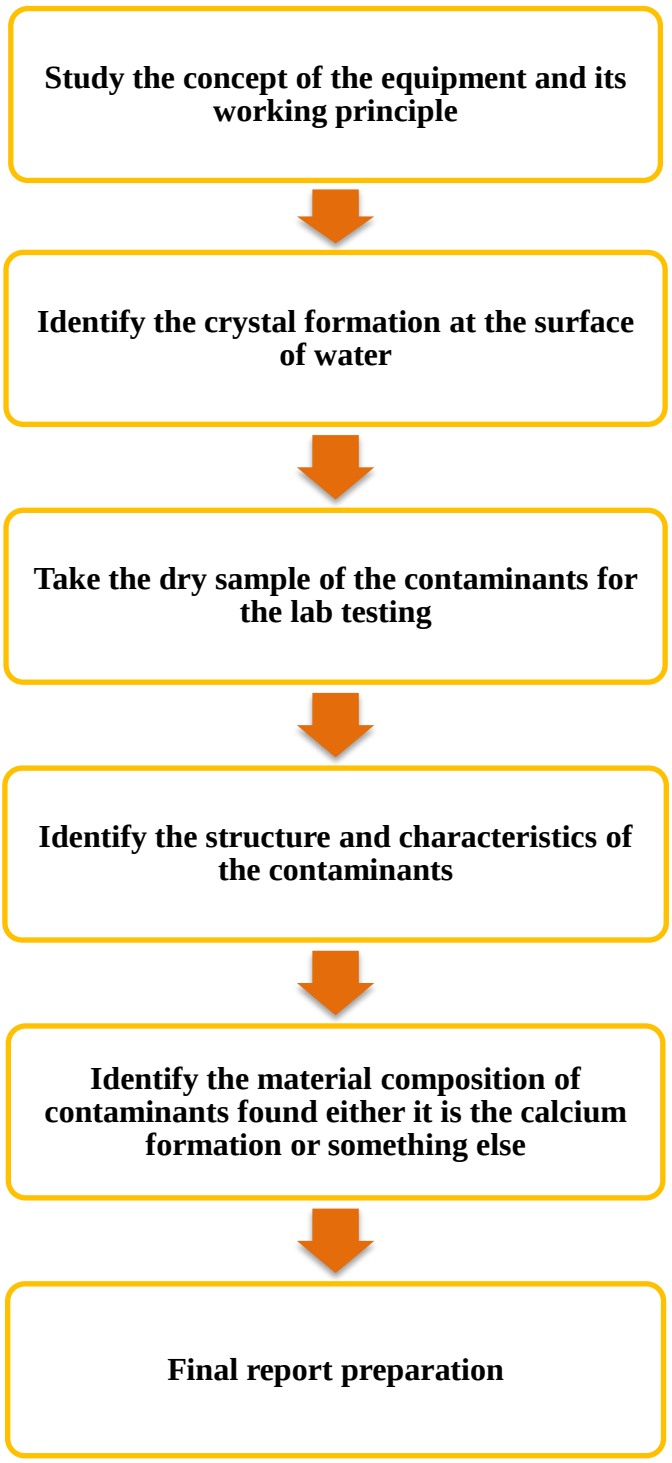
Data collection

Humidity is measured using hygrometer to get the relative humidity and pH value is measured using the pH meter or pH paper by immersed it in the water. The temperature is measured using the thermometer which placed inside the incubator. The data is recorded every day. From the data collected, the graph is plotted to see the trending of the graph and monitor any abnormalities. Upon obvious appearance of the crystal-like contaminants at the surface of water after the eggs start to hatch, take the picture and monitor the amount of the contaminants appear. Then the sample of the contaminant is taken for the testing under digital microscope and Scanning Electron Microscope (SEM) to obtain its characteristics and view the structure which cannot be seen by the naked eyes and calcium carbonate testing is done to test on the composition followed by XRD, GC-MS and FTIR.

Sample testing and analysis

After completed the eggs hatching cycle, the water used for eggs hatching observed and the dry sample of the contaminants is taken for XRD testing to test on the composition of the contaminants to see if there is calcium carbonate formation. Then the sample was tested using microscope to get larger view on the structure of the contaminants. Then another sample will be taken for the SEM testing to get the characteristics of the contaminants. There are about five samples will be taken for the lab testing. Another testing was done to test on the material of the contaminants using GC-MS and FTIR.

3.3.KEY MILESTONE



3.4.GANTT CHART

No	Detail/month	January 2013	February 2013	March 2013	April 2013	May 2013	Jun 2013	July 2013	August 2013
1	Literature survey and research work								
2	Preparation of extended proposal								
3	Preparation for proposal defense (presentation)								
4	Preparation and submission for interim report								
5	Egg hatching process + data collection + analysis								
6	Preparation of FYP2 progress report & Poster presentation								
7	Oral presentation								
8	Final report and Technical paper preparation								

3.5.EGGS HATCHING PERIOD

MARCH

MON	TUE	WED	THU	FRI	SAT	SUN
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	34
25	26	27	28	29	30	31

APRIL

MON	TUE	WED	THU	FRI	SAT	SUN
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MAY

MON	TUE	WED	THU	FRI	SAT	SUN
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JUNE

MON	TUE	WED	THU	FRI	SAT	SUN
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

JULY

MON	TUE	WED	THU	FRI	SAT	SUN
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST

MON	TUE	WED	THU	FRI	SAT	SUN
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Table3.1: Eggs hatching period

3.6.TOOLS

The equipment required for this project are:

- Incubator (egg hatching process)
- Thermometer (to measure temperature inside incubator and water)
- Hygrometer (to measure relative humidity)
- pH meter (to measure the pH of the water)
- Camera (to take picture on the crystal growth)
- Digital Microscope (testing on the contaminant's structure)
- X-Ray Diffraction (XRD) (testing on the contaminant's material composition)
- Field Emission Scanning Electron Microscope (FESEM) (testing on the contaminants structure)
- Fourier Transform Infrared Spectroscopy (FTIR) (testing on the contaminant's material composition)
- Gas Chromatography-Mass Spectrometry (GC-MS) (testing on the contaminant's material composition)

Figure3.4: Incubator

Figure3.5: Digital Microscope

Figure3.6: XRD

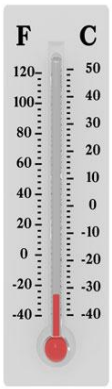


Figure3.7: Thermometer

Figure3.8: Hygrometer

Figure3.9: pH meter

Figure3.10: FTIR

Figure3.11: FESEM

Figure3.12: GC-MS

CHAPTER 4

RESULTS AND DISCUSSION

4.1.DATA COLLECTION

First experiment data (May 2013)

DAY	TEMP °C	TEMP °F	RH %
1	39	100	53
2	39	100	55
3	39	100	54
4	39	100	51
5	39	99.5	50
6	39	100	60
7	39	100	54
8	39	100	56
9	39	100.5	58
10	39	100.5	55
11	39	100	57
12	39	100	48
13	39	100	53
14	39	100	49
15	39	100	49
16	39	100	58
17	39	100	61
18	39	100	62
19	39	100	63
20	39	100	61
21	39	100	59

Table4.1: First experiment data

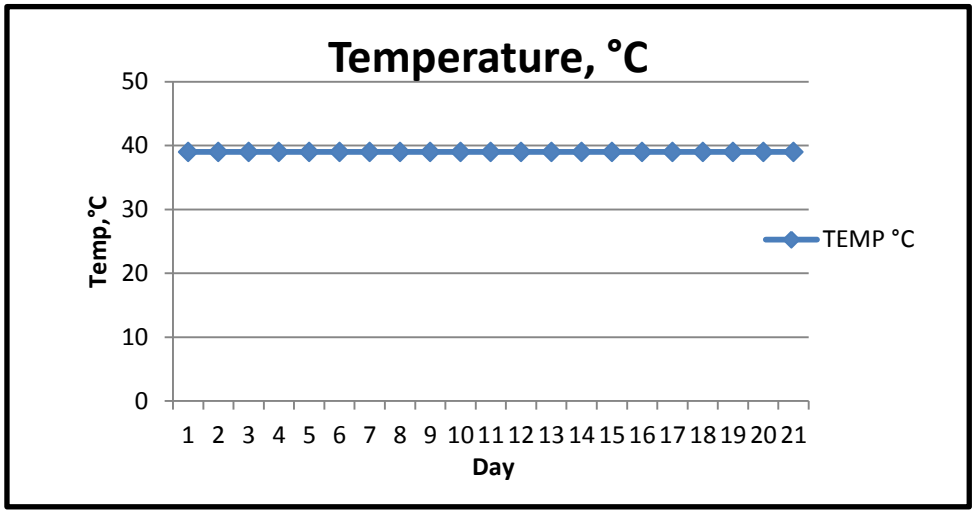


Figure4.1: Temperature, °C

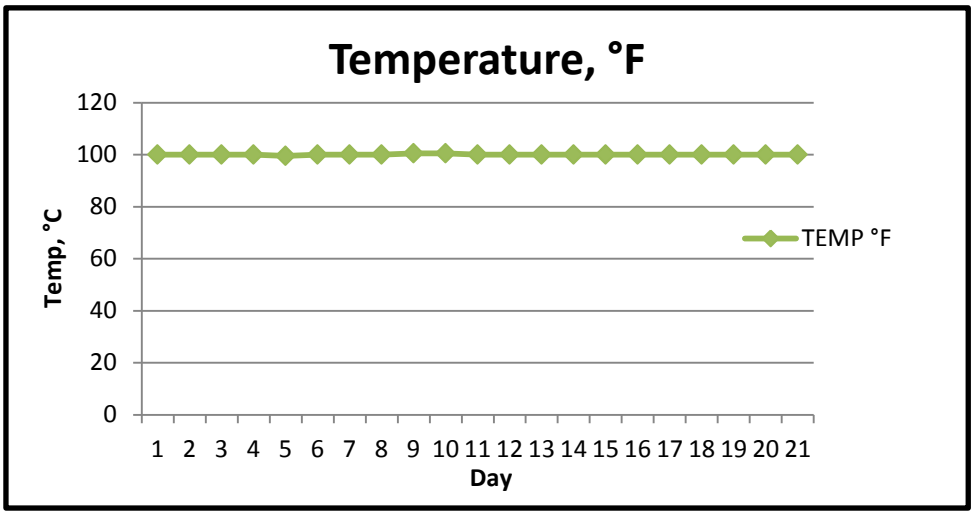


Figure4.2: Temperature, °F

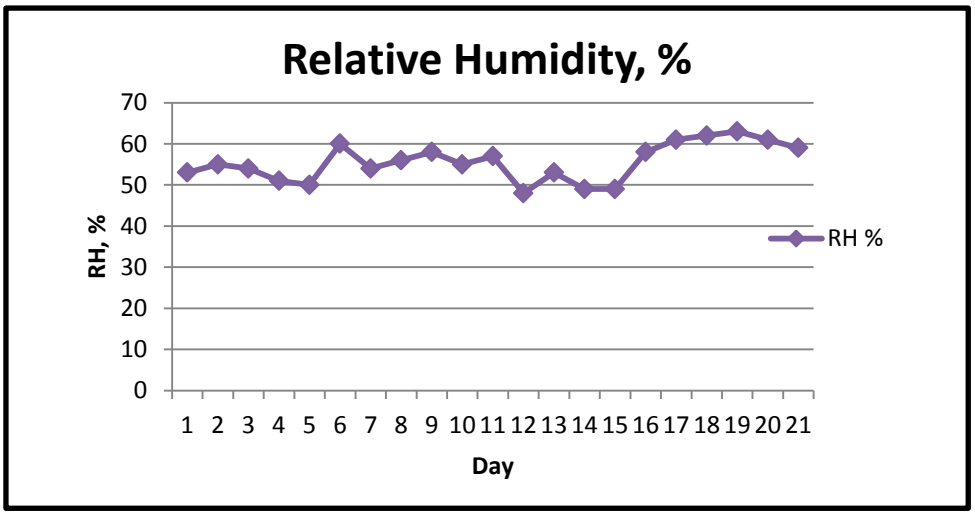


Figure4.3: Relative Humidity, %

From the data collected during first experiment on the monitoring of eggs hatching process, figure 4.1 and figure 4.2 above shows the temperature in °C and also in °F is constant. Sometimes the temperature is a slightly higher but it still within the range of acceptable limit for the incubation process. For the relative humidity in figure 4.3, it is not stable throughout the cycle. This is due to the incubator is moved from one place to another which make some of the water spilled out of the pan. During next eggs hatching process, precaution is taken by carefully handle the incubator to prevent invalid data. Due to invalid data taken from the second experiment of the egg hatching process because some of the eggs are spoil and fluid came out from the eggs fall into the water which makes the water become contaminated, third experiment is done.

Third experiment data (July 2013)

DAY	TEMP °C	TEMP °F	PH VALUE	RH %
1	39	100	7	54
2	39.1	100	7	53
3	39	100	7	53
4	39	100.5	7	53
5	39	100	7	54
6	39	100	7	53
7	39	100	7.1	53
8	39.1	100	7.1	54
9	39	100	7.1	53
10	39	100	7.1	54
11	39	100	7.1	53
12	39	100	7.1	53
13	39	100	7.1	52
14	39	100	7.2	53
15	39	100	7.1	56
16	39	100	7.2	56
17	39	100	7.2	63
18	39	100	7.2	63
19	39	100	7.6	65
20	39	100	7.7	65
21	39	100	7.7	66

Table4.2: Third experiment data

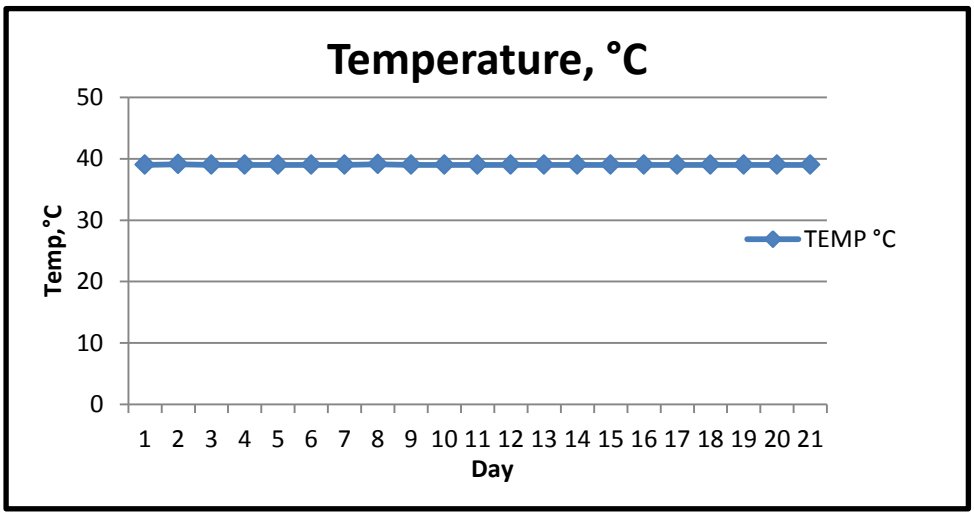


Figure4.4: Temperature, °C

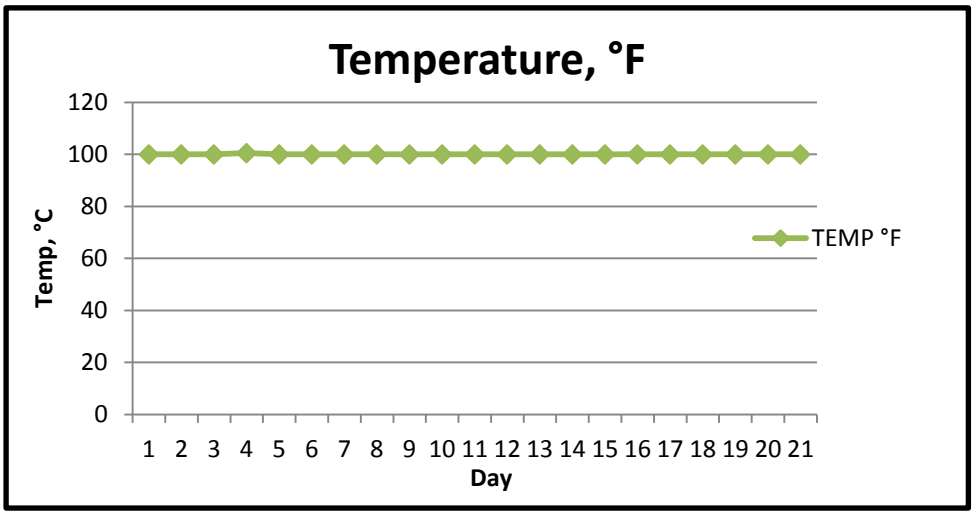


Figure4.5: Temperature, °F

Figure 4.4 and figure 4.5 above shows no abnormalities where the temperature inside incubator is maintained at 39 °C which is around 100 °F. The temperature is maintained constant at desired temperature for eggs hatching process. Therefore, when another batch of eggs hatched in the same incubator without changing the water, temperature is not the factors that affect the hatchability of the eggs.

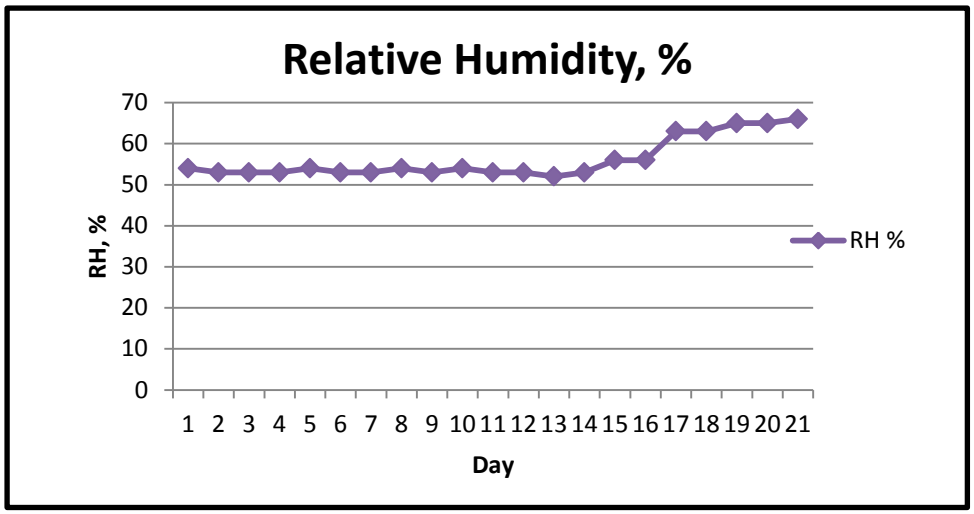


Figure4.6: Relative Humidity, %

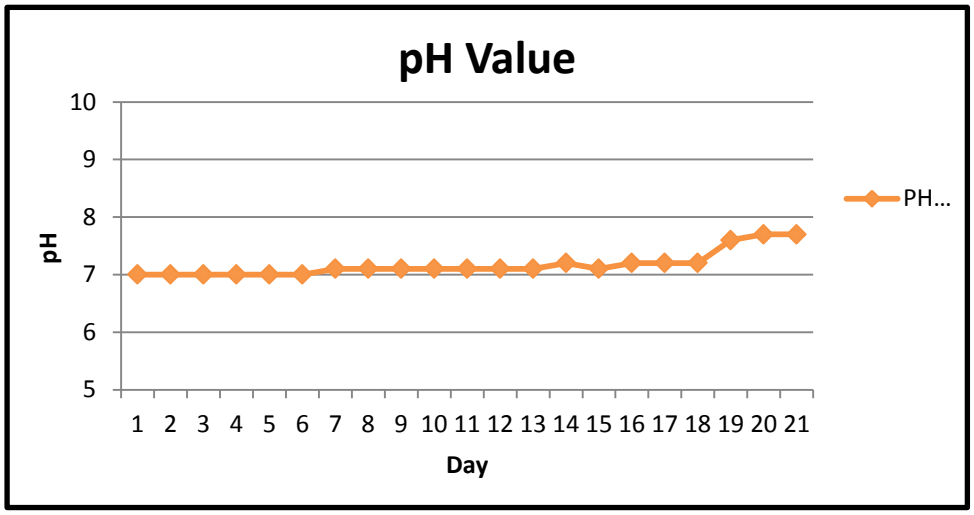


Figure4.7: pH value

From figure 4.6 above, relative humidity is maintained at about 50 to 55 % during the early cycle of eggs hatching process and it increased up to 65 % during the last few days before hatching which meet the requirement for the eggs hatching process.

The pH value of water used in eggs hatching process is pH 7 which is at neutral state. However, after the eggs hatched at day 19, the contaminants begin to appear, it shows in figure 4.7 that the pH value increased nearly to pH 8 where the water now becomes alkaline. After one complete eggs hatching cycle, when another batch of eggs are hatched using the incubator without changing the water used, some of the eggs do not hatch. Based on the observation from the study, it is believed that the presence of the contaminants affects the hatchability of the fertile eggs when it turns the water from neutral state to become alkaline.

4.2.WATER CONDITION

Figure4.8: Day 1

Figure4.9: Day 19

Figure4.10: Day 21

Figure4.11: Day 21 zooming view

Figure 4.8 show the 1st day of eggs hatching and figure 4.9 is the condition of the water on day 19 while figure 4.10 is on day 21. One complete cycle of eggs hatching take about 21 days for all the eggs to hatch. During the experiment, there is nothing changed with the water where no contaminants are found. When three of the eggs start to hatch on day 19, the contaminants begin to appear and on day 21 after all of the eggs hatched, the contaminants increase rapidly. Based on the observation, the contaminants might come from the inside of the egg shell when the eggs hatched. However, it is subjected to further study to figure out where exactly the contaminants came from.

Figure4.12: First cycle

Figure4.13: Second cycle

From the experiment, it is found that the crystal-like contaminants are not grows in the water, but it was increased when more eggs were hatched. It is found that the contaminants are produced when the eggs shell stretched during the hatching process, then the surface of the egg shell membrane peel off, bend and roll producing the crystal-like contaminants. The contaminants fall down from the egg tray to the water surface. Figure 4.12 shows all the eggs already hatched during first cycle and figure 4.13 shows that during second cycle of the eggs hatching process using the same contaminated water, only two of them were hatched and the others do not hatch. The contaminated water seems to affect the hatchability of the eggs.

4.3. CONTAMINANTS STRUCTURE AND MICROSTRUCTURE

Figure4.14: Normal view

Figure4.15: digital microscope 30X magnification

Figure4.16: digital microscope 100X magnification

Figure 4.13 shows the contaminants under normal view, while figure 4.13 and figure 4.14 show the contaminants under digital microscope at 30X magnification and 100X magnification. From the observation, the contaminants are in the condition that it bend and roll and becoming a cylinder shape crystal-like structure.

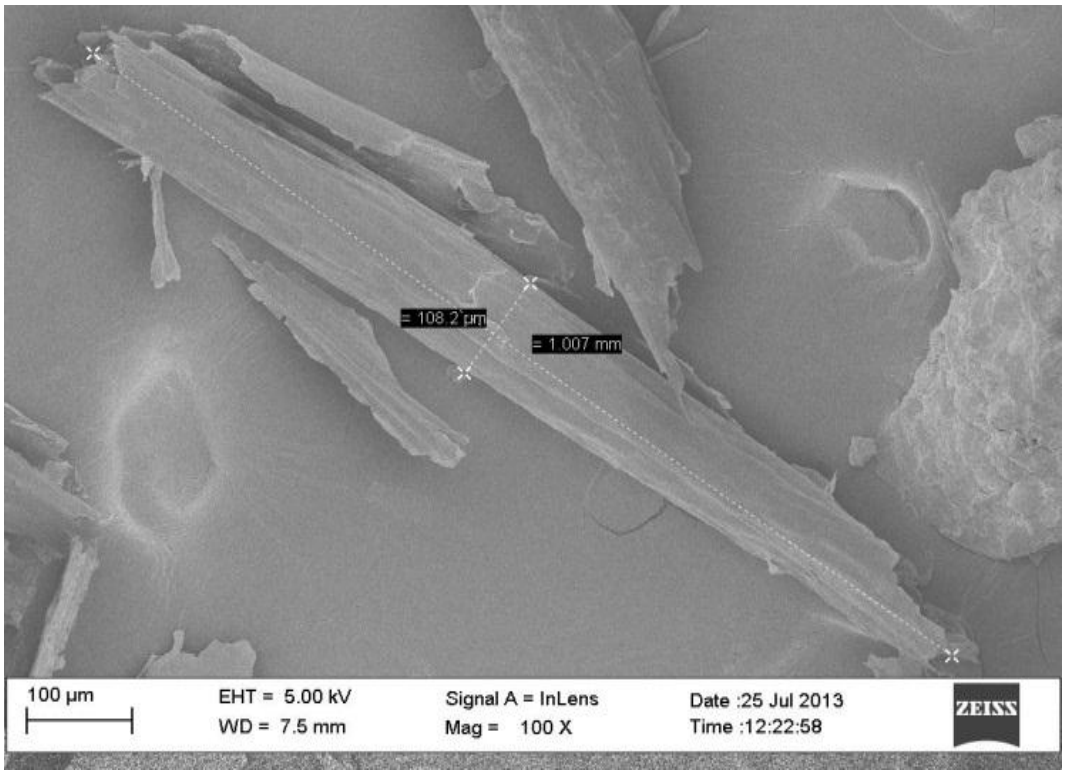


Figure4.17: SEM 100X magnification

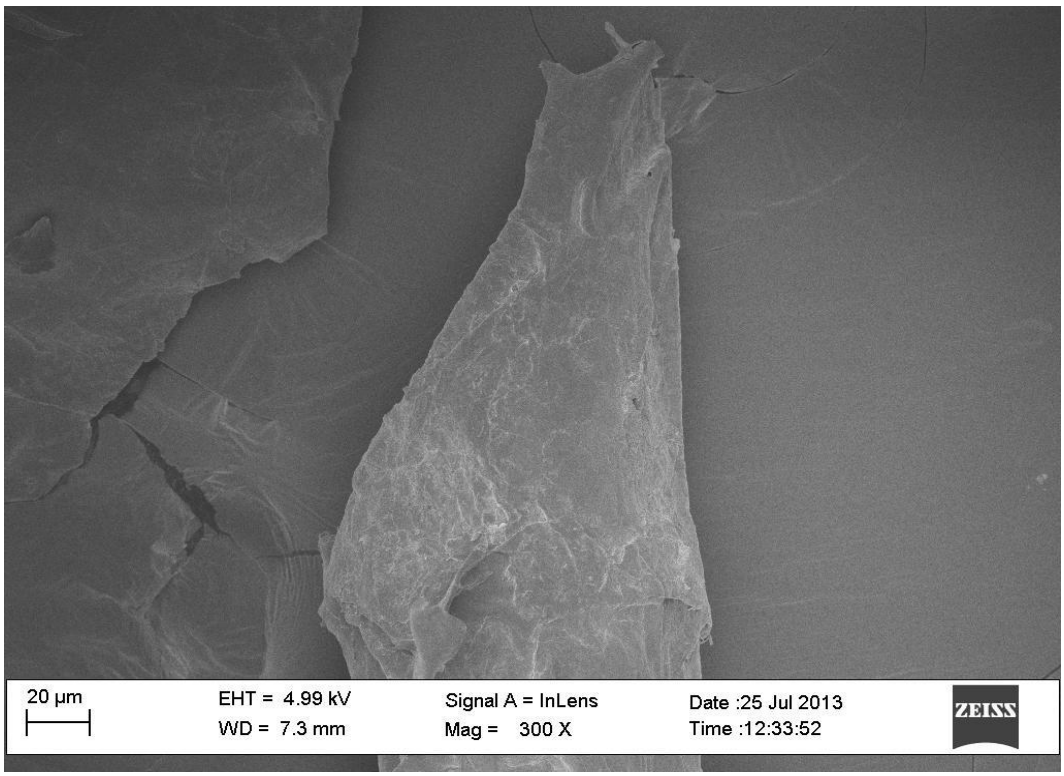


Figure4.18: SEM 300X magnification

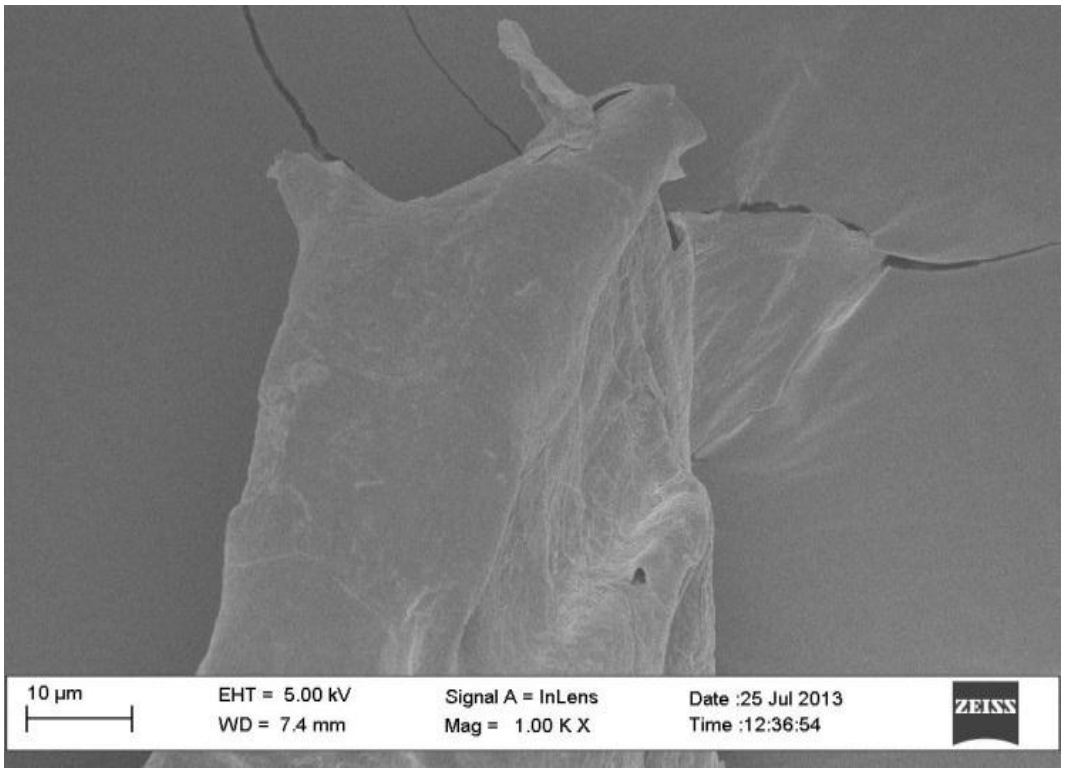


Figure4.19: SEM 1000X magnification

Figure 4.15 shows the microstructure of the contaminants at 100X magnification. It shows the width of the contaminants is about 108.2 µm and the length about 1.007 mm. Figure 4.16 is the end part of the contaminants at 300X magnification and figure 4.17 is the end part of contaminants at 1000X magnification. It is believes that the contaminants came from the egg shell.

4.4.EGG SHELL MICROSTRUCTURE (SEM 300X magnification)

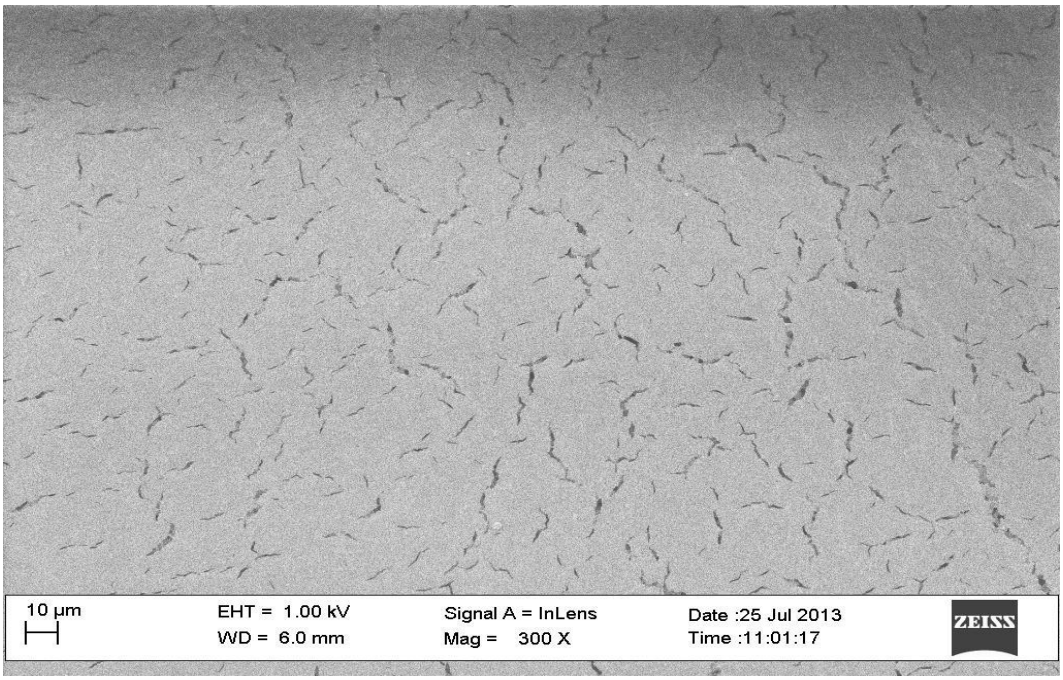


Figure4.20: New egg shell

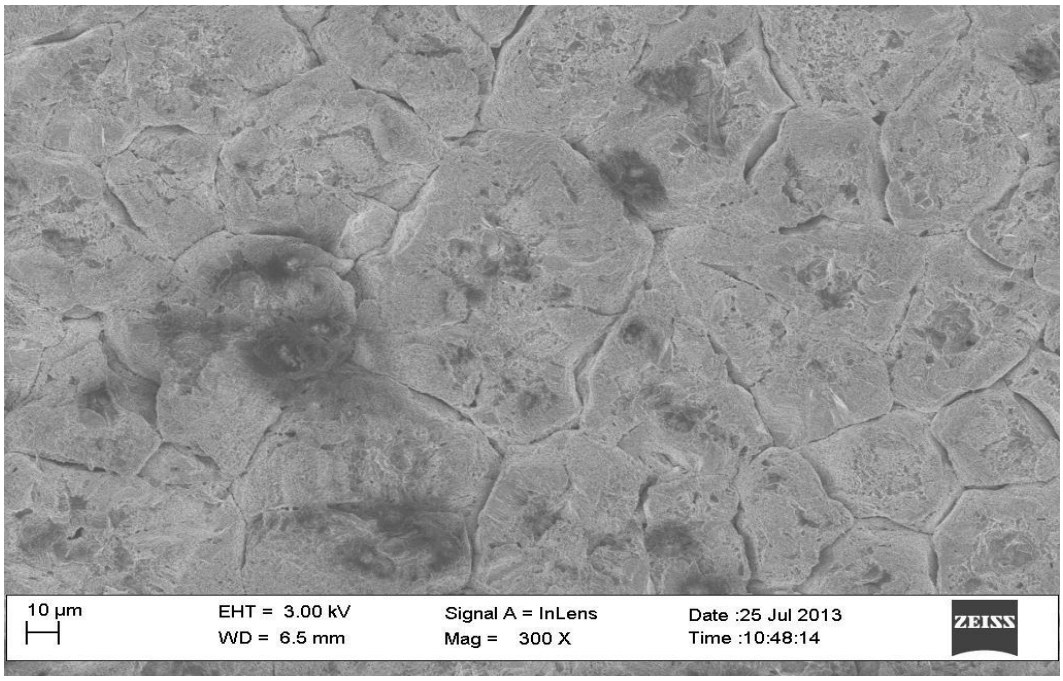


Figure4.21: Hatched egg shell

Figure 4.20 above show the microstructure of new egg shell and figure 4.21 show the microstructure of hatched egg shell. Based on the study and observation from this experiment, the contaminants structure seems to match the pores of the hatched egg shell. The pores of hatched egg shell are longer and bigger as compared to the new egg shell. Therefore, it is conclude that the contaminants came from the egg shell when it stretched and the surface of the egg shell membrane peel off then roll producing the crystal-like contaminants.

4.5.COMPOSITION OF THE CONTAMINANTS

Calcium Carbonate Testing

Testing is done to figure out what is the material composition of the contaminants whether it is calcium carbonate or bacterial formation. To test on the presence of calcium carbonate, one basic testing is done using vinegar which react with calcium carbonate by producing bubbles. The testing is done on two samples which are the egg shell and the contaminants which expected to be a calcium carbonate formation. The results are show in the figure below.

Figure4.22: Egg shell

Figure4.23: Crystal-like contaminants

From figure 4.22 the egg shell which contains calcium carbonate react with vinegar and producing bubbles. Figure 4.23 is the crystal-like contaminants which also show some bubbles. Therefore, the composition of the contaminants material is concluded to have the presence of calcium carbonate.

XRD Testing

From XRD testing, the results from the graph shows there is no peak which means the sample is not a crystalline structure. To find out what is the material and composition of the contaminants, testing using Fourier Transform Infra-red Spectrometer (FTIR) is done.

FTIR Testing

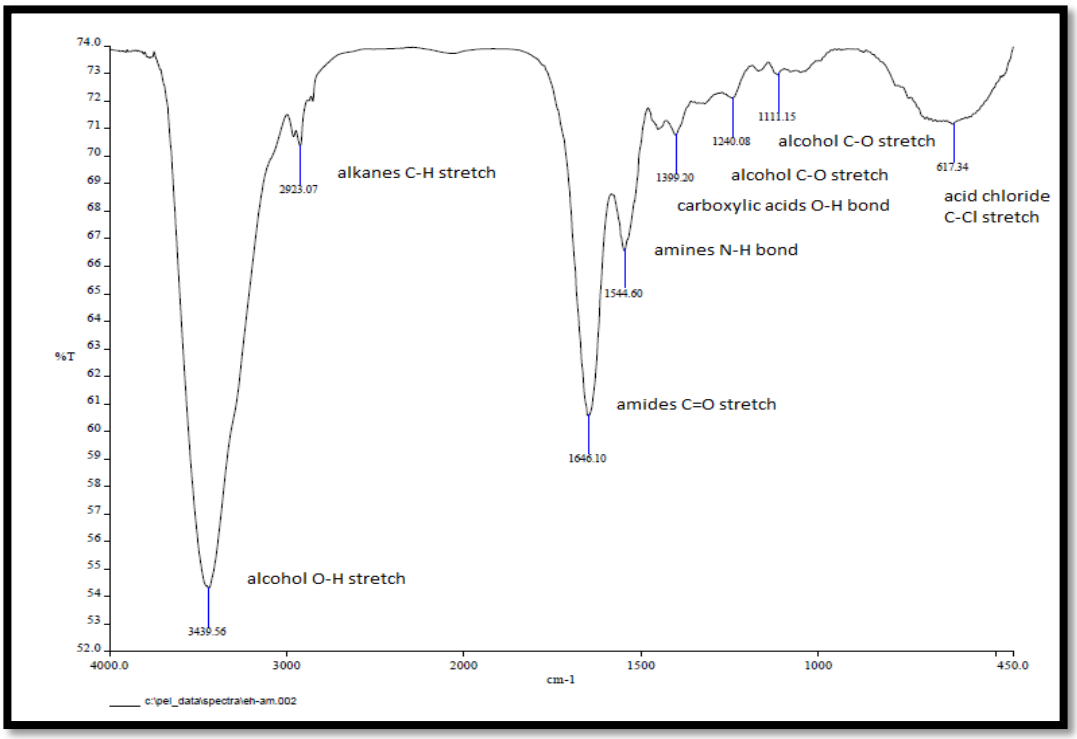


Figure4.24: FTIR testing

Figure 4.24 above shows the result under FTIR testing. The contaminants could be in a group of alcohol O-H stretch, alkanes C-H stretch, amides C=O stretch, amines N-H bond, carboxylic acid O-H bond, alcohol C-O stretch or acid chloride C-Cl stretch. Due to time constraint, the exact material of the contaminants is subjected to further studies to understand the concept of FTIR to get the accurate results.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1. CONCLUSION

From the experiment conducted, the data collected shows constant result on the temperature and also the relative humidity which meets the requirement for the eggs hatching process to take place. Based on the observation, there are no changes with the water during the process. On day 19, three of the eggs start to hatch, and the contaminants begin to appear on the water surface. The pH value of the water starts to increase to pH 7.7 which is it become alkaline. On day 21, all of the eggs were hatched and number of the contaminants increased. Another batched of eggs hatching is continued using the same water and it is found out that only two of the eggs were hatched while the other fertile eggs do not hatch. It is conclude that the existence of the contaminants affect the hatchability of the eggs. Earlier, the structure of the contaminants is not known. The sample of the contaminants is taken for the testing under digital microscope and SEM to observe their structure. Based on the figures show earlier, the contaminants structure is compared to the hatched egg shell structure and it is observed that contaminants size match the pores size of the hatched egg shell. Based on the findings, it is conclude that the contaminants came from the eggs itself when it stretched during hatching and the surface of the egg shell membrane peel off then roll producing the crystal-like contaminants. The composition of the contaminants is not known. The testing is done to figure out its material composition. Calcium carbonate testing is done using vinegar. Calcium carbonate reacts with vinegar by producing bubbles. From the testing, there are some bubbles presence when the vinegar is pours on the contaminants. Therefore, it is concluded that the contaminants have the presence of calcium carbonate. FTIR testing is also done. However, it is subjected to further study to figure out the accurate material of the contaminants.

5.2. RECOMMENDATION

This experiment is still subjected to further study to figure out what exactly is the material of the contaminants. The results on FTIR and GC-MS required further study to understand the concept of the data analysis from the testing on how to select the accurate material of the contaminants from the raw data. More study on the structure also can be done to confirm where the contaminants come from for more accurate result. More technical study can also be done on the working principle of the incubator such as auto water-changing of the water used during egg hatching process after one complete cycle.

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