

# QUALITY CHALLENGES IN EGG FARMING: A CASE STUDY IN HEAP SOON FARMING SDN BHD

<sup>1</sup>Tan Hup Siang and <sup>2</sup>Shahimi Bin Mohtar

<sup>1</sup>School of Technology Management and Logistics, College of Business,  
University Utara Malaysia, 06010, Sintok, Kedah, Malaysia

<sup>2</sup>School of Technology Management and Logistics, College of Business,  
University Utara Malaya, 06010 Sintok, Malaysia

Email: [hst199024@hotmail.com](mailto:hst199024@hotmail.com), [shahimi@uum.edu.my](mailto:shahimi@uum.edu.my)

## ABSTRACT

*Egg and shell quality are the important factors that decide the profit of an egg farm. The aim of research is to understand the actual farm quality control, what kind factor that will affect egg and shell quality and what are the quality challenges that Heap Soon Farming had met. The literature review had mentioned factors that affect egg quality and quality guideline to measure an egg. An interview was carried out and a checklist had been used to investigate what are the factors that affect egg quality and solution to solve the egg quality problem. The result of interview had identified that the diseases are major factor which compromise egg and shell quality in Heap Soon Farming. Beside this, vaccination and daily health check to layer is used as preventive measure to avoid diseases and low shell quality. Furthermore, it was proposed that Heap Soon Farming introduce the use of enzyme in decreasing egg shell quality problem.*

## Keywords

*Layer, Eggs, Factors, Quality*

## 1.0 INTRODUCTION

Based on the literature review conducted, agriculture can say is includes many industries such as the poultry industry, farming industry, egg production industry and so on. Agriculture includes all of the services and activities involved in producing plants and animals, and their products, and in getting them to the consumer (Lee, 1967). Beside this, agriculture indicate plowing a field, planting seed, harvesting a crop, milking cows, or feeding livestock (Baruah, 2013). Agriculture is from the basic to the end and can describe as a whole process. For example, we are starting by feeding a chicken until we sell out the chicken to market, is can say as the agriculture.

Poultry farming is breeding the chickens, ducks, geese and turkeys for two main purposes which are meat and egg only (Ramos, 2011). The poultry farm can divide into two types, one is the breeding the

poultry for the purpose of get the meats which call as broiler and second is breeding the poultry to get their eggs and supply to market as the one of the daily food consumption for human had call as layer. The poultry industry nowadays is a big industry and it exists anywhere and any country.

In the egg farming, one of the critical challenges is the quality of the egg shells, as this determines the price and profit of the egg framing. In Malaysia, there are lot of the egg farms are facing some egg shell quality problem in their farm and egg shell quality problem is the basic problem or normal issues that always happen in the farm (Raghavan & Chandran, 2002). In additional, they had found that there are many reason which can causing the egg quality become bad or the egg shell become thin and so on.

## 1.1 Problem statement

There are many reasons for egg shell quality problems. Some of the reasons are environmental and genetic factor (Jin et al, 2011), storage time and temperature (Samlli et al, 2005). These problems will lead to lower profit to egg farm and increased wastage. Therefore, it is important to investigate the cause of egg quality problems and provide solution to avoid further loss for the egg farms.

## 1.2 Objective

1. To recognize the daily process of egg production and eggs quality control in Heap Soon Farming
2. To determine what are the challenges that faced by Heap Soon Farming SDN BHD.

## 2.0 LITERATURE REVIEW

### 2.1 Poultry farming

The poultry farming is appearing in every place in the world. It is sectors which focus on breeding the birds to get certain product that they want and to fulfill the human daily meat consumption needs. The

products that produce by the poultry farming are one of the human food sources and the protein source that needed by human every day.

According to Ramos (2011) had defined that poultry farming is an activity on breeding the domesticated birds such as chickens, turkeys, geese and duck in the farm. Beside this, poultry farming had divided into two sectors which one is provide the meat and another one is to provide the egg. These two different sectors had category as broiler (meat) sector and layer (egg) sector. The poultry farming had brought the benefit and profit for the human who involve in this business. Thus, the poultry farming will just focus on the breeding the birds only and it is different with other farming such as plantation or breeding livestock which might involve lot of the time and capital to start a new business.

## 2.2 Malaysia poultry farming

In Malaysia, poultry farming is one of the sectors in the livestock sector. It is one of the economy incomes for Malaysia. The poultry farming in the Malaysia is will mostly breeding the chicken and duck only which is different with the poultry farming theory which include the duck, chicken, geese, turkey, pigeon and emu. In Malaysia, there are lots of the broiler farm and layer farm in certain state.

In the past, the chicken population in year 2003 is almost 94% of the poultry population and the duck population which is 5% only (Arshad, Abdullah, Kaur, & Abdullah, 2007). It had show in the table 1.

Table 1: Population of chickens and ducks in Peninsular Malaysia, 1999 – 2003 (In million units)

Category	1999	2000	2001	2002	2003
<b>Chickens</b>	90.9	96.3	119.9	139.4	151.6
<b>Ducks</b>	4.5	4.6	6.0	6.3	7.7
<b>Others</b>	1.6	2.1	1.9	2.8	2.6
<b>Total poultry</b>	97	103.0	127.8	148.5	161.9
<b>% chicken</b>	93.7	93.5	93.8	93.9	93.6

Source: Online <http://agrolink.moa.my/jph/dvs>

Based on the selected agricultural indicator report, it had show that the livestock production Malaysia had increase compare with year 2010. Meanwhile, chicken had the highest recorded number of livestock in Johor. Perak recorded the highest number of duck (Department of statistic, 2012).

Table 2: Number of livestock by type and state, Malaysia, 2011

Jenis ternakan Type of livestock	Kerbau Buffalo	Lembu Cattle	Kambing Goat	Bebiri Sheep	Babi Swine	Ayam Chicken	Bek Duck
<b>Jumlah Total</b>	<b>123,213</b>	<b>768,403</b>	<b>476,431</b>	<b>126,412</b>	<b>1,801,247</b>	<b>231,249,057</b>	<b>9,219,884</b>
Johor	5,162	112,742	60,605	25,603	281,955	60,265,213	1,370,489
Kedah	9,237	73,688	48,149	9,891	670	24,552,827	768,085
Kelantan	6,245	108,398	37,833	31,350	434	1,755,004	57,214
Melaka	6,621	31,818	48,638	8,766	47,675	17,253,440	423,418
Negeri Sembilan	4,639	54,375	51,513	18,890	959	16,480,092	16,705
Pahang	12,490	114,797	34,976	13,013	3,300	9,613,217	15,076
Pulau Pinang	371	11,900	11,098	861	324,737	12,557,728	494,217
Perak	14,366	54,336	46,246	3,737	480,979	31,880,006	5,553,200
Perlis	74	7,062	7,042	2,244	857	1,566,100	25,179
Selangor	898	25,142	31,711	4,117	254,349	12,389,504	38,591
Terengganu	10,520	96,306	35,346	3,324	-	2,710,166	52,194
Sabah	45,088	62,623	48,457	2,049	72,315	5,258,517	44,167
Sarawak	7,502	14,731	14,615	2,567	333,117	34,967,243	361,349
W.P. Kuala Lumpur	-	465	202	-	-	-	-

Sumber: Jabatan Perkhidmatan Veterinar  
Source: Department of Veterinary Services

## 2.3 Different between broiler industry and layer industry.

The broiler industry is breeding the chicken to get the meat and sell to the market, but the layer industry is breeding the layer to get the egg and sell to market. In Malaysia, the broiler population in Malaysia chicken population is higher than layer population (Arshad et al., 2007). Wong (2010) cited Wong and Tan (2009b) defined that broiler industry had started from 1970s but layer industry is start from 1980s. There are two kind broiler chicken that been breed in the farm which is Cobb and Ross species broilers. For the layer species which have few kind and it fulfill a good laying ability (Wong, 2010). The different between the broiler and layer chicken is on the product, when the broiler is achieve 42 days above, it will get kill and get the meat but the layer is feed until it cannot lay out the good quality egg. The different between broiler and layer industry can get from table 3.

Table 3: Comparison between broiler industry and layer industry.

Source	Broiler industry	VS	Layer industry
<b>Wong (2010)</b>	Chicken meat	Purpose	Chicken eggs
	Cobb and Ross broilers	Chicken species	Lohmann brown hens Hisex brown hens ISA brown hens
<b>(Hamra, 2010)</b>	From 1970s	Year of industry started	From 1980s
	Mostly 42 days can achieve 2kg.	Grow up times	Mostly 19 week can lay eggs
	Larger than layer birds	Chicken body frame and weight	Smaller than broiler birds
	Meat production only	Purpose	Meat and egg production

## 2.4 Quality guideline for good quality egg and egg shell.

Eggs are playing an important role for human daily food. It is one of the protein that needed by human body. Therefore, the quality of egg is important because it can decide the profit of the layer farms and it also will decide the human healthy.

On the other hand, egg shell and egg quality not only decide that human eating a good egg and it also decide that a farm profit too. Therefore, egg quality and shell quality is important for the farm. From the table 4, the quality of egg shell will measure based on the egg weight, shell texture, breaking strength, shape, thickness and so on; internal egg quality mostly will based on the albumen and yolk color and defect of it also.

Table 4: Quality guideline for egg shell and egg.

Source	Quality guideline to measure the egg quality and shell	
	Egg shell quality	Internal egg quality
(Roberts, 2003 )	<ul style="list-style-type: none"> <li>• Egg weight</li> <li>• Egg shell color</li> <li>• Egg shell breaking strength</li> </ul>	<ul style="list-style-type: none"> <li>• Albumen height</li> <li>• Yolk color score</li> </ul>
(Cordin & Robert, 2009)	<ul style="list-style-type: none"> <li>• Shell cleanliness</li> <li>• Shell soundness</li> <li>• Shell texture</li> <li>• Shell shape</li> </ul>	<ul style="list-style-type: none"> <li>• Relative viscosity of the albumen</li> <li>• Freedom from other matter in albumen</li> <li>• Shape of yolk</li> <li>• Zero defect of yolk</li> </ul>
(Chukwuka et al., 2011 )	<ul style="list-style-type: none"> <li>• Measure on stain</li> <li>• Adhering dirt and foreign matter</li> <li>• Egg shape</li> <li>• Shell texture</li> <li>• Shell shape</li> <li>• Ridges</li> <li>• Shell thickness</li> </ul>	<ul style="list-style-type: none"> <li>• Air cells</li> <li>• Albumen</li> <li>• Yolk color, smell, texture</li> <li>• Blood or meat spot</li> </ul>

## 2.5 Factor that affect quality of egg shells and egg.

Egg quality is always get concern by customers when they are buying egg in market or shop. Thus, customer normally will based on the egg shell strength, albumen consistency, yolk color and price to decide an egg quality (Raghavan & Chandran, 2002). There are six factors that listed in figure 1 which cause the hens lay out the low quality egg:

### 2.5.1 Environmental factors

Normally the environmental factors are always one the factors that will affect the quality of egg and egg shell. In addition, the environmental had divided into many factors such as the air quality, the storage time, stress and so on.

Ammonia gases is the major harmful gas in the poultry operation and the bird feces are contain with the uric acid which can easily producing the ammonia gas. Therefore, choosing the housing

system is one of the important steps so that the worker can clean the stool easily (Xin et al., 2011) . Beside this, storage temperature and time will directly affect internal egg quality. When the temperature is increase to 29 °C, the internal egg quality will become very low, so this temperature is the maximum temperature that will cause the egg quality becoming low (Jin, Lee, Lee, & Han, 2011) .

### 2.5.2 Stress

According to Xin *et al* (2011) cited Mashaly *et al* (2004) stated that heat stress is occur when the air circulation in the housing system is not enough during the hot weather. This will cause the production performance of the hens become low and it also will cause the hens reduce the feed intake, and harm hen's immune function. Thus, the farm management should always care about this factor to make sure they would not have the low quality egg.

### 2.5.2 Water quality and food quality.

Water also plays an important role for poultry daily life. The water quality for poultry also must be taking serious because it will decide the egg shell and egg quality. Beside this, the feed for poultry must be balance diet because it will make sure that hens get enough supplements that needed and lay out a good quality egg.

The drinking water for layers must pay more attention by farm management. The drinking water must include some calcium so that the egg that been lay out will have a good strength. The drinking water that contain certain mineral will help the hens lay out a nice strength egg shell compare with the water without mineral (Chukwuka et al., 2011) . Otherwise, water quality must be clean and without electrolytes and the temperature of water must be low so that hens can consume (Ahmadi & Rahimi, 2011).

Coming next is the feed quality. The nutrition will affects egg shell quality. Provide the balance of dietary mineral and vitamins can help the hens to produce out the good quality egg. To solve the wet dropping problem, egg farmers can consider to using the enzyme to feed the hens (Ahmadi & Rahimi, 2011). Therefore, if levels of calcium and other mineral above the requirement level of layers will bring impact for layers.

### 2.5.3 Age of layers

One of the factors that will affect the egg quality and shell is the age. Same as human also, when layers are getting old, the egg might not be good quality anymore. This is natural law, no one can change it.

The age of hens and species will affect the egg shell quality. As long as the age of layers getting old, the egg shell quality will become low; the younger

layers with not mature shell grains may produce thin shell egg (Ahmadi & Rahimi, 2011). Beside this, as the age of layer is getting increase, the Hough unit of the albumen will decrease; thus, the age of layers and Hough Unit of albumen is related with each other (Awosanya et al., 1998; Chukwuka *et al*, 2011). Therefore, the age of layers will decide the egg shell either is thick or thin and the egg size beside than balance of the calcium and other mineral in the feed that hens consume.

### 2.5.4 Disease

Disease, another serious factor that will affect egg shell and egg quality because it causes hens sick and it will directly lay out the low quality egg. According to Ahmadi & Rahimi (2011) defined that trematode and *Prasthogonimus* spp will make the layer oviduct become inflame and lay out the soft shell egg and other low quality eggs. Beside this, there are lot of the disease can affect the layers and egg quality.

The disease such as:

- Newcastle
- Avian influenza
- Avian ancephalomyelitis
- Mycoplasma Gallisepticum (MG)
- Infectious Bronchitis (IB)
- Infectious Laryngotracheitis (ILT)
- Avian Encephalomyelitis (AE)

The disease above there are major disease that had define by authors which will directly affected the hens healthy and cause the hens lay out the low quality egg and shell. To avoid this kind disease happen, the farm should always check the layer health so that can solve the problem on the time.

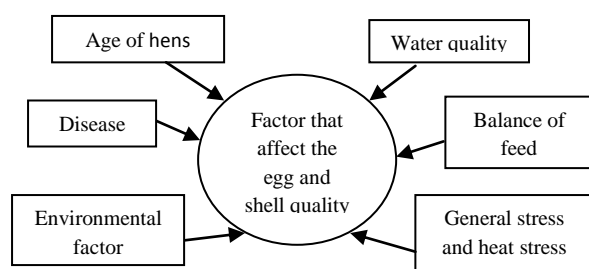


Figure 1: Factor that affect the egg and shell quality.

## 3.0 METHODOLOGY

### 3.1 Data source

There are two kind data that use in this research paper which is primary data and secondary data. The primary data that had been used is the qualitative method to collect data meanwhile the secondary data that had been used is from the journal and article that collect from the online scholar to refer

the theory and information support about the egg quality and shell.

### 3.2 Research technique of this paper

This study is using the qualitative method (interview) as the method to collect primary data. Reason of using the interview method is because the question that been set will more on the experience of owner to egg quality control. The result gain by qualitative method is more suitable and useful in this research due to limited farm that willing to provide data compare with the quantitative method. According to Seidman (2006) mention that interview was not use to answer the question that set, not to test hypothesis but it is use to understand the lived experience of the people and meaning they make of that experience. Interview also need to separate into three series which is start from life history of the owner, coming next is detail of experience and end with reflection on the meaning (Seidman, 2006). Through these three series of interview, researcher will have very detail information from the participant. Same as this research paper, researcher need to ask about the history of farm then continue with owner experience to egg quality control or hen health control. Based on the interview to owner of the farm, they will telling the experience of they had to control the quality and also provide the suitable solution to solve the problem that happen. This will make us more understand about the process of quality control.

## 4.0 FINDINGS

This research paper is using the qualitative method to complete the data collection. The interview method had been carried out with Heap Soon Farming owner, Mr. Ong. Using the interview method can help researcher to understand more about the quality control for egg and shell. It also related with the quality control process that been carried out by the Heap Soon Farming. From the interview that had done, the data had separated into five parts:

### 4.1 Company background

The egg farm that involve in this research paper is the Heap Soon Farming SDN BHD. It is a farm which involve in the layer industry. It was started from year 2006 until now. Location of this farm was located in Trong, Taiping, Perak. The owner of this farm is Mr. Ong.

## 4.2 Egg production and egg quality control in Heap Soon Farming.

This part will discuss about the actual farming daily process and egg quality control in the Heap Soon Farming. From this part of study, the process and quality control of Heap Soon Farming is useful for other egg farm to refer and use it as a guideline to improve the egg quality.

### 4.2.1 Grower involvement

The layers that rise in Heap Soon Farming were the Hisex brown hen species. The amount of layers in farm was 1,250,000 and 25 closed houses had been built. Each house is able keep about 50,000 layers. The daily egg production is 800,000.

Grower involve in taking care layer health and manage egg quality is important because they can early realize the problem of hen health or egg quality problem. This will reduce the risk of farm loss profit.

Mr. Ong mentions that daily check for layer health is a must.

In addition, Mr. Ong agrees that:

- Daily quality check for egg shell is a must for Heap Soon farm.
- The farms which can produce own feed will help to save cost and provide a balance supplement for layer.
- Workers that attain training will easy to manage quality challenges.

In Heap Soon farming, daily check for layer health and egg quality is a necessary daily process for the farm. These show that grower involvement is important because it related with hens health and egg quality.

### 4.2.2 Grower skill and understanding of egg quality control

Grower skill is very important for us to understand. It is related with the way to manage the quality of egg and shell; it also will define the real quality control process by Heap Soon Farming which cannot get from the article or journal.

From the data collection, some of the findings from literature were same with Mr. Ong experience and opinion:

- Hens stool will affect the air quality of closed house and cause hens get sick.
- Air quality is important for closed house and he suggest that using cooling pad to control the temperature of closed house.
- Feed also is a factor will affect egg quality.
- Newcastle disease, Infectious Bronchitis, Mycoplasma Gallisepticum (MG) and Avian

Encephalomyelitis (AE) are the disease that causing low egg shell quality.

Based on the data collect from interview, disease was the major factor compare with other factors that will affect the egg quality.

However, according to the findings of literature had showed that six factors will affect the egg quality but some of it had disagreed by Mr. Ong:

- Hot weather will cause heat stress to closed house.
- Water quality was the main factor to affect egg shell quality.
- Temperature of 29 °C will which state in the literature review mention will spoil egg quality.
- Egg drop syndrome, winked egg shell and thin egg shell will always happen in farm.

### 4.2.3 Farm Opinion and thinking

In this part, study will focus on Heap Soon Farming opinion and thinking. The experience or opinion of Heap Soon Farming that listed in this article will help other layer farms to improve the farm quality process and daily process:

- Trained worker is able to manage the quality challenges.
- Diseases are the major cause that affects egg and shell quality.
- Egg quality is decided a farm profit and cost.
- Disease had divided into two types, which is virus type and bacteria type.
- Bio security can reduce the disease happen in farm.

## 4.3 Challenges that faced by Heap Soon Farming

The challenges that Heap Soon farm had met is to vaccination re – schedule to solve the virus or disease problem. Mr. Ong had mention that the time for vaccine to cure layer is different. The time of vaccine work for each batch layer is different so Mr. Ong unable to estimate the actual time of the vaccine work. So this is the challenges had faced by the Heap Soon Farming.

As a result, Mr. Ong had agreed using bio security will reduce risk of disease happen to layer and disease and the time of a vaccine work to layer will be the major challenges for the Heap Soon farm. Beside this, Mr. Ong also agrees that giving the layer to consume the enzyme will help to improve the layer egg in the same time.

## 5.0 DISCUSSION

From the finding parts, the data had showed that disease is the major factor that affect the egg and shell quality. In this chapter, researcher will discuss about the benefit by using the bio security in farm

and daily check layer health and also the use of vaccination to layer.

What is the benefit of bio security in egg farm? Nowadays, bio security is playing an important role in the farm. It had been used to reduce the disease happen and help the farm to reduce financial loss due to the layer disease outbreak (Al-Saffar, A. Al-Nasser, Al-Haddad, Al-Bahouh, & Mashaly, 2006). On the other hand, Mr. Ong had mention that daily check for layer health is a needed process. The reason of doing this process is to prevent disease and make sure the layer health is under control. Beside this, vaccinations that given to layer also can help to prevent the layer get sick and avoid layer lay out low quality eggs. From the opinion of Mr. Ong showed that each vaccination have different function, using the suitable vaccination just can cure the layer. Different vaccinations have it own time to become effective and it becomes a challenge to Heap Soon Farming, so the farm must record all the time so that these can easily their future work. Each method has its own benefit, but from the opinion of researcher, bio security is very useful and suitable compare with other methods to the egg farm. Bio securities provide the egg farm a set of safe protection from outside until inside.

## 6.0 Conclusion

As a conclusion, this study had been carried out to identify the quality challenges in egg farming. Based on the findings, the major factors that affect egg quality are the disease. It is different with the factors that had been state in the literature review. Vaccination, daily layer health check and enzyme had been suggested by Heap Soon Farming to solve the egg quality problem. Thus, the actual farming practice is quite different with the theoretical literature. The idea and opinion that provided by Heap Soon Farming is very useful and wishing it can help others layer farms to improve their egg quality in future. Beside this, there are still many rooms for researcher to improve and do better for future research.

## REFERENCES

- Ahmadi, F., & Rahimi, F. (2011). Factors Affecting Quality and Quantity of Egg Production in Laying Hens: A Review. *World Applied Sciences Journal* 12 (3): 372-384.
- Al-Saffar, A., A. Al-Nasser, Al-Haddad, A., Al-Bahouh, M., & Mashaly, M. (2006). *Principles of poultry biosecurity program*. Kuwait: Kuwait Institute for Scientific Research.
- Arshad, F. M., Abdullah, N. M. R., Kaur, B., & Abdullah, A. M. (2007). 50 years Malaysian agriculture transformational issues, challenges and direction Retrieved 28 March, 2013, from [http://www.econ.upm.edu.my/~fatimah/Chapter%204%20-%20Marketing%20of%20Poultry%20in%20Malaysia\\_Structural%20Issues%20and%20Challenges.pdf](http://www.econ.upm.edu.my/~fatimah/Chapter%204%20-%20Marketing%20of%20Poultry%20in%20Malaysia_Structural%20Issues%20and%20Challenges.pdf)
- Baruah, B. K. (2013). Agribusiness management, its meaning, nature and scope, types of management tasks and responsibilities. Retrieved 28 March, 2013, from <http://assamagribusiness.nic.in/agriclinics/agribusiness%20management.pdf>
- Chukwuka, O. K., Okoli, I. C., Okeudo, N. J., Udedibie, A. B. I., Ogbuwu, I. P., Aladi, N. O., . . . Omede, A. A. (2011 ). Egg quality defects in poultry management and food safety. *Asian Journal of Agricultural Research*, 201. doi: 10.3923.
- Cordin, G., & Robert, C. (2009). egg production and egg quality conversation Retrieved 28 March, 2013, from [http://protmed.uoradea.ro/facultate/anale/ecotox\\_zooteh\\_ind\\_alim/2009/zoot/51%20Gavru%20Codrin.pdf](http://protmed.uoradea.ro/facultate/anale/ecotox_zooteh_ind_alim/2009/zoot/51%20Gavru%20Codrin.pdf)
- Department of statistic, Malaysia. (2012). Selected agricultural indicators 2012 report. Retrieved 28 March, 2013, from [http://www.statistics.gov.my/portal/download\\_Agriculture/files/Selected\\_Agricultural\\_Indicators\\_Malaysia\\_2012.pdf](http://www.statistics.gov.my/portal/download_Agriculture/files/Selected_Agricultural_Indicators_Malaysia_2012.pdf)
- Hamra, C. F. (2010). An Assessment of the Potential Profitability of Poultry Farms: A Broiler Farm Feasibility Case Study Retrieved 28 March 2013, from <http://www.utm.edu/departments/msanr/pdf/Hamra%20Research%20Project%20Final.pdf>
- Jin, Y. H., Lee, K. T., Lee, W. I., & Han, Y. K. (2011). Effects of storage temperature and time on the quality of eggs from laying hens at peak production. *Asian – Aust. J. Anim. Sci*, Vol. 24, No. 2: 279 – 284.
- Lee, J. S. (1967). Understanding the agribusiness concept Retrieved 24 March, 2013, from <http://www.eric.ed.gov/PDFS/ED130111.pdf>
- Raghavan, V., & Chandran, T. (2002). Problem encountered in Malaysian egg production and quality. *WORLD POULTRY - Elsevier Volume 18, No 6. '02*.

- Ramos, L. (2011). Important and advantages of poultry farming and what people can get from it Retrieved 28 March, 2013, from <http://ezinearticles.com/?Importance-and-Advantages-of-Poultry-Farming-and-What-People-Can-Gain-From-It&id=6594067>
- Roberts, J. R. (2003 ). Egg quality guidelines for the Australian egg industry Retrieved 28 March, 2013, from <http://sydney.edu.au/vetscience/apss/documents/2003/APSS2003-roberts-pp91-94.pdf>
- Seidman, I. (2006). *Interviewing as Qualitative Research* (third ed.). Teachers College, Columbia University New York and London: Teachers College Press, 1234 Amsterdam Avenue, New York, NY 10027.
- Wong, H. K. (2010). Manipulation of nutrient composition in poultry Retrieved 28 March, 2013, from [http://www.mardi.gov.my/c/document\\_library/get\\_file?uuid=f55c58d7-f8dc-4b31-8f3c-93dcef7fca5d&groupId=10138](http://www.mardi.gov.my/c/document_library/get_file?uuid=f55c58d7-f8dc-4b31-8f3c-93dcef7fca5d&groupId=10138)
- Xin, H., Gates, R. S., Green, A. R., Mitloehner, F. M., Jr., P. A. M., & Wathes, C. M. (2011). Environmental impacts and sustainability of egg production systems *Poultry Science* 90 :263–27. doi: 10.3382.