

Cost Effectiveness of Egg Powder Production from Indigenous Chicken

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ABSTRACT The study used a household survey research design to evaluate the cost effectiveness of producing egg powder in Mkhambathini. The study findings show that the majority of respondent households were: engaged in production of indigenous chickens; owned indigenous chickens, especially resource-poor rural communities due to the low input requirements; women were responsible for their rearing and management of the chicken and willing to learn more about egg powder; practicing indigenous egg storage methods. Diseases and predation were the main challenges to effective production of the eggs. The study recommends training of rural chicken farmers, especially women, on flock management for effective egg production. The production of egg powder using locally available eggs was beneficial since suppliers are located far from rural areas thereby minimising transportation cost. Rural communities could integrate indigenous drying technology (sun-drying) with modern food safety techniques to preserve eggs for improved food security.

INTRODUCTION

The practice of keeping indigenous chicken for egg production and preservation have been used for centuries across cultures for sustainable food security. Different indigenous egg preservation techniques have been used including sun drying and pickling. Rural households in developing countries are faced with various challenges associated with keeping indigenous chickens for egg production (Aklilu et al. 2008). Indigenous chickens in rural communities are maintained under scavenging regimes with minimal households providing supplementary feed and vaccination (Mtleni et al. 2009). The limitation of feed resources is a problem which affects egg production (Leta and Bekana 2010). Supplementary feeding is essential because it promotes health of eggs and chickens leading to increased flock size, high growth and fertility rates and chickens being less prone to diseases (Mapiye et al. 2008). Although indigenous chickens are well adapted to harsh environmental conditions, the mortality of chickens is most common during hot-wet and hot-dry seasons because chickens are more prone to diseases in such seasons (Yemane et al. 2013). Poultry diseases are a major threat to egg production (Elders and Pym 2009). In South Africa, KwaZulu-Natal province, the failure to vaccinate chickens against poultry

diseases is a major challenge for rural households (Tarwiyeri and Fanadzo 2010).

Housing structures are essential because they provide shelter to chickens for egg laying and protect chickens from predators (Dinka et al. 2008). Rural households in KwaZulu-Natal province have been reported to lack appropriate housing structures for their chickens, only thirty-four percent of the households had poultry housing resulting to loss of egg laying chickens and eggs through predation (Tarwiyeri and Fanadzo 2010) Although rural households might produce eggs and be willing to market their eggs, transport becomes an infrastructural constraint which hinders market access for selling egg products (Mapiye et al. 2008). In South Africa, rural households are faced with the geographical burden of being located in remote areas where roads are poorly developed (Thamaga-Chitja and Morojele 2014). Hence the failure of households to secure markets results in produce loss through spoilage.

Such challenges result in decreased egg yields for sale and household consumption. Therefore, households resort to purchasing eggs instead of producing them (Mnyandu 2013). Still, the issue of market access becomes a dominant challenge in such a situation due to inadequate roads and increasing egg and transportation costs which reduce the economic power of

households to purchase eggs. The distance from markets exacerbates the risk of eggs from breaking and affecting the quality of eggs. At a household level, most of the rural households have no or limited access to electricity, thus, cooling storage systems such as refrigerators that could extend the shelf-life of eggs are not accessible to rural communities (Lehohla 2011). Eggs stored at room temperature results in egg spoilage hence storage facilities such as refrigerators are required to maintain egg quality. Egg storage time and temperature affects the quality of an egg, the changes that occur in a stored egg result in quality losses and nutritional value reduction (Olobatoke and Mulugeta 2012).

Rural households need to be trained on general flock management for effective egg production and to further adopt egg preservation technique which is cost-effective and capable of diversifying livelihood options. Rural households could adopt egg powder as an egg preservation strategy. Egg powder has successfully been used by the food industry as an alternative to fresh egg because it provides a convenient alternative to fresh eggs due to its nutritional and functional properties, increased shelf life, refrigeration not required for storage, easy transportation and handling and also its microbial safety (Rannou et al. 2013). Rural communities could integrate Indigenous Knowledge System (IKS) drying technology (sun-drying) with modern food safety techniques to preserve eggs for their improved food availability, accessibility and quality stability. The proven possibility of making egg powder using the sun drying method at a household level calls for appropriate education and training on egg powder production for rural households (Mnyandu 2013).

The objectives of the study were to:

1. To assess egg production in rural households of Mkhambathini
2. To evaluate the cost effectiveness of producing egg powder at a household level
3. To determine the perceived benefits of producing egg powder at a household level

METHODOLOGY

The study was conducted in Mkhambathini local municipality, KwaZulu-Natal, South Africa. The criteria for including households in the study were that they were engaged in egg production and were willing to participate in the

study. Key informants were used to identify the households engaged in chicken rearing. A total of 110 household representatives participated in the survey to explore egg production patterns and challenges. From the survey participants a purposeful quota sample of 20 adult women and 20 youths (16 to 35 years old) participated in a series of four focus group discussions (FDGs) to assess the perceived benefits of producing egg powder at a household level. A market research using commercial food websites was conducted to determine the physical and economic access to egg powder for rural households.

The questionnaire had 20 questions which enquired about demographic data, egg production patterns and challenges. A questionnaire written in isiZulu was administered to 110 respondents. A series of four focus group discussions were conducted in the study area to determine the perceived egg production challenges and benefits of producing egg powder at a household level by rural households of Mkhambathini. The focus group discussions were conducted following a focus group discussion guide and were facilitated by field workers fluent in isiZulu. In order to obtain different perceptions from different age groups, the participants were divided into two demographic groups, youths and adult women. Each focus group discussion was made up of eight to twelve participants. A digital video camera was used to record the focus group discussion sessions. The recorded data was transcribed into text. The transcribed text, together with hand written notes were used to generate the main findings of the focus group discussions.

A market research was conducted to review the cost of egg powder in the commercial market. Commercial food websites were used to search for information using key words such as "cost" or "cost benefit analysis" and "egg powder". The cost effectiveness of egg powder in the commercial market was compared to producing egg powder at a household level for rural households in Mkhambathini.

The Statistical Package for Social Sciences (IBM SPSS), version 21, was used to analyze quantitative data and descriptive statistical analysis was performed. Focus group discussions were analyzed by linking themes, concepts, patterns and quotes which emerged from the discussions with the relevant literature.

RESULTS AND DISCUSSION

Respondent's Demographic and Socio-economic Characteristics (n=110)

The majority of respondents were female (88%), while twelve percent were male. The women (68%) owned indigenous chickens, men only account for twenty-one percent of ownership and children eleven percent. Although twenty-one percent and eleven percent of the men and children, respectively, owned indigenous chickens, only sixteen percent and seven percent of the men and children, respectively, were responsible for chicken management in their households. This leaves women predominantly responsible for chicken rearing and management. This is in line with literature indicating that indigenous chicken rearing and management are seen as a responsibility for women (Leta and Bekana 2010). The age of the respondents ranged from 16 to 65 years and the majority (46%) of respondents were in the 26 to 35 age range, whilst the minority (4%) of respondents were in the 56 to 65 age range. Data analysis showed that most of the respondents were literate. Only eight percent of the respondents had no formal education, whilst sixty-three percent of the respondents had received secondary school education. The majority of the respondents were either unemployed or had part-time employment. As a result, forty-three percent of the respondents received less than R800 per month, whilst six percent of the respondents had income above R3500 per month.

Egg Production in Rural Mkhambathini

Households in rural Mkhambathini were engaged in extensive production of free-range indigenous chickens; the flock size was generally not greater than 50 whereby seventy-eight percent of the households owned between one and ten indigenous chickens. This is in agreement with the fact that low input indigenous chicken production is very popular amongst resource-poor rural communities (Mapiye et al. 2008). A high proportion of the respondents indicated that in a year, a hen lays a maximum of four clutches of eggs while a very low proportion of the respondents indicated that only one clutch of eggs is produced by one hen throughout the year.

The observed clutching frequency of 4 clutches per hen in a year by rural households of Mkhambathini is similar to what was reported in southern Ethiopia. The majority of respondents in Southern Ethiopia indicated that they observed a clutching frequency of 4 clutches per hen in a year (Yemane et al. 2013). While in Ghana, a majority of households in observed a clutch number of 3 clutches per hen in a year (Hagan et al. 2013). The capability of a flock to effectively produce eggs or to reach the maximum clutching frequency of 4 clutches per hen in a year is strongly influenced by general flock management (Moges et al. 2010). In rural Mkhambathini, egg production was characterised by low input and output system and scavenging was a major feeding system. This justifies the reason why forty-six percent of the respondents never observed the maximum clutching frequency of 4 clutches of eggs per hen in a year.

Challenges Before and After Egg Production in Rural Mkhambathini

Diseases and Predation

Although eggs may be produced in rural Mkhambathini, focus group discussions revealed that chickens were lost through diseases and predation. Among the classes of chickens, chicks and hens were severely attacked by predators. As a result, seventy-eight percent of households had fewer than 11 chickens in their households, this hindered effective egg production. The findings indicate that there is a need for training rural households of Mkhambathini on general flock management; this will contribute to the effective production of eggs in the study area.

Lack of Egg Storage

A high proportion (59%) of households used egg storage methods which have been used in the past, from one generation to the next and only forty-one percent households had access to modern preservation technologies in rural Mkhambathini. Thirty-nine percent of the households stored eggs in grass woven baskets and twenty percent stored them in boxes with the inside covered with grass. Similar egg storage challenges have been reported in rural areas of other African countries, about 57.1 percent of

rural households in Ethiopia stored eggs on nests, 18.5 percent in baskets and 5.6 percent in iron dishes (Molla 2010).

Due to poor egg storage methods, eggs do not last long in storage in rural Mkhambathini. Upto eighty-four percent of the respondents in this study reported that eggs did not maintain their quality after more than two weeks of storage. The findings indicate that Indigenous Knowledge System (IKS) of egg preservation was not effective in the study area, therefore, there is need for an egg preservation technique in rural Mkhambathini. Household in rural Mkhambathini could adopt egg powder as an egg preservation strategy since it has been successfully used by the food industry as an alternative to fresh egg because of its nutritional and functional properties, increased shelf life and refrigeration not required for storage, easy transportation and handling and also its microbial safety.

The Cost Effectiveness Analysis of Egg Powder

The different pricing of egg powder by different suppliers is shown in Table 1. The findings show that generally egg powder is targeted to benefit urban dwellers and it seems to be expensive for poor resourced communities. For instance, in South Africa, a 500g of egg powder (40 eggs) cost R58.50. However, the same amount can purchase 60 fresh eggs from most South African supermarkets. Although fresh eggs are the cheapest in the market compared to egg powder, the benefits are very minimal. There is limited use of locally produced fresh eggs in rural areas of KwaZulu-Natal due to lack of storage facilities, thus, households are forced to

purchase eggs form markets, however, freshness, storage facilities and transportation still compromises the quality and fragility of eggs (Mnyandu 2013).

This indicates that rural households in Mkhambathini could benefit more if they could produce their own egg powder using locally available eggs since egg powder suppliers are located far from rural areas of Mkhambathini. Therefore, it appears to be cost effective for rural households in Mkhambathini to produce their own egg powder at a household level. In a month, twelve percent of the households purchased 60 eggs at R65 and seventy-nine percent of the households bought 30 eggs at R32 from formal markets. This could be attributed to the fact that eggs were regarded as expensive by rural households of Mkhambathini. This suggests that rural households in Mkhambathini are in need of a cost effective intervention which will enhance the consumption of eggs as a source of protein.

Analysis of Profitability of Egg Powder Entrepreneurship at Rural Household Level

Unprocessed eggs:

(i) Formal market price = R32 for 30 eggs

(ii) Informal market price = R20 for 30 eggs

(i) Price of 500 g of egg powder processed from 40 eggs = R58

(ii) Estimated price of egg powder processed from 30 eggs = $(30/40) \times R58 = R43.50$

Therefore:

(i) Gross profit from egg powder processed from 30 eggs obtained from formal market eggs = $(2) (ii) - (1)(i) = R43.50 - R32.00 = \mathbf{R11.50}$

Table 1: The pricing of egg powder by different suppliers

Supplier	Place	Size (g/kg)	Cost (ZAR/US\$)	Target market
Sun spray food ingredients ¹	South Africa	500g/ 0.5kg	R58.50/\$5.15	Restaurants, hospitals, boarding schools and online shoppers
Honeyville farms ²	USA	1020g/ 1kg	R218.98/\$19.29	Online shoppers and Urban dwellers
Emergency essentials ³	USA	1133.98g/ 1.13kg	R249.18/\$ 21.95	Online shoppers and urban dwellers
Augason farms ⁴	San Francisco Peninsula	935g/ 0.935kg	R238.16/\$20.98	Online shoppers and urban dwellers

¹ <http://www.sunspray.co.za/products-egg.htm>

² <http://shop.honeyville.com/powdered-whole-eggs.html>

³ <http://beprepared.com/provident-pantry-dehydrated-whole-egg-powder-40-oz.html>

⁴ <http://www.walmart.com/ip/Augason-farms-Emergency-Food-Whole-Eggs-Dried-egg-product-33-0z/2177161>

(ii) Gross profit from egg powder processed from 30 obtained from informal market eggs

$$= (2) \text{ (ii)} - (1) \text{ (ii)} = R43.50 - R20.00 = \mathbf{R23.50}$$

From the above analysis, it can be seen that rural entrepreneurship in egg powder could be profitable. The eggs from the informal market are produced at rural household level and are much cheaper, they cost R20 for 30 eggs compared to R32 for 30 eggs from the formal market. Alternatively, the egg powder processor could obtain the eggs from own household production, which would further increase the profit. Therefore there is a potential to increase the utilisation of eggs produced at rural household level through local egg powder entrepreneurship. The households would earn cash income from either the sale of eggs or egg powder or both. The increased utilisation of eggs and value added entrepreneurship (egg powder business) would increase demand for local eggs and thereby improving rural household livelihoods. Households in the study area could produce egg powder using locally available resources at zero cost (Table 2).

Producing egg powder at a household level can only be possible provided that village chickens are fed a nutritious diet, vaccinated against diseases, provided with shelter to minimise egg-laying chicken loss through predation and women are trained on egg powder production. The production of egg powder at a household level could contribute to the frequent consumption of egg-based food products since egg powder has capacity to ensure the availability of eggs at

all time. This could particularly contribute to the alleviation of Protein-Energy Malnutrition. The cost and benefit of producing egg powder at a household level versus purchasing egg powder from commercial markets and purchasing eggs from commercial markets to make egg powder is shown in Table 3.

Table 3 shows that producing egg powder at a household level and purchasing egg powder from commercial markets both have the benefit of ensuring the availability of a protein rich food product with increased shelf-life. However, by producing egg powder at a household level, rural households could minimise transportation cost. This could also diversify their livelihood options through entrepreneurship opportunities while ensuring food and nutrition security at a household level. However, purchasing egg powder from commercial markets will not open up any livelihood opportunities and households will be required to pay for transport cost and egg powder cost which is yet to increase due to price inflation. Although producing egg powder at a household level comes with the labour cost of flock management for effective egg production and producing egg powder, the inputs will be very minimal since rural households in Mkhambathini can utilise locally available resources.

The Willingness to Produce Egg Powder at a Household Level by Rural Households of Mkhambathini

None of the respondents in rural Mkhambathini were familiar or had knowledge of egg

Table 2: Locally available resources in rural Mkhambathini

<i>Item</i>	<i>Description</i>
<i>Egg-laying Chickens</i>	Households in rural Mkhambathini are actively involved in extensive production of free-range indigenous chickens.
<i>Feeds and Feeding</i>	Chickens in rural Mkhambathini scavenge for their own feed and are provided with water and kitchen left overs as supplementary feeding.
<i>Housing</i>	Currently there are no chicken housing structures in rural Mkhambathini. However, locally available material can be used to construct shelter for the chickens (Ahlers 2009).
<i>Vaccines</i>	Households mainly rely on indigenous knowledge systems to treat poultry diseases. This can be integrated with modern veterinary services to prevent poultry diseases (Ahlers 2009).
<i>Preservation Techniques</i>	Currently there are limited skills in egg preservation in rural Mkhambathini. Modern food safety techniques integrated with IKS-based sun drying method which is an indigenous method can be used to process eggs into powder; this method of preserving food has been practised in rural areas for many generations (Sagar and Suresh-Kumar 2010). It has been used successfully to dry meat, fish, vegetables, corn and fruits in most African countries.
<i>Women</i>	68% of women in Mkhambathini are actively involved in chicken production and management, they could be trained on egg powder production to improve their livelihood options as they are one of the vulnerable groups in rural communities.

Table 3: The cost and benefit of producing egg powder at a household level compared to purchasing egg powder from commercial markets and purchasing eggs from commercial markets to make egg powder

	<i>Benefits</i>	<i>Costs</i>
A. <i>Producing Egg Powder at Household Level</i>	<i>Tangible Benefit</i>	<i>Tangible Cost</i>
	- Availability of protein rich food product	- Labour
	- Reduced transport cost	- Flock management
	<i>Intangible Benefit</i>	- Producing egg powder
	- Improved shelf-life of eggs	
	- Livelihood opportunities	
	- Improved food and nutrition security	
B. <i>Purchasing Egg Powder from Commercial Markets</i>	<i>Tangible Benefit</i>	<i>Tangible Cost</i>
	- Availability of protein rich food product	- Transport cost
	- Improved shelf-life of eggs	- Egg powder cost
	<i>Intangible Benefit</i>	- Food price increase
		<i>Intangible Cost</i>
		- No livelihood opportunities
C. <i>Purchasing Eggs from Formal Markets for Producing Egg Powder at Household Level</i>	<i>Tangible Benefit</i>	<i>Tangible Cost</i>
	- Availability of eggs to produce egg powder	- Transport cost
		- Cost of eggs
		- Egg quantity
		- Food price increase
		- Producing egg powder
	<i>Intangible Cost</i>	- Egg quality and fragility

Tangible= quantifiable

Intangible = not quantifiable

powder. However, focus group discussions revealed that respondents were willing to learn more about egg powder in relation to producing it at a household level. The production of egg powder at a household level was associated with socio-economic benefits by rural households of Mkhambathini. These findings are summarized in Table 4.

The households in rural Mkhambathini have indicated that producing egg powder at a household level could create job opportunities for the unemployed and also ensure egg safety and the availability of a protein rich food product at all times. The perceived benefits of producing egg powder at a household level by rural households of Mkhambathini highlights the opportunity to

introduce egg powder as an egg preservation technique in rural Mkhambathini. There are a limited number of egg powder producers in South Africa; this indicates a market opportunity for rural households in the line of producing eggs and selling them to potential egg powder producers or processing their own egg powder using the eggs they produce.

CONCLUSION

The study findings show that rural households in Mkhambathini were engaged in extensive production of free-range indigenous chickens. Poultry diseases and predation were identi-

Table 4: The perceived benefits of producing egg powder at a household level by rural households of Mkhambathini

<i>Question</i>	<i>Theme</i>	<i>Quotes</i>
<i>How Could You Benefit from Producing Your Own Egg Powder?</i>	Employment	"learning how to produce egg powder could create jobs for the unemployed" "we can make and sell egg powder to get money"
	Protein source	"we can consume the egg powder we make and save money because we won't have to purchase eggs from markets"
	Quality, food safety and storage challenges	"we won't have to worry about buying rotten eggs from the market and egg spoilage during storage"

fied as the major challenges which hindered the effective production of eggs in the study area. The majority of respondents who owned indigenous chickens were responsible for rearing and management of the chickens. Indigenous chicken production is very popular amongst resource-poor rural communities due to the low input requirements. Local chicken farmers used indigenous egg storage methods such as grass woven baskets stored in boxes with the inside covered with grass. Respondents were willing to learn more about egg powder in relation to producing it at a household level.

RECOMMENDATIONS

The study recommends for training of rural chicken farmers, especially women, on general flock management to contribute to effective egg production. Rural households could benefit more if they produced their own egg powder using locally available eggs since egg powder suppliers are located far from rural areas thereby minimising transportation cost. This could also diversify their livelihood options through entrepreneurship opportunities while ensuring food and nutrition security at a household level. The study identified that producing egg powder at household level can only be possible provided that indigenous chickens are fed with a nutritious diet, vaccinated against diseases and provided with shelter to minimise egg-laying chicken loss through predation.

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