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THE HEALTH AND ECONOMIC DIMENSIONS OF HONEY PRODUCTION IN IMO STATE, NIGERIA

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ABSTRACT: A study was conducted on honey production in Imo state of Nigeria, with a focus on the health and economic dimensions of the industry. The research was carried out using a multi-stage sampling procedure, and a sample size of 80 honey-producer respondents was selected. Data was collected through a well-structured questionnaire and analyzed using descriptive and inferential statistics. The study found that honey producers in the area had a mean age of 51 years, 11 years of education, 21 years of farming/bee-keeping experience, and a household size of 6 persons. The average annual household income was €709.10, with a farm size/number of hives kept of 72 hives per farmer and a quantity of honey produced per annum of 145 litres. The cost and returns analysis showed that the cost of production of honey per litre and profit per litre were €0.40 and €2.40, respectively. The study also determined the nutritional uses and health benefits of honey (e.g. healing wounds, treating ulcers, controlling sore throats and colds, boosting immunity, and as an antibacterial agent). Several factors, including uncontrolled bush burning, bee forage shortage, deforestation, theft of beehives, colony absconding, and poor agricultural practices which strongly constrain honey production has been observed. It is concluded that honey production is a very profitable venture with numerous uses and health benefits and venturing youths into honey production as a source of livelihood should be encouraged, and extension education should be tailored to technologies in beekeeping and the identification of genuine honey to minimize the success of adulteration, among others.

Keywords: Economic, Forage shortage, beekeeping, Honey, Health Benefits, Natural products

INTRODUCTION

Based on available studies, Obianefo et al. (2019) and FAO (2021) highlighted that the agricultural sector is the largest employer in Nigeria, engaging over 70% of the population, with honey production being a significant contributor to agricultural gross domestic product (GDP) and employment. However, the share of agriculture in Nigeria's GDP has been on a decline, from about 90% before independence to around 22.35% in early 2021 (CBN, 2014). Given this concerning trend, there is a need to explore underutilized agricultural sectors like beekeeping (Muktar, 2018).

Beekeeping offers low land requirements, cost-effectiveness, and substantial economic benefits as it promotes crop pollination while creating job opportunities in both rural and urban areas (Ogunola et al., 2019; Degrandi-Hoffman et al., 2019). Nigeria's honey production is currently at only 15,000 tons annually, well below its potential (Ayodele, 2017). Smallholder farmers dominate this sector, but despite the favorable conditions for honey production, the industry largely remains untapped and outdated in its methods. Nevertheless, rising interest and investment in the sector suggest a growth potential.

Honey's therapeutic properties extend to wound healing and other health conditions, boasting numerous benefits such as antioxidant, antimicrobial, and anti-inflammatory effects (Samarghandian et al., 2017; Medhi et al., 2008). Moreover, honey is a healthier alternative to refined sugars, being lower on the glycemic index (Babacan and Rand, 2007; Pataca et al., 2007). However, despite its profitability, with returns of €0.50 per litre of honey (Babatunde et al., 2008) and an average net income for beekeepers, production levels remain insufficient to meet domestic demand, leading to significant imports (Muktar, 2018).

Issues of honey adulteration further complicate the market, as adulterants like starch and inverted syrup are commonly used to increase profits (Aliaño-González et al., 2020; Arroyo-Manzanares et al., 2019). While recent techniques have been developed for quality control, knowledge gaps about the economics and health benefits of honey production in Imo State persist. This study aims to address these gaps by exploring farmers' perceptions of honey's health benefits, assessing the economic returns for beekeepers, and addressing the challenges faced in production.

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MATERIALS AND METHODS

The study was conducted in Imo State, which is divided into three agricultural zones: Owerri, Orlu, and Okigwe. The state lies within latitude 4°45'N and 7°15'N and latitude 6°50'E and 7°25'E. The state is bounded in the east by Abia state, in the west by River Niger and Delta state, in the north by Anambara state, while Rivers state lies in the south. Imo state covers an area of about 5,100sq/km and a population of 3,934,899 (National Population Commission, (NPC, 2006). Rainfall distribution is bimodal with peaks in July and September and a two-week break in August. The rainy season begins in March and lasts till November. The high temperature and humidity experienced in the state favour the luxuriant vegetation of tropical rainforests. This also favors honey production as there is an abundant supply of nectar from flowers for their consumption.

Multi-stage sampling procedure was used in sampling. Stage one involved random selection of Owerri agriculture from the three zones because the state has the same type of vegetation all over the zones Owerri zone has eleven LGAs. Stage two involved a purposive selection of two Local Government Areas, Aboh Mbaise and Ahiazu Mbaise based on their intense honey production activities as reported by extension agents in Imo State, Agricultural Development Programs (ADP). Stage three involved random selection of five Communities each from the 2 selected LGAs giving (10) Communities. Thereafter two villages were selected randomly from each of 10 communities selected in stage three above, giving 20 villages for the study. Finally, in stage 4, four households that engage in honey production were selected purposively from each of the 20 villages giving 80 respondents.

Data for the study were gathered through a well-structured questionnaire administered to primary data sources. Data collected included those on the farmers' socio-economic characteristics, the nutritional/health benefit of honey as food to farmers, the cost and revenue components of honey production and the real and perceived uses of honey in the study area amongst others. Data were analyzed using descriptive and inferential statistics and net return model as appropriate The Likert type measurement scale was used extensively in this study because it has the feature of transforming a respondent's subjectivity into an objective reality. The net return model specified below was used to determine the net return accruing to honey producers.

NI = TR – TC ... eqn (I)

TC = Total Variable Cost + Total Fixed Cost ...equ (II)

NI = TR – (TVC + TFC) ...eqn (III)

Where; NI= Net income/Return, TR= Total Revenue, TC = Total Cost

RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

Table 1 displays how the respondents are distributed based on their socioeconomic characteristics. The results show that the mean age of honey producers is 51 years. This implies that the respondents are mature men who are at the prime and productive time of their lives. They are expected to have gotten reasonable experience in honey production given their ages. This finding agrees with that of Ogunola, et al. (2019) who found that most honey producers in their study area are between the ages of 41-50 years and are able-bodied men strong enough to produce effectively and efficiently. The mean number of years spent in formal education is 11 years. This implies that the respondents are mostly literate farmers having acquired secondary education and therefore can read and write. This standard of education implies that the crop of beekeepers can learn and be in a position to adopt modern technologies involved in honey production. They should also be produced efficiently and in large quantities. This finding is in tandem with that of Bifarin et al. (2008) who found that the majority (100%) of the honey producers were literate and married while 98% of them were males. The mean level of experience is 21 years. This of course shows that respondents have very good knowledge of honey production and should be producing efficiently. They are also in the best position to know the best methods of keeping bees and harvesting honey. However, this finding does not agree with Oluwaseyi, (2019) who opined that most honey producers in Kwara state had experience of between 6-10 years only and made use of modern bee-keeping technology.

The average household size in the area is six persons, which conforms to the international standard of one man, one woman, and four children. This finding agreed with the United Nations Database of Household Size and Composition (2017) which revealed that the household size within Europe and Northern America is fewer than three persons whereas in Africa and the Middle East, the average household size is five or more persons. The mean annual household income is €709.10. This implies that the per capita household annual income is €118.18 and daily income of €0.32 which is below one dollar per day at the current exchange rate of about €0.43/dollar (Degrandi-Hoffman et al, 2019). It also implies that the farmers in the study area belong to the poverty-ridden class who survive on less than one dollar per day. However, following the new international poverty line as set (Wakagri and Yigezu, 2021) at $2.15 using 2017 prices, people who survive on less than $2.15 a day are living in extreme poverty. About 648 million people globally were in this situation in 2019. Farmers in this area are living in more than extreme poverty and require special intervention to escape from the poverty level where they are.

Table 1 - Socioeconomic characteristics

Socioeconomic variable	Mean
Age	51 years
Household size	6 persons
Farming experience	21 years
Level of education	11 years
Annual household income	€709.10
Farm size	72 hives
Quantity of honey produced	145 litres/annum
Sex	100% male

Source: Field survey data, 2023

Nutritional and health usefulness of honey

Table 2 shows the nutritional and health benefits of honey as perceived by respondents in the study area. According to Table 2, out of the 13 factors a priori expected and perceived to be among the nutritional and health usefulness of honey, only 11 are significant given the five points Likert scale measurement system where those whose mean is greater or equal to (Mean ≥ 3.0) are adjudged to be significant. The above result reveals that honey is used to improve the taste of food with a mean of 4.8, in confectionaries with a mean of 4.49, in cosmetics with a mean of 4.49, controlling cough 4.42, and in traditional medicines 4.13. Other important uses and health usefulness of honey include in facilitation of healing wounds, treatment of ulcers, control of sore throats, and colds, as an immune booster, and as an antibacterial agent. The other expected healthy benefits of honey as shown in Table 3.2 may not have been significant amongst the respondents due to ignorance of their uses in the activities or conditions by the respondents in the study area. These findings are in tandem with the observations of Samarghandian et al. (2017) who said that traditionally, honey has been used in the treatment of various health conditions such as eye. diseases, bronchial asthma, throat infections, tuberculosis, thirst, hiccups, fatigue, dizziness, hepatitis, constipation, worm infestation, piles, eczema, and for healing ulcers and wounds. It is also used as a nutritious supplement. Moreover, honey is known to have ingredients that exhibit antioxidant, antimicrobial, anti-inflammatory, antiproliferative, anticancer, and antimetastatic effects. Also, Medhi et al. (2008) and Kumari and Nishteswar (2012) found that honey accelerates the healing of wounds; this agreed with the finding of this study with a mean value of 3.67.

Net returns from honey production

Table 3 shows the cost and return analysis of honey production in the study area. According to Table 3, the total cost of producing one litre of honey in the study area is €0.40. On the other hand, the profit or net return per litre of honey sold is €2.40. This indicates that honey production is a highly profitable business. This finding is consistent with the research conducted by Babatunde et al. (2008), which suggests that honey production is a lucrative venture. The study found that beekeepers produced an average of 313 litres of honey per annum and earned a gross income of €0.50 per litre.

Qualities and mode of identification of original/Genuine honey

Table 4 shows the perception of respondents on the qualities and mode of identification of genuine honey. The study found that all the factors except crystallization are significant in determining the authenticity of honey. Among the identified factors, the viscosity of honey is the most significant, followed by the thumb test, heat/matchstick test, water test and vinegar test. Other tests like infrared-based spectroscopy, Raman spectroscopy, Nuclear magnetic resonance spectroscopy and Isotope ratio mass spectrometer are also significant. Still, most of the respondents showed poor knowledge of their applicability. A study by Khalil et al. (2015) found that honey is rich in antioxidants, flavonoids, phenolic acids, organic acids, amino acids and proteins. These antioxidants have several preventative effects against various diseases, making honey a popular source of antioxidants. Additionally, honey has healing effects and antibacterial properties, making it useful in treating ulcers and wounds. Honey also has a hygroscopic feature that allows it to absorb moisture when exposed to air, which is a useful quality test. The study also revealed that the respondents were aware of the healing effects of honey and its antibacterial properties, as well as its hygroscopic feature. However, they showed ignorance of the applicability of other factors like the antioxidant feature and the vinegar test. Studies like Chen et al. (2011), Özbalci et al. (2013), Ribeiro et al. (2014), and Salvador et al. (2019), and have used various spectroscopy techniques to identify the components present in honey and detect adulteration.

Constraints to commercial production of honey in the study area

Table 5 shows the constraints to large-scale/commercial honey production in the study area. The results indicated that uncontrolled bush burning, shortage of bee forage, and deforestation were the most significant challenges to honey production in the study area. Other obstacles like theft of beehives, colony absconding and poor agricultural practices were also found to have a strong impact on honey production. Moreover, drought, extreme temperatures, pests and diseases, and relative humidity were also observed to affect honey production in the study area. These findings are consistent with those of Wakagri and Yigezu's (2021) review paper, where they identified that extreme temperatures, relative humidity, drought, deforestation, poor apicultural practices, unsafe pesticide utilization, and pests were among the factors that limit honey production.

Table 2 - Nutritional and health benefits of honey as perceived by respondents in the study area

Perceived nutritional/health usefulness of honey	SA		A		UND		D		SD		Mean	Rank
	F	%	F	%	F	%	F	%	F	%		
Improve Taste of food	65.00	81.00	14.00	18.00	1.00	1.00	0.00	0.00	0.00	0.00	4.80	1st*
Healing of wound	40.00	50.00	20.00	25.00	10.00	12.50	5.00	6.25	5.00	6.25	3.67	5th*
Control cough	50.00	62.50	20.00	25.00	5.00	6.25	3.00	3.80	2.00	2.50	4.42	3rd*
Treating of ulcer	20.00	25.00	20.00	25.00	30.00	37.30	5.00	6.25	5.00	6.50	3.56	6th*
Control cold	15.00	18.80	20.00	25.00	30.00	37.30	12.00	15.00	3.00	3.80	3.40	8th*
Control Hypertension	15.00	18.80	10.00	12.50	20.00	25.00	29.00	36.30	6.00	7.50	2.99	10th
Control burn	5.00	6.25	10.00	12.50	30.00	37.30	20.00	25.00	15.00	18.80	2.62	12th
Control of sores throat	18.00	22.50	10.00	12.50	40.00	50.00	10.00	12.50	2.00	2.50	3.40	8th*
Immune booster	30.00	37.50	10.00	12.50	20.00	25.00	5.00	5.25	15.00	18.80	3.44	7th*
Use in Confectionaries	50.00	62.50	25.00	31.30	1.00	1.25	2.00	2.50	2.00	2.50	4.49	2nd*
Beer making	5.00	6.25	10.00	12.50	35.00	43.80	25.00	31.30	5.00	6.50	2.81	11th
Tobacco making	5.00	6.25	10.00	12.50	40.00	50.00	15.00	18.80	10.00	12.50	2.81	11th
Traditional medicine/herb mixture	40.00	50.00	15.00	18.80	20.00	25.00	5.00	6.25	0.00	0.00	4.13	4th*
Cosmetics/cream/soap	50.00	62.50	20.00	25.00	9.00	11.30	1.00	1.25	0.00	0.00	4.49	2nd*
Antioxidant qualities	1.00	1.25	5.00	6.25	50.00	52.50	20.00	25.00	4.00	5.00	2.06	13th
Antibacterial agent	20.00	25.00	10.00	12.50	25.00	31.30	20.00	25.00	5.00	5.25	3.25	9th*

*Source: Field survey data, 2023 SA = Strongly Agreed, A = Agreed, UND = Undecided, D = Disagreed, SD = Strongly disagreed. Mean value ≥ 3.0, Significant Rank depicts the position of significant.

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Table 3 - Cost and return analysis of honey production in the study area.

Annual cost / Expenditure items		Annual benefit/Income items	
Variable costs		(F) Total output of honey	11,570 L
Packaging container	€1778.42		
Labour cost	€1287.23	(G) Average unit price of honey	€2.81/L
Transportation	€465.78		
Processing cost	€372.62	(H) Total revenue from honey (F*G)	€32480.07
Miscellaneous cost	€124.21		
(A) Total variable Cost (TVC)	€4028.25	(I) Mean revenue from honey	€406.00
Fixed cost components			
Depreciation of items	€547.64	(J) Net return (H - C)	€27825.14
Rent on Farm Office	€67.75		
Utilities	€11.29	(K) Mean net return (J/80)	€347.81
(B) Total fixed cost (TFC)	€626.68	(L) Net return/litre (J/F)	€2.40
(C) Total cost (A+B)	€4654.93		
(D) Mean cost of production	€58.19	Profit/litre	€2.40
(E) Quantity of honey produced	11,570 L		
Cost of Production/litre (TC/E)	€0.40/L		

Source: Field survey data, 2023. Variables in parentheses are the (A) Total Variable Cost, which is the cost incurred in the production processes of honey; (B) Total Fixed Cost, which is the combination of the cost of equipment, and other fixed inputs used in the production; (C) Total Cost, which is the sum of the total variable cost and total fixed cost; (D) Mean Cost of production, which is the average cost of production by the total sample size; (E) Quantity of honey produced, which is the volume of honey extracted from the numbers of hives kept; (F) Total Output of honey, which is the volume of honey extracted from the numbers of hives kept; (G) Average unit price of honey, which is the average price sold by the total respondents; (H) Total revenue from honey (Price × Quantity of honey produced); (I) Mean revenue from honey which is the average revenue earned by the respondents; (J) Net Return, which is the return earned after cost have been deducted; (K) Mean net return, which is the return earned after cost have been deducted from the individual respondents, and (L) Net Return per litre, which is the return earned from the sales of a litre of honey after the cost of producing a litre of honey is deducted.

Table 4 - Perception of respondents on qualities and identification of genuine honey

Qualities and identification of genuine honey	SA		A		UND		D		SD		Mean	Rank
	F	%	F	%	F	%	F	%	F	%		
Hygroscopic	10.00	12.50	20.00	25.00	20.00	25.00	20.00	25.00	10.00	12.50	3.00*	7th
Antibacterial/Healing	20.00	25.00	20.00	25.00	20.00	25.00	10.00	12.50	10.00	12.50	3.40*	4th
Antioxidant effects	10.00	12.50	10.00	12.50	50.00	62.50	5.00	6.25	5.00	6.25	3.20*	5th
Treating of ulcer	20.00	25.00	20.00	25.00	20.00	25.00	5.00	6.25	5.00	6.25	3.20*	5th
Use of infrared-based spectroscopy	5.00	6.25	10.00	12.50	60.00	75.00	2.00	2.50	3.00	3.75	3.20*	5th
Use of Raman spectroscopy	10.00	12.50	10.00	12.50	50.00	62.50	5.00	6.25	5.00	6.25	3.20*	5th
Nuclear magnetic Resonance Spectroscopy	5.00	6.25	5.00	6.25	65.00	81.30	4.00	5.00	1.00	1.25	3.10*	6th
Isotope Ratio Mass Spectrometry	5.00	6.25	10.00	12.50	60.00	75.00	3.00	3.75	2.00	2.50	3.20*	5th
Heat testing (Matchstick test)	30.00	37.50	20.00	25.00	20.00	25.00	5.00	6.50	5.00	6.50	3.80*	2nd
Water test	20.00	25.00	30.00	37.70	20.00	25.00	3.00	3.75	7.00	8.75	3.70*	3rd
Thumb test	25.30	1.25	25.00	31.25	20.00	25.00	6.00	7.50	4.00	5.00	3.80*	2nd
Vinegar test	10.00	12.50	5.00	6.50	50.00	62.50	10.00	12.50	5.00	6.50	3.10*	6th
Crystallization	10.00	12.50	30.00	37.50	20.00	25.00	10.00	12.50	10.00	12.50	2.70	8th
Viscosity	30.00	37.50	30.00	37.50	20.00	25.00	0.00	0.00	0.00	0.00	4.10*	1st

*Source: Field Survey Data, 2023; SA= Strongly Agreed, A= Agreed, UND= Undecided, D= Disagreed, SD= Strongly Disagreed. Mean value ≥ 3.0, Significant rank depicts the position of significant

Table 5 - Constraints to commercial honey production in the study area.

Constraints to commercial honey production	SA		A		UND		D		SD		Mean	Rank
	F	%	F	%	F	%	F	%	F	%		
Extreme temperatures	20.00	25.00	30.00	37.50	10.00	12.50	10.00	12.50	10.00	12.50	3.50	5th
Pest and diseases	20.00	25.00	20.00	25.00	20.00	25.00	10.00	12.50	10.00	12.50	3.40	6th
Relative humidity	10.00	12.50	20.00	25.00	40.00	50.00	5.00	6.25	5.00	6.25	3.30	7th
Drought	20.00	25.00	30.00	37.50	10.00	12.50	15.00	18.70	5.00	6.25	3.60	4th
Deforestation	30.00	37.50	40.00	50.00	5.00	6.25	2.00	2.50	3.00	3.75	4.20	1st
Poor agricultural practices	30.00	37.50	30.00	37.50	10.00	12.50	8.00	0.10	2.00	2.50	4.00	2nd
Colony absconding	30.00	37.50	30.00	37.50	10.00	12.50	10.00	12.50	0.00	0.00	4.00	2nd
Poor attitude to pesticide usage	20.00	25.00	30.00	37.50	20.00	25.00	5.00	6.25	5.00	6. 25	3.70	3rd
Shortage of bee forage	35.00	43.80	30.00	37.50	10.00	12.50	5.00	6.25	0.00	0.00	4.20	1st
Theft of beehives	30.00	37.50	30.00	37.50	15.00	18.70	3.00	3.75	2.00	2.50	4.00	2nd
Uncontrolled bush burning	30.00	37.50	40.00	50.00	5.00	6.25	3.00	3.75	2.00	2.50	4.20	1st

Source: Field Survey Data, 2023; SA = Strongly Agreed; A = Agreed; UND = Undecided; D = Disagreed; SD = Strongly Disagreed. Mean Value ≥ 3.0; Significant Rank depicts the position of significant factors @ ≥ 3.0.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, producing honey as a farm business can be very profitable, with a net return of €2.40 per litre of honey sold. Findings showed that by producing a litre of honey, the farmer made a profit of €0.10. This can improve the economic well-being of the farmers if done repeatedly. Honey is known to be a healthy food for humans and has many beneficial properties, such as being an antioxidant and antibacterial agent. It can also be used as a prophylactic substance in medicine. Honey is a better alternative to refined sugar, especially due to its low glycemic index value.

Based on the findings of the study, the following recommendations were made;

1. The government are required to encourage youths to engage in honey production as a profitable enterprise by providing soft loans specifically for honey production to interested farmers.

2. The study suggested adequate extension education on honey production, emphasizing the importance of honey as a healthy food and medicine. This will also bring about the teaching of better technologies for honey production, making it attractive to both the highly educated and others.

3. Extension education are encouraged to focus on the scientific methods of identifying genuine honey, as most of the farmers interviewed do not have an idea of the modern and scientific methods of identifying genuine honey.

4. Farmers are encouraged to be trained on appropriate farming practices to avoid destroying the eco-support systems that protect and preserve the lives of bees and other flora and fauna useful for honey production.

5. Controlled grazing and preservation of our forests, as well as adequate security in our fields, should be ensured to avoid observed theft and destruction suffered by farmers.

6. The government are suggested to provide poverty alleviation facilities such as health care and education in the area to reduce the level of poverty observed in the area.

DECLARATIONS

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Authors' contribution

I.U.O.Nwaiwu, F.A.Kadiri, M.N.Osuji, I.I.Ukoha, and K.H.Anyiam: Conceptualization, Methodology design, Models Design, Data Analysis, Section writing and proofreading.

U.G.Anyanwu, F.O.Nwosu, I.O.Oshaji, and E.U.Nwachukwu: Questionnaire design, data collection, section writing and grammar check.

O.C.Enoch, I.G.Isaiah, M.B.Bala, and A.C.Obasi: Data collection, Data sorting and data entering.

J.A.Madu, and E.I.Nnorom = Data coding, Data curation, Data Processing.

Ethical consideration

There is no direct contact with the bees, and the study is based on analytical findings.

Consent to publish

All the authors consented to publish the article.

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Competing interests

There is no existence of conflict of interest among the authors.

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