Jurnal Ilmu Pertanian Indonesia (JIPI), April 2025
(Indonesian Journal of Agricultural Sciences)
ISSN 0853-4217 EISSN 2443-3462

Vol. 30 (2): 346–352
http://journal.ipb.ac.id/index.php/JIPI
DOI: 10.18343/jipi.30.2.346

Feasibility of Vacuum Dryer Jet Air System in Powdered Honey Process

Anang Lastriyanto*, Khoiril Anam, La Choviya Hawa

(Received May 2024/Accepted January 2025)

ABSTRACT

Powdered honey represents a development from liquid honey to a powdered form. Product development is a critical component for businesses to be sustainable. Powdered honey processing is significant because it extends shelf life, facilitates transportation and storage, and makes it easier to utilize in a variety of food and beverage items. Furthermore, powdered honey can broaden market reach, provide value, and meet consumer desire for more practical and long-lasting products. Producers can use economic analysis to examine several components of their final product. By taking essential elements into account, business leaders can make better judgments about investments, machinery selection, and cost control to optimize earnings. The purpose of this study was to evaluate the economics of using vacuum drying equipment with a jet air system to produce powdered honey. The investigation was carried out at the Lastrindo Engineering Laboratory in Klojen, Malang, Indonesia. The results show that producing powdered honey with a vacuum drying machine and a jet air system has a positive NPV of IDR 640,134,063; a B/C Ratio of 1.22; and an IRR of 73.93%, making the investment plan for this machine economically viable. According to sensitivity analysis, increases in raw material prices and labor wages have a smaller impact than a loss in production, which has the greatest influence on the vacuum drying machine's profitability in powdered honey manufacturing.

Keywords: economic analysis, powdered honey, vacuum dryer

INTRODUCTION

Honey is widely used as a natural sweetener for medical purposes (Schramm *et al.* 2003) even for cosmetics. Honey powder is one of the innovations in honey processing (Cui *et al.* 2008) which aims to improve the ease of handling (Sathivel *et al.* 2013), storage, and application of honey (Ram 2011). Honey production in 2021 decreased by 89.3% to 51,338 L. In 2022 and 2023, production increased again to 189,780 and 283,438, respectively (BPS 2022). Honey consumption in Indonesia is around 40–60 g per person per yr, indicating the low consumption of honey in Indonesia compared to other countries such as the United States, France, Germany, Japan, and the United Kingdom which reaches 1,000 to 1,600 g per person per yr. The increase in productivity and the decrease in honey consumption drive the need for a solution to this situation.

Along with the low consumption of honey in Indonesia, one of the measures to boost the appeal of honey products is the development of powdered honey. However, turning honey into powdered honey has several issues, particularly about the drying temperature, which can degrade the quality and nutritional content of the honey. Drying is used to produce powdered honey. Honey nutrients, such as diastase enzymes (Raeymaekers and Assessment 2006), are destroyed at temperatures above 63°C (Turhan *et al*. 2008), making honey highly sensitive to inclusion in the processing process. Honey powder is typically produced using a spray drying machine (Suhag *et al*. 2021). The temperature ranged from 70 to 90°C (Samborska *et al*. 2019) could harm the quality and nutritional content of honey (Ghazali *et al*. 1994). A vacuum drying machine is one of the latest advancements in powder honey processing technologies. This technique works by eliminating the moisture content of the material under low pressure in an enclosed environment. The use of low pressure in the drying chamber lowers a material's boiling point, allowing the drying process to be carried out at low temperatures (Fahmi *et al*. 2014). Vacuum dryers are often used to dry high temperature-sensitive materials (Zain 2005). Vacuum drying permits the water in the material to evaporate at lower temperatures (water's boiling point less than 100°C) since the vacuum pressure is lower than air pressure. As a result, using vacuum drying equipment not only reduces damage caused by high temperatures, but also delivers benefits such as nutrient preservation, product damage prevention, shorter drying time, and improved product quality (Kutovoy *et al*. 2004).

Economic analysis is an important facet of running a business, particularly when using technology to handle agricultural products. The profitability of a business is determined by the difference between its production costs and revenue. Understanding the

Faculty of Agricultural Technology, Brawijaya University, Malang 65145, Indonesia
* Corresponding Author: Email: anangl@ub.ac.id

fundamental concepts and practices of food processing (Paembonan *et al*. 2020) can help predict expenses and boost business profitability (Hidayat 2023). In the absence of precise data, organizations may struggle to make educated judgments about cost efficiency and prospective profits due to a lack of detailed information on operating and energy expenses, as well as feasibility metrics such as net present value (NPV) and internal rate of return (IRR). Without precise data, business owners risk making inefficient investments or losing money. With this knowledge, corporate actors can make judgments about cost efficiency and possible revenues.

The goal of this study was to assess the feasibility of drying machines (using NPV, B/C ratio, and IRR values) as well as a sensitivity analysis. Thus, the hypothesis in this study is that the studied drying machine has positive financial viability, with an NPV value better than zero, a B/C ratio > 1, and an IRR higher than the cost of capital level, implying that it has significant profit potential for business players.

METHODS

Materials and Equipment

Acacia honey from Riau was used as an ingredient. Meanwhile, the instruments employed include a Lastrindo Engineering water jet system vacuum dryer, a Graphtec gl200a midi logger, a Ducar brand digital scale with a capacity of 40 kg, an OEM brand digital watt meter, a Wiebrock stainless vacuum gauge, and a 12-volt power supply model S-120-12.

Research location

The Lastrindo Engineering Laboratory in Kelojen District, Malang City, was where this study is being conducted. The trial ran from January to February 2024.

Procedures

The experimental method was used to collect data for machine economic analysis. The experiment was carried out at the maximum capacity of the drying machine. According to Mutlu and Erbaş (2021), a honey ratio of 60% results in stronger antioxidant activity, which helps to retain the quality of honey. The drying temperature was 55°C for 240 min; according to Sahu and Devi (2013), the best temperature maintains a balance between nutrient quality and drying efficiency. Figure 1 shows the water jet system vacuum dryer machine.

This water jet system vacuum drying machine has a production capacity of 3,000 g (wet samples) per process, an electric power of 10–12 kWh, a maximum vacuum pressure of –92 kPa, and an adjustable drying temperature. The drying process was used to collect vital information for calculating the machine's cost and conducting an economic analysis, such as comprehensive machine specifications and pricing, as well as projected manpower requirements. The gathered data was utilized to calculate the economic and financial analysis of the drying equipment.

Break-Even Point (BEP) (Priyo 2012)

The point at which cash collections equal the cost, leaving no gain or loss. The calculations were as follows.

$$\text{BEP} = \frac{FC}{(\text{P} - \text{VCunit})} \quad \text{.....(1)}$$

where

BEP = Break-even point (kg per yr)
FC = Fixed cost (IDR per yr)
P = Drying labor wages (Rp per kg)
VCunit = Variable cost per appliance capacity (IDR per kg)

(a) (b) (c) (d)

Figure 2 Components of the vacuum dryer machine of the water jet system produced by Lastrindo Engineering. (a) drying rack, (b) box control panel, (c) vacuum water jet system, (d) dryer chamber tube.

Financial Analysis

- Net present value (NPV) (Murti 2017)

The present value of all cash flows generated by operating the vacuum drier machine minus the initial investment. Positive NPV denotes profit, whereas negative NPV indicates loss. The formula for calculating NPV is as follows.

$$NPV = \sum \frac{(Bt-Ct)}{(1+i)^t} \text{.........(2)}$$

where
Bt = Total revenue
Ct = Total cost of current expenses
i = Interest rates
t = *t*th year

- Internal Rate of Return (IRR) (Murti 2017)

The discount rate makes the present value of cash flow zero. The following is the IRR formula.

$$IRR = \mathbf{i}' + \frac{\mathbf{NPV}'}{\mathbf{NPV}'-\mathbf{NPV}''}(\mathbf{i}'' - \mathbf{i}') \text{............(3)}$$

where
i' = Discount rate (positive NPV)
i" = Discount rate (negative NPV)
NPV' = Positive NPV
NPV" = Negative NPV

- Cost-Benefit Ratio (B/C Ratio) (Subagiyo 2016)

Compare the net benefit value to the machine's entire investment and operating costs. A value > 1 shows that the benefits exceed the costs.

$$B/C\ Ratio = \frac{\mathbf{B}}{\mathbf{C}} \text{.....(4)}$$

where
Bt = Total of current revenue
Ct = Total of current expenses
i = Discount rate (bank interest rates)
t = *t*th year

Sensitivity Analysis

Three sensitivity analysis approaches were used: (1) increasing the price of raw materials (liquid honey) by 10, 20, and 30%; (2) increasing labor wages by 10, 20, and 30%; and (3) decreasing output by 10, 20, and 30% (Pasaribu 2012). Sensitivity analysis involved calculating the NPV, B/C ratio, and IRR using a discount factor table based on these three approaches.

RESULTS AND DISCUSSION

Data was collected to determine the worth of the costs incurred. It started by identifying various investment needs. The starting and total costs will affect the overall production cost. Table 1 shows the economic analysis test scenario data for the vacuum drying machine. The findings reveal that the procedure of generating powdered honey with an initial dough weight of 3,000 g yields powdered honey in the range of 83–85%. This method requires varying amounts of liquid petroleum gas (LPG), ranging from 2,490 to 2,545 g, while energy consumption ranges from 2,150 to 2,255 W. These findings suggest that the less LPG and electricity required, the more efficient the drying process is. Variations may occur due to differences in machine operating conditions or slightly variable dough compositions, but in general, this procedure provides a relatively high yield of more than 80%, showing significant efficiency potential for large-scale powdered honey production. This data serves as the foundation for economic analysis computations.

In addition to the test scenario data, cost assumptions must be made while doing the economic analysis of the vacuum drying machine. Table 2 gives the scenarios' values and assumptions. The goal of these scenarios and assumptions is to present a realistic image of the overall costs involved in production activities, allowing us to analyze the machine's investment feasibility and profitability.

Fixed Costs

Table 3 displays the fixed cost values. Fixed costs are those that do not vary with production volume (Thian 2022). The depreciation cost is calculated using the straight-line approach, which is (Acquisition price – Residual value)/Useful life. The acquisition price is the cost of purchasing an item, whereas the residual value is its expected value as it ages. The cost of renting commercial space is often specified in a leasing agreement, which includes a monthly or annual rental fee. Furthermore, maintenance costs include the expenditures incurred to keep the assets in good working order, which may be determined by summing up all charges for routine maintenance and repairs conducted over a particular time period. All costs incurred are related to the acquisition of fixed capital goods until the business is ready to produce (Prihadi 2019).

Table 5 Assumptions of economic analysis

Dough weight (g)		LPG needs (g)	Electricity requirements (W)	Yield of powdered honey (%)
Wet	Dry			
3.000	2.490	2.255	2.934	83
3.000	2.535	2.195	2.937	85
3.000	2.545	2.150	2.934	85

Table 6 Scenarios and assumptions

Description		Value	Unit
Interest		14%	per year
Maintenance costs		10%	from investment
Residual life of the equipment		10%	from investment
Rental fee	IDR	2.111.208	IDR per month
Raw material price	IDR	310.800	IDR per process
Raw material cost	IDR	24.864.000	IDR per month
Total of raw materials		240	kg per month
Packaging price	IDR	1.920.000	IDR per month
Number of workforces		2	People per shift
Labor wages	IDR	100.000	IDR man day
Machine capacity		12,0	kg per day
Business hours		16	hour per 4-shift per 4 hrs
Equipment working days		240	days per year
GAS fuel price	IDR	17.083	IDR per kg
GAS fuel consumption		734,4	kg per month
Electricity prices	IDR	1.700	IDR per kwh
Electricity consumption		3.848,8	kWh per month
Honey powder produced		192	kg per month

Table 7 Fixed costs

Cost	Fixed cost (IDR/yr)
Depreciation	91.292.612
Business place rental	25.334.500
Equipment maintenance	53.155.400
Total	169.782.512

Variable Costs

Table 4 displays the variable costs. Working wages are derived by determining hourly or per unit wage rates for employees and multiplying by the number of hours worked or units produced. The cost of gas is estimated by multiplying the amount of gas consumed (in kg or L) by the price per unit of gas. To determine electricity expenses, multiply the entire amount consumed (in kWh) by the applicable electricity rate per kWh. The cost of raw materials is determined by adding the costs of all materials used in the manufacturing process, depending on the quantity purchased and the price per unit. To calculate the cost of packing, multiply the quantity of packaged products by the cost of packaging per unit. Fixed costs vary depending on how frequently or how much the product is produced (Prihadi 2019), while operating costs might alter in response to variations in production levels (Thian 2022).

Basic Costs

The basic costs were calculated as the total cost divided by the number of machine capacity multiplied by the number of working days per year. The cost was IDR 317,311 per kg (Mowen *et al*. 2006). Fixed costs, such as machine depreciation, will be charged proportionally to each unit of product, whereas variable costs will rise with production volume. This is reinforced by the operational management cost theory, which claims that calculating a competitive cost of production necessitates regulating production expenses, including drying costs (Carter and Usry 2009). The selling price of powdered honey was fixed at IDR 419,579 per kg, calculated by multiplying the cost by 1.5 times.

Economic Analysis

Revenue. Revenue is the amount of machine capacity per day multiplied by the working days of a year multiplied by drying costs. The calculation results are IDR. 1,208,386,830 per yr.

Expenditure. Expenses were calculated by multiplying the quantity of machine capacity per day by the number of working days per yr and the principal cost. The annual expense is calculated at IDR 805,591,220.

Income. Income is difference between revenue and expenditure. The calculation of income is IDR 402,795,610 per yr.

Break-Even Point (BEP)

The calculation results show that the BEP will be achieved in 20 months, in other words, the water jet system vacuum dryer will begin to break even at about 20 months after the start of operation. This indicates that during the first twenty months of operation, the revenue from the sale of powdered honey will be used to cover all the cost of purchasing machinery, operating costs, and maintenance costs. Bianchini and Simioni (2021) also analyzed investments in the drying industry, which showed that investments can be returned in a relatively short time.

Financial Analysis

In determining the feasibility, it is necessary to conduct a financial analysis on the business to be run. The determination of feasibility or not is carried out using several criteria, including Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit/Cost Ratio (B/C Ratio).

Net Present Value (NPV). NPV is used to assess the future value of cash flows as well as the success of an investment at present, especially to determine whether the investment will yield profits over a given period. Calculating the present value (PV) of cash flows, the discount factor (DF) is calculated by considering the economic life of the machine, which is 5 years and the interest rate of 14%. The value of cash flow for 5 years can be seen in Table 5. NPV was obtained by subtracting the value of PVC from PVB. The results of the calculation obtained an NPV value of IDR 640,134,063. The NPV value is positive, so this business is worth doing. In the research of Damanta *et al.* (2019) profitable investment with a positive NPV value, provides a solid foundation for business actors to develop and improve operational efficiency in the industry.

Benefit/Cost Ratio. The value of the B/C Ratio divided the amount of PVB by PVC is 1.22. Since the B/C ratio is >1, this business is feasible. The results of Erbay and Hepbasli's (2017) research show that B/C ratio > 1 indicating that the economic benefits obtained exceed the costs incurred for investment and operations.

Internal Rate of Return (IRR). IRR is used as an indicator to evaluate whether an investment is worth it or not. In this study, the rate of return was compared to the bank interest rate (14%). An IRR of 73.93% was obtained which exceeded the bank's interest rate, so it was concluded that this business was feasible. The expected IRR of any investment must be understood by the decision-makers, which must be done through a thorough financial analysis (Damanta *et al.* 2019).

Sensitivity Analysis

To obtain a more thorough understanding of the economic analysis of this drying machine, it is necessary to conduct a sensitivity analysis. The goal is to identify critical limits in assessing the economic sustainability of machine operations based on three assumptions. The results of the calculation of the sensitivity analysis value can be seen in Figure 2. The results of the sensitivity test on the vacuum dryer of the water jet system to produce powdered honey showed that the decrease in production had the most significant impact on profitability with a gradient of –0.24. This means that any 1% decrease in production will decrease profitability by 0.24%, making it a very sensitive parameter in the production process of powdered honey. Meanwhile, the increase in raw material prices has a gradient of –0.08, indicating that profitability decreases by 0.08% for every 1% increase in raw material prices. The increase in labor wages has the least impact on profitability with a gradient of –0.03. This finding is in accordance with the theory of sensitivity analysis which states that changes in cost and production variables will have a direct effect on the profitability of the project (Heizer *et al.* 2020). In general, these results indicate that production control is critical in maintaining profitability, while changes in raw material and labor prices are relatively more tolerable.

CONCLUSION

The analysis shows that a vacuum dryer with a water jet system to produce powdered honey is worth an investment. Based on the NPV value marked positively, the IRR value exceeds the bank interest rate, the B/C ratio is > 1, and the BEP can be achieved in the 20th month. Sensitivity analysis shows that the

Table 8 Variable costs

Cost	Vraible cost (IDR/yr)
Wages	96.000.000
Gas	37.654.400
Electricity	19.628.064
Raw material	298.368.000
Packaging	23.040.000
Total	474.690.464

Table 9 Cash flow

Yr	Revenue (IDR/month)	Expenditue (IDR)	Balance	Profit (IDR/month)	PF	Net income (IDR/month)	Net expenditure (IDR/month)
0	-	531.554.000	531.554.000	531.554.000	1,000	-	531.554.000
1	80.559.122	53.706.081	209.790.012	26.853.041	0,877	70.665.896	47.110.598
2	80.559.122	53.706.081	110.983.976	26.853.041	0,769	61.987.628	41.325.086
3	80.559.122	53.706.081	432.230.464	26.853.041	0,675	54.375.113	36.250.075
4	80.559.122	53.706.081	753.004.452	26.853.041	0,592	47.697.467	31.798.312
5	80.559.122	53.706.081	1.074.250.939	26.853.041	0,519	41.839.884	27.893.256

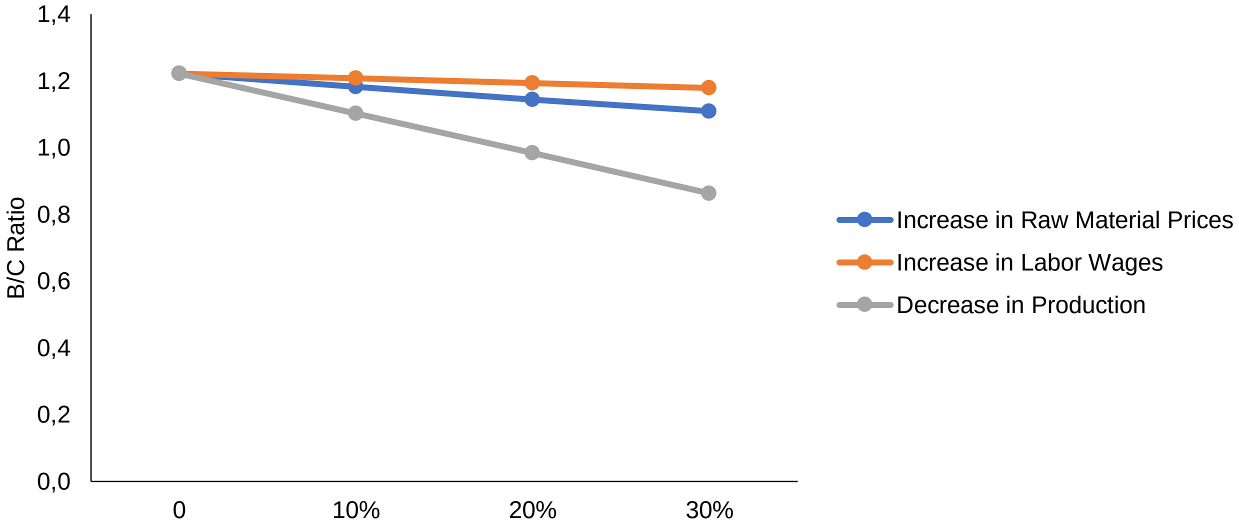

Figure 3 Sensitivity analysis of water jet system vacuum dryer machine.

decrease in production has the greatest impact on the profitability of vacuum drying machines in the production of powdered honey, while the increase in raw material prices and labor wages has a smaller impact.

ACKNOWLEDGEMENT

Our gratitude to the Rispro LPDP program and to the Lastrindo Engineering Laboratory for providing funds and facilities for this research.

REFERENCES

Bianchini DC, Simioni FJ. 2021. Economic and risk assessment of industrial wood chip drying. *Sustainable Energy Technologies Assessments*. 44: 101016. https://doi.org/10.1016/j.seta.2021.101016

Carter WK, Usry M. 2009. *Cost Accounting* Book 2. Translated by Krista. Jakarta (ID): Salemba Empat.

Cui Z-W, Sun L-J, Chen W, Sun D-W. 2008. Preparation of dry honey by microwave–vacuum drying. *Journal of Food Engineering*. 84(4): 582–590. https://doi.org/10.1016/j.jfoodeng.2007.06.027

Damanta T, Asmara S, Novita D, Tamrin T. 2019. Analisis ekonomi alat pengering biji kakao tipe bak sistem penghembus udara panas (Studi kasus di Desa Penengahan Kecamatan Gedong Tataan Kabupaten Pesawaran Provinsi Lampung). *Jurnal Ilmiah Rekayasa Pertanian dan Biosistem*. 7, 126–138. https://doi.org/10.29303/jrpb.v7i1.106

Erbay Z, Hepbasli A. 2017. Assessment of cost sources and improvement potentials of a ground-source heat pump food drying system through advanced exergoeconomic analysis method. *Jurnal Energy*. 127: 502–515. https://doi.org/10.1016/j.energy.2017.03.148

Fahmi D, Susilo B, Nugroho WA. 2014. Pemurnian Etanol Hasil Fermentasi Kulit Nanas (Ananas comosus L. Merr) dengan Menggunakan Destilasi Vakum. *Journal of Tropical Agricultural Engineering and Biosystems-Jurnal Keteknikan Pertanian Tropis dan Biosistem*. 2(2).

Heizer J, Render B, Munson C. 2020. *Operations Management: Sustainability and Supply Chain Management*. London (UK): Pearson.

Histifarina D, Musaddad D, Murtiningsih E. 2004. Teknik pengeringan dalam oven untuk irisan wortel kering bermutu. *Jurnal Hortikultura*. 14(2): 107–112.

Jaya F, Radiati LE, Estiasih T, Rosyidi D. 2023. Ilmu dan Teknologi Pengolahan Madu Bubuk. Malang (ID): Universitas Brawijaya Press. https://doi.org/10.11594/ubpress9786232967021

Kutovoy V, Nikolaichuk L, Slyesov V. 2004. The theory of vacuum drying. *Simposium Pengeringan Internasional, A* , 1–5.

Ghazali MH, Ming T, Hashim D. 1994. Effect of microwave heating on the storage and properties of starfruit honey. ASEAN *Food Journal*. 9 (1): 30–35.

Mowen MM, Hansen DR, Guan L. 2006. *Cost Management: Accounting and Control*. Mason (US): Thomson South Western.

Murti H. 2017. Analisis kelayakan finansial unit usaha mesin pemanen padi (combine harvester) di Kecamatan Seputih Raman Kabupaten Lampung Tengah. *Jurnal Ilmu Ilmu Agribisnis*. 5(3).

Mutlu C, Erbaş M. 2021. Evaluating the effects of different drying methods, carrier materials and their ratios to produce bioactive honey-like powder. *Journal of Apicultural Research.* 59(5):599-608. https://doi.org/10.1080/00218839.2021.1885877

Paembonan FY, Molenaar R, Rumambi DP. 2020. Analisis ekonomi mesin pengering padi (*Oryza sativa* L.) menggunakan vertical dryer agrindo tipe VRD60 di Kelompok Tani Harapan Bersama di Desa Bigo Selatan. *Jurnal Teknologi Pertanian*. 11(2): 118.

Pasaribu AM. 2012. *Perencanaan dan Evaluasi Proyek Agribisnis* (*Konsep dan Aplikasi*). Yogyakarta (ID): Lily Publisher.

Perumal R. 2007. Comparative performance of solar cabinet, vacuum assisted solar and oven drying method [thesis]. Canada (CA): Natural Resources Technology Department, University Montreal,

Prihadi T. 2019. *Analisis Laporan Keuangan.* Jakarta (ID): Gramedia Pustaka Utama.

Priyo M. 2012. *Ekonomi Teknik*. Yogyakarta (ID): Penerbit: LP3M UMY.

Raeymaekers B. 2006. A prospective biomonitoring campaign with honeybees in a district of Upper-Bavaria (Germany). *Environmental Monitoring*. 116: 233–243. https://doi.org/10.1007/s10661-006-7389-8

Ram AK. 2011. Production of spray-dried honey powder and its application in bread. Baton Rouge (US): Louisiana State University and Agricultural & Mechanical College.

Sahu, Devi KD. 2013. Modeling of vacuum puffing characteristics and color change of liquid honey. *Industrial Crops and Products*. 48: 118–123. https://doi.org/10.1016/j.indcrop.2013.04.019

Samborska K, Jedlińska A, Wiktor A, Derewiaka D, Wołosiak R, Matwijczuk A, Błażowski Ł. 2019. The effect of low-temperature spray drying with dehumidified air on phenolic compounds, antioxidant activity, and aroma compounds of rapeseed honey powders. *Food Bioprocess Technology*. 12: 919–932. https://doi.org/10.1007/s11947-019-02260-8

Sathivel S, Ram AK, Espinoza L, King J, Cueto R, Solval KM. 2013. Application of honey powder in bread and its effect on bread characteristics. *Journal of Food Processing & Technology*. 4: 11. https://doi.org/10.4172/2157-7110.1000279

Schramm DD, Karim M, Schrader HR, Holt RR, Cardetti M, Keen CL. 2003. Honey with high levels of antioxidants can provide protection to healthy human subjects. *Journal of Agricultural Food Chemistry*. 51(6): 1732–1735. https://doi.org/10.1021/jf025928k

Subagiyo S. 2016. Analisis Kelayakan Finansial Penggunaan Alsintan Dalam Usaha Tani Padi Di Daerah Istimewa Yogyakarta. *Jurnal Pertanian Agros*. 18(1): 33–48.

Suhag Y, Nayik GA, Karabagias IK, Nanda V. 2021. Development and characterization of a nutritionally rich spray-dried honey powder. *Foods*. 10(1): 162. https://doi.org/10.3390/foods10010162.

Suliani S, Nawawi ZM, Dharma B. 2023. Analisis Potensi Ekonomi Pertanian Permakultur dan Pengembangannya di Desa Hutabaru Sil, Kec. Dolok, Kabupaten Padang Lawas Utara Perspektif Ekonomi Islam. *Jurnal Ilmiah Ekonomi Islam*. 9(2), 2036-2046.

Thian A. 2022. *Analisis Laporan Keuangan*. Yogyakarta (ID): Penerbit Andi.

Turhan I, Tetik N, Karhan M, Gurel F, Tavukcuoglu HR. 2008. Quality of honeys influenced by thermal treatment. LWT-*Food Science Technology*. 41(8): 1396–1399. https://doi.org/10.1016/j.lwt.2007.09.008

Zain S. 2005. *Teknik Penanganan Hasil Pertanian*. Bandung (ID): Pustaka Giratuna.