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Heat Treatment of Edible Bird's Nest to Fulfill Export Requirements to Canada

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Abstract: The export requirements for swallow's nest (EBN) to Canada refer to the import procedure edible bird's nest (other than cooked canned commercially sterile) published by the Canadian Food and Inspection Agency (CFIA). One of the conditions is that the EBN is heated to a minimum temperature of 100 oC within a minimum of 1 hour. This study aims to test the heating treatment of EBN with a temperature of 100 °C for 1 hour according to the requirements of export to Canada and compare it with the requirements of the World Organization of Animal Health (WOAH). This researcher used clean EBN that had not been heated, coming from the island of Sumatra. The EBN sample was divided into four groups. The first group as a control, the second group heated 70 oC for 3.5 seconds, the third group heated 100 oC for 1 minute and the fourth group heated to 100 oC for 1 hour. The parameters tested in each group were sialic acid, physicochemical (water content, pH, water holding capacity (WHC), and water absorption index (WAI)). In addition, sensory attributes (color, taste, aroma, and texture) were also tested using panelists. The treatment of heating EBN at 100 °C for one hour causes protein denaturation that changes the functional properties of EBN. This treatment also reduces the developing power of EBN by up to 50% and has a significant influence on sensory and physicochemical properties, both color, taste, aroma, and texture. Heating EBN 100 °C for one hour reduces EBN quality, while EBN heating according to WOAH requirements i.e. heating 70 °C for 3.5 seconds does not affect EBN quality. Heating treatment of EBN 100 °C for one hour is not recommended.

Keyword: Canada, Quality, Heating, Swallow's nest, Temperature

INTRODUCTION

Indonesia is the world's largest producer of swallow's nest. Seventy-five percent of global edible bird’s nest (EBN) production comes from Indonesia. This commodity has been exported to various countries, including Hong Kong, China, Vietnam, Singapore, Malaysia, USA, Taiwan, Australia, Canada, and Japan. It is also one of Indonesia's leading export commodities. According to data from *the Indonesian Quarantine Full Automation System* (IQ-FAST) from the Indonesian Quarantine Authority, in 2023, Canada imported 2.150,38 kg of EBN, ranking ninth out of 10 largest importers of EBN from Indonesia, as seen in Figure 1 below.

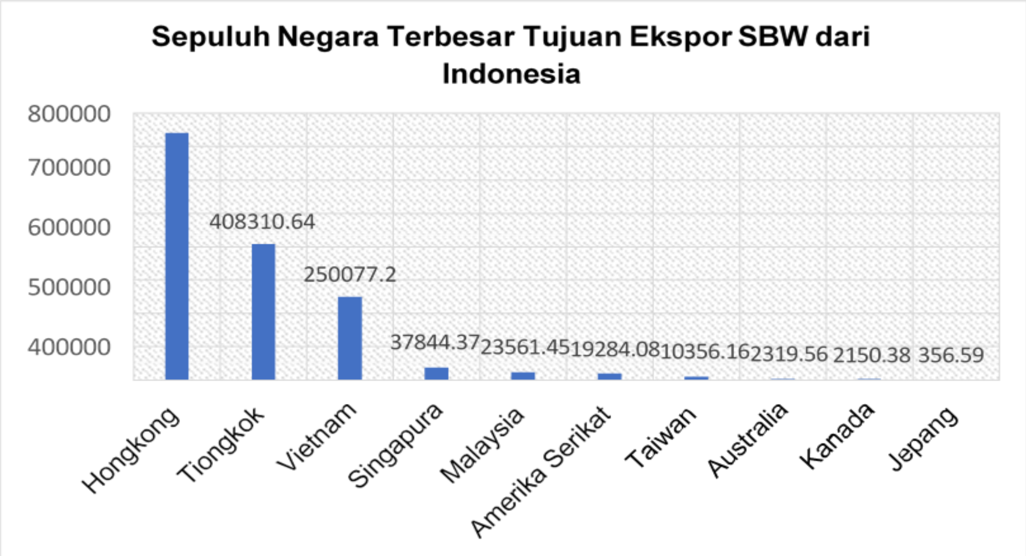

Figure. 1. EBN Export Destination Countries from Indonesia in 2023

According to IQFAST data from the Indonesian Quarantine Authority, four technical implementation units (UPTs) of the Indonesian Quarantine Authority handled EBN exports to Canada in 2023. These UPTs are the Jakarta Animal, Fish, and Plant Quarantine Center (BBKHIT), the Banten Quarantine Center (BKHIT), the Central Java Quarantine Center (BKHIT), and the East Java Quarantine Center (BKHIT). At least 22 companies exported EBN to Canada in 2023. Meanwhile, based on the Indonesian Quarantine Authority IQ-Fast (2024), during January to September 2024, there were 15 companies/individuals that exported EBN to Canada.

The requirements for exporting bird's nest to Canada refer to the import procedure for edible bird's nest (other than cookedcanned commercially sterile) issued by the Canadian Food and Inspection Agency (CFIA), as stated in the Decree of the Head of the Agricultural Quarantine Agency Number 6291/Kpts/HK.140/K/7/2021, concerning Guidelines for Animal Quarantine Measures forthe Export of EBN from the Territory of the Republic of Indonesia to Countries Other Than the People's Republic of China. Based on this regulation, some of the requirements set by Canada include, (1) EBN products are processed with attention to good hygiene and sanitation conditions; (2) EBN products are heated to a minimum temperature of 100 oC for a minimum time of 1 hour. If using the target microorganism Clostridium botulinum with a Z value = 10 oC and a reference temperature of 121.1 oC with use equality Fo=10 = (T-Tref)/Z x t (T = 100 oC, Tref – 121,1 oC, Z -10 oC, dan T = 60 minute), then F = 0.5 minutes; In addition (3) a sanitation certificate signed by the Quarantine Officer stating that there isevidence of the heating process in point (2); a complete description of the shipment including shipping marks and container numbers(if any); and all EBN shipped have been inspected and are free from feces, ectoparasites, feathers, and dirt on the surface (Barantan 2021).

Further details on the EBN heating procedure refer to the Decree of the Head of the Agricultural Quarantine Agency Number 2732/KPTS/KR.120/K/12/2018 concerning Guidelines for Verification of Heating of EBN for Export to the RRT (Barantan 2018). However, the target minimum core temperature for EBN products is 100 oC with a minimum time of 1 hour. If EBN exportersto Canada do not carry out the heating process using the above scheme, an import permit is required and is evaluated on a case-by-case basis by the Canadian Government (CFIA).

In 2018, the Agricultural Quarantine Techniques and Methods Application Testing Center (BUTTMKP) conducted anapplication test entitled "Verification of Heating Treatment of EBN to Inactivate Avian Influenza Virus . " The results were EBN heating where the core temperature of the EBN must not be below 70 oCelsius and maintained for at least 3.5 seconds, has been proven to eliminate the Avian Influenza virus, without affecting the quality of the EBN (BUTTMKHP 2018). This heating is in accordance with Chapter 10.4 of the World Organization of Animal Health (WOAH) regarding Infection with High Pathogenicity Avian Influenza Viruses (WOAH 2024). This heating method is the reference for Indonesian exporters for EBN to be exported to China.

The Agricultural Quarantine Agency conducted a retort heating trial for EBN in 2022. The retort heating was compared with the WOAH heating results. The results revealed a significant difference between the retort and WOAH heating results. The water absorption index of EBN heated with the retort method decreased significantly compared to that of EBN heated with the WOAH method. This indicates that the swelling power of EBN heated with the retort method is significantly reduced compared to the retort method. Meanwhile, the protein and sialic acid test results for the two methods did not show a significant difference (Barantan 2022).

Fahriani et al. (2023a) also stated that the retort method affects the quality of EBN by decreasing the rehydration capacity of EBN after heating. Meanwhile, the results of nitrite testing showed that heating with the retort method did not significantly affect the nitrite levels in EBN. The retort method is not recommended for heating clean EBN. Heating treatment of EBN at commercial sterilization temperatures (retort) as a raw material can be recommended for evaluation so that it is not a requirement in trade.

EBN consumers typically assess the shape, volume, color, density, rehydration capacity, aroma, and dry ness of the EBN theyintend to consume. Heating at the temperature and time applied to EBN commodities destined for export to Canada can indirectly affect the quality of the EBN. Therefore, it is necessary to compare EBN treatments using the Canadian-required method with those inaccordance with WOAH requirements to obtain reliable scientific data. Studies related to the effect of heating swiftlet nests at 100 °C for 1 hour have not yet been conducted in Indonesia.

The research aims to test the heating treatment technique of EBN at a temperature of 100 °C for1 hour according to Canadian requirements, which does not affect the quality of EBN. The second objective is to compare the heating treatment of EBN according to Canadian requirements with the requirements of WOAH. Meanwhile, the expected target is to obtain aprocessing technique for EBNs according to the requirements proposed by Canada, without affecting the quality of EBN. Theresults of this application test are expected to be a reference/recommendation to the Indonesian Quarantine Agency, as a policy material for determining the standard processing technique for EBN for export to Canada.

METHOD

Research on Heating Bird's Nests at 100°C for 1 Hour in Accordance with Canadian Requirements." Conducted at the Animal, Fish, and Plant Quarantine Technique and Methods Testing Center (BUTTMKHIT). Laboratory testing was conducted at theFaculty of Agricultural Technology, IPB University. The tools used are conventional wet steam type heaters (*single* and *multi-tray*), thermocouples *and* thermodata *loggers*, analytical scales, timers, sterile tweezers and sterile spatulas. The material used is ready-to-export EBN from Sumatra Island. The EBN sample used is EBN which is clean from feathers and dirt, and has not been treated. Heating. The nest is oval-shaped and medium-sized, 50 days old, weighing

6 ± 0.5 grams. The sample is white and symmetrical, withthe legs trimmed. The thickness of the swallow's nest legs used as samples was selected. Efforts were made to ensure that thethickness of the EBN legs between samples was similar.

Sample Preparation

Each nest was weighed and its weight recorded. The sample was then divided into four equal parts. One part served as a control (without heating), one part served as treatment 1, one part served as treatment 2, and one part served as treatment 3. The initial temperature of the sample was recorded. Each treatment was replicated three times. Each sample for each treatment was labeled and randomized. Next, drilling was performed to install the sensor in the thickest part of the EBN leg. The heating method used for export to Canada is the same as that used for EBN export to China. The differences lie in the temperature and treatment time.

Heating Equipment Preparation

1. EBN heating tool *pre-heating* process

Preheating aims to provide the heating device with a steam- saturated condition at the same temperature. During the *preheating* process, the initial water temperature must be recorded. The heat source is a gas cylinder with a capacity of 25-30%. Assuming a small gas capacity will not exert too much pressure on the device. If the gas pressure is low and produces optimal results for the device, then using a cylinder with full capacity will not cause significant problems related to gas pressure. Both temperature and time must be met during *preheating* (Barantan 2018).

2. Coldest *Point*

The coldest point is the point used to place the temperature sensor. To find this point, a heat distribution test is performed todetermine the coldest point of the device (Barantan 2018).

3. Penetration

Perform an initial temperature calculation on the EBN sample before placing it in the heating device. Next, the EBN, whichhas been fitted with a heat monitor, is placed in the heating device (Barantan 2018). Some things to note when carrying out heating treatment can be seen in Table below.

Table 1. Heating Treatment

No	Data	Hasil Satuan
1.	Water level (recommended: 2/4 to ¾ of the distance between the base of the heater to the bottom shelf)	Cm
2.	Minimum gas pressure (bar) / heat source regulator level (1,2,3/10,20, …100)	Bar
3.	Initial temperature of EBN during first heating	^{o}C
4.	Maximum weight of EBN	Gram
5.	T *indicator pre heating*	^{o}C
6.	t pre heating	Detik
7.	*Come up time* / CUT (second)[a,b]	(Detik)[a,b]
8.	t_{total} = CUT + 5 (second/minute)[c]	(detik/menit)[c]
9.	$T_{indicator\ total}$ that is the temperature at the time t_{total} (^{o}C)	^{o}C
10.	Heated EBN preparation scheme	Skema
11.	Heating operators (at least 2 people, namely the operator who inserts the EBN before heating and the operator who takes the EBN after heating.	

Sample Treatment Method

There are four types of treatment in this application test, namely samples without heating treatment as a control, heating treatment with a temperature of 70 ^{o}C for 3.5 seconds as treatment 1. Furthermore, heating treatment with 100 ^{o}C for 1 minute as treatment 2, and heating treatment with 100 ^{o}C for 1 hour as treatment 3.

Treatment 1

The temperature at the core of the EBN using hot steam must reach 70 °C for at least 3.5 seconds (rounded to 5 seconds). Sensor readings are taken at 96.3 °C for 139 seconds. After the sample reaches the core temperature and the specified time, it is cooled. Then, the weight is conditioned to be the same as before heating (weighed grams before heating is the same as grams after heating). Samples with the same heating treatment are homogenized. The image of the sample treatment 1 can be seen in Figure below.

Figure 2. Sample Treatment 1

Treatment 2

The temperature at the EBN core using hot steam must reach 100°C for one minute. The sensor reading is taken at 96.3 °C for 139 seconds. After the sample reaches the core temperature and the specified time, it is cooled. Then, its weight is conditioned to bethe same as before heating (weighed grams before heating is the same as grams after heating). Samples with the same heating treatment are homogenized. An image of the sample treatment 2 can be seen in Figure below.

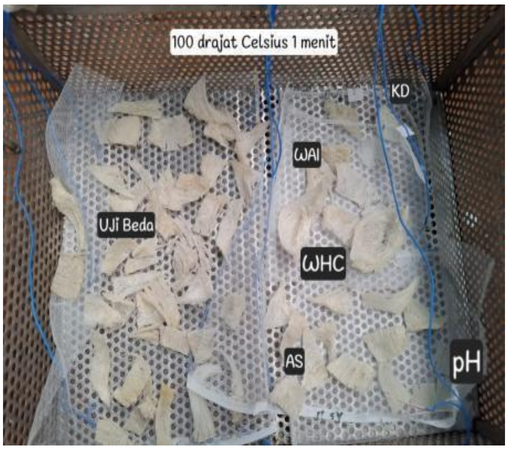

Figure 3. Sample Treatment 2

Treatment 3

The temperature at the core of the EBN using hot steam must reach 100 °C for one hour. Sensor readings are taken at 96.3 °C for139 seconds. After the sample reaches the specified core temperature and time, it is cooled. Then, its weight is conditioned to be the same as before heating (weighed grams before heating is the same as grams after heating). Samples with the same heating treatment are homogenized. An image of sample treatment 3 can be seen in Figure below.

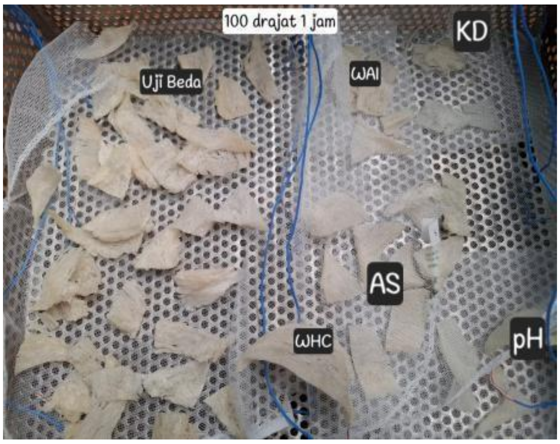

Figure 4. Sample Treatment 3

Sialic Acid Testing Using Spectrophotometry Method

Sample preparation was carried out by referring to the method developed by Li et al. (2011). The EBN sample was dried at 105 oC for 60 minutes, cooled, ground with a mortar while removing any remaining dirt and feathers, then filtered with a 100 meshsieve to filter out dirt and feathers. A total of 0.12-0.13 g of EBN powder was placed in a 25 ml screw cap test tube, 20 ml of 50% acetic acid solution was added and then heated with reflux for 10 minutes to release sialic acid. The tube was cooled and the solution was transferred to a 100 ml test tube and rinsed with distilled water to 100 ml. A total of 10 ml of the solution was transferred into a 15 ml centrifuge bottle, added 1.2 g of ammonium sulfate and stirred then centrifuged at 3000 rpm for 10 minutes. A total of 2 ml of supernatant was transferred into a10 ml screw tube, added 2 ml of ninhydrin indicator (2.5 g of ninhydrin in 60 ml of glacial acetic acid and 40 ml of HCl) which will reactwith sialic acid to form a yellow color and 2 ml of glacial acetic acid, stirred and then heated in a water bath at a temperature of 100 oC for 10 minutes. Next, the spiral tube is immediately cooled under running water. A total of 2 ml of supernatant was put into a cuvette andits absorbance was measured with a visible light spectrophotometer at a wavelength of 470 nm.

Preparation of sialic acid standards was carried out by referring to the method developed by Li et al. (2011). Standard sialicacid (N-Acetylneuraminic acid, Sigma-Aldrich Chemie) as much as 5 mg in 1 ml of aqua-bides (5000 μg/ml), then successively dissolved into six concentrations of sialic acid in stages, namely 200, 100, 50, 20, 10 and 5 μg/ml. A total of 2 ml of standard solutionat each concentration was added with 2 ml of ninhydrin indicator (2.5 g ninhydrin in 60 ml of glacial acetic acid and 40 ml of HCl), 2 ml of glacial acetic acid, stirred then heated in a water bath at a temperature of 100 oC for 10 minutes. Then the screw tube was immediately cooled under running water. A total of 2 ml of supernatant was put into a cuvette and its absorbance was measured with avisible light spectrophotometer at a wavelength of 470 nm.

Data Analysis

The results are presented as the average sialic acid content with a 95% confidence interval. Univariate analysis using t- tests and analysis of variance was conducted to determine significant differences between sialic acid content and the observed variables (Hidayat and Istiadah 2011). To classify the samples based on their geographic origin then a chemometric analysis was carried out using principal component analysis or PCA (Jolliffe 2011).

Water Level Testing (*Moisture* content (MC))

A total of 1 gram of the swallow's nest sample was placed in an aluminum-coated container, and dried at a temperature of 135 °C for 8 hours. Water content is calculated using the equation below (Singh and Muthukumarappan 2015):

$$Moisture\ content\ (\%) = \frac{Ws - Wds}{W_s} \times 100\%$$

Where, W_s = *initial sample weight* (g) and W_{ds} = *weight of dried sample* (g

pH testing

A 5-gram sample of EBN was homogenized in 50 ml of distilled water using *a chopper*. The pH of the solution wasmeasured using a calibrated pH meter (AOAC 1999).

Water Holding Capacity (WHC) Testing

A 2.5-gram sample of EBN was dissolved in 30 ml of distilled water using a 50 ml centrifuge tube. The solution was vortexed for 30 seconds and then centrifuged at 3,000 × g for 15 minutes. The supernatant was discarded, and the remaining gel was weighed (Singh and Muthukumarappan 2015). WHC is calculated using the following formula WHC (%) = (Wg/Ws)* 100% *where W = weight of the gel remaining in the centrifuge tube (g); W = initial sample weight (g)*

Water Absorption Index (WAI) Testing

A 2.5 g sample of bird's nest was dissolved in 30 ml of distilled water using a 50 ml centrifuge tube and vortexed for 30 seconds.The solution was then centrifuged at 3,000 × g for 15 minutes. The *supernatant* was then transferred to an aluminum - coated container, dried at 135 °C for 3 hours to remove water (Singh and Muthukumarappan 2015). WAI was calculated using the following formula (WAI (-) = Wg/Wds

Where W = *weight of the gel remaining in centrifuge tube* (g); W = *weight of dried supernatant* (g)

Sensory Attribute *Analysis*

Swiftlet samples from treatments 1, 2, 3, and the control were soaked for 1 hour, drained, then cooked using *a double boiler* for 30 minutes. Then the samples were divided equally among the panelists. The panelists were instructed to conduct a comparative test between the CONTROL sample and the treatment sample, as shown in below. Each panelist was given 1 control sample and 3treatment samples. The panelists were asked to try the CONTROL sample and then compare it with treatment sample 1. Next, they tried the CONTROL sample and compared it with treatment sample 2, and compared the CONTROL sample with treatment sample 3. The panelists were also asked to identify differences in the quality of each sample (Meilgaard *et al.* 20007). The results of the sampleevaluation were then filled into a Google form via the link https://ipb.link/sensori-EBN.

The panelists wrote down the differences in color, texture, taste, aroma, *aftertaste*, and *overall* of the four samples, by selecting the No difference column. Very little; Somewhat different; Moderate; Large; and Very large.

Statistical Analysis

Statistical *analysis* using IBM® SPSS® Statistics software, version 26 (IBM, USA), with *a* 95% confidence level . *Analysis ofvariance* (ANOVA*)* and Dunnett 's test (2-sided) were performed to identify differences between the treatment and control samples.

RESULT AND DISCUSSION

Before the heating treatment, the swallow's nest heating device was verified. The verification results can be seen in the data below. Please note: the figures listed apply only to the device used for testing.

Initial Water Temperature	: 27.6°C
Water Level	: Max. 6 cm
Water Filling	: Manual
Gas Pressure	: 20% Scale
Gas Valve Level	: Maximum Flame Scale
SWW Weight	: -
Initial SWW Temperature	: 26.4°C

1. Preheating Test Phase

Final Preheating Temperature: 92.0 °C
Preheating Time: 27 minutes (m) 57 seconds (s)
SHP Position: Point No. 9 (See Figure 11 below)

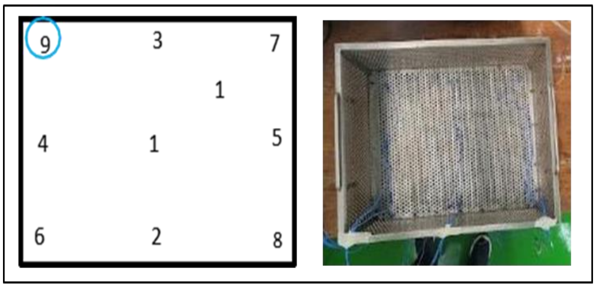

Figure 5. Position of the slow heating point (SHP) on the EBN heater

2. Product Penetration Test Stage:

a. Penetration 1 (Target Temperature 70°C, 5 seconds)
Achieved-indicator 82.2°C
CUT 28s
Total indicator 82.9°C
CUT + 5s 33s
b. Penetration 2 (Target Temperature 70°C, 5 seconds)
Achieved-indicator 91.9°C
CUT 32s
Total indicator 92.7°C
CUT + 5s 37s

c. Penetration 3 (Target Temperature 100°C, 1 minute)
Achieved-indicator 115.2°C
CUT 3m 24s
Total indicator 116.2°C
CUT + 1m 4m 24s
d. Penetration 4 (Target Temperature 100°C, 60 minutes)
Achieved-indicator 114.3°C
CUT 2m 56s
Total indicator 115.8°C
CUT + 60 m 1h 2m 56s

Two types of laboratory tests were conducted on the swiftlet nests in this application trial: physicochemical and microbiological. The physicochemical tests included sialic acid testing using spectrophotometry, pH testing, water holding capacity (WHC) testing, water absorption index (WAI) testing, and water content testing. The microbiological tests used a test for the presence of Salmonella enteritis bacteria in spiked EBN.

Based on the results of the physicochemical tests on the swiftlet nests, with three different temperature and time treatments, and three replications, the results are as shown in Table 5 below.

Table 2. Physicochemical Test Results

Sample	pH	Mc (%)	WAI (–)	WHC (%)
Kontrol	8.70 ± 0.09	26.34 ± 0.17	631.63 ± 32.90	813.66 ± 21.48
Perlakuan 1	8.84 ± 0.02*	31.80 ± 0.06*	584.54 ± 67.20	727.41 ± 24.90*
Perlakuan 2	8.97 ± 0.02*	32.52 ± 0.23*	455.68 ± 56.47*	654.12 ± 5.33*
Perlakuan 3	9.01 ± 0.03*	26.48 ± 0.95	310.81 ± 32.63*	471.82 ± 9.45*

Note: Data are expressed as mean ± standard deviation of three replicates.
*significant difference with control sample ($p < 0.05$) with 95% confidence level Mc = moisture content, WAI = water absorption index, WHC = water holding capacity

Based on Table 2, above, the data shows that the WHC and WAI decreased with increasing treatment temperature. This indicates protein denaturation in the treated EBN. Protein denaturation results in changes in structural conformation, resulting in the structure's WHC and WAI properties. This decrease in WAI indicates that the functional properties of the protein from the EBN treated at higher heat temperatures experienced a decrease in solubility. The decrease in WHC and WAI indicates very significant protein denaturation, with a nearly 50% decrease in protein solubility compared to the control. Consequently, the swelling power of the treated EBN decreased drastically, due to the drastic decrease in WHC and WAI. Meanwhile, the moisture content between the control and treatments 1, 2, and 3 showed significant differences but no trend. Meanwhile, the pH levels in the swiftlet nests between the control and treatments 1, 2, and 3 showed significant differences.

The results of sialic acid testing on swiftlet nest samples using the spectrophotometric method were shown in Table 3 below. The test was performed three times.

Table 3. Sialic acid test results

Sialic acid content	Average ± standar deviasi
Kontrol	11.750 ± 0.212^{a}
Perlakuan 1	11.050 ± 0.212^{ab}
Perlakuan 2	10.500 ± 0.283^{b}
Perlakuan 3	10.50 ± 0.00^{b}

The average sialic acid content found in EBN from Kalimantan and Java ranges from 9.20%–13.62% with an average of 11.16±1.0468 (Helmi 2018). The test results on EBN from Sumatra used in this application test ranged from 10.3 to 11.6.

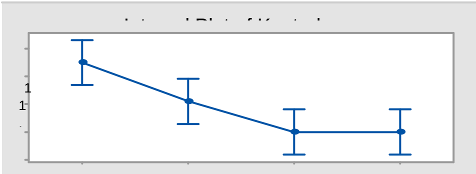

Figure 6. Statistical analysis of sialic acid test results

Meanwhile, statistical analysis using ANOVA on the sialic acid test results can be seen in Figure 12 above. Based on the statistical analysis above, it can be seen that the heating process produced significantly different results in terms of sialic acid reduction. The control and treated bird's nest samples were soaked for 30 minutes, then cooked using a double boiler. EBN consumers typically soak for 30 to 60 minutes before heating, to soften the EBN's texture.

Afterward, the cooked samples were divided equally for sensory attribute testing. The attributes in question were color, aroma, taste, and texture. A total of 22 panelists conducted the sensory attribute testing. This test was a control difference test. The purpose was to determine the effect of the treatment on the control. There was no comparison between treatments, only a comparison between the treatment and the control. The results of the sensory attribute testing can be seen in Table below.

Table 4. Sensory attribute test results (Difference-from-control test result)

Attribute	A		B		C	
	Mean difference	Sig.	Mean difference	Sig.	Mean difference	Sig.
Color	0.86*	0.004	1.64*	<0.001	3.36*	<0.001
Texture	1.32*	<0.001	3.41*	<0.001	4.32*	<0.001
Aroma	1.09*	0.001	2.09*	<0.001	2.09*	<0.001
Taste	0.55	0.091	1.86*	<0.001	2.27*	<0.001
Aftertaste	0.73*	0.022	1.59*	<0.001	2.27*	<0.001
Overall	0.95*	0.002	2.41*	<0.001	3.64*	<0.001

Note: *significant difference with control sample ($p < 0.05$) with a confidence level of 95%

The color, texture, aroma, aftertaste, and overall attributes of all samples showed statistically significant differences from the control sample with a $p < 0.05$ value. For the taste attribute, sample A showed no significant difference compared to the control sample ($p < 0.05$). Sample A showed a slight difference from the control sample, as evidenced by the relatively smaller mean difference value.

Based on Table 5 above, the asterisked numbers indicate that the 70 °C for 3.5 seconds treatment was significantly different compared to the control in terms of color, aroma, aftertaste, and overall taste. When the temperature was increased, the results of treatments 1, 2, and 3 were all significantly different. Taste remained similar between the control and treatment 1. However, treatments 2 and 3 were all significantly different. This indicates that increasing the temperature and heating time can alter the functional properties, or physicochemical properties, of the bird's nest.

All panelists were also asked to write a qualitative description on the questionnaire. A summary of the panelists' descriptions can be seen in Table 5 below.

Table 5. Summary of the results of the qualitative description of the sensory attribute test

Sampel	Dekripsi Kualitatif
A	Sampel A memiliki sedikit perbedaan dengan sampel kontrol. Aroma tidak terlalu amis bila dibandingkan dengan kontrol. Serta terdapat sedikit perbedaan pada tekstur dan warna.
B	Sampel B memiliki perbedaan besar dengan sampel kontrol, dalam hal teksur. Tekstur dari sampel B lebih keras dan kasar dibandingkan dengan kontrol. Selain itu, aroma dari sampel B lebih amis dari sampel kontrol. Terdapat juga perbedaan warna, namun hal ini kemungkinan besar merupakan bias dari perbedaan porsi masing-masing sampel
C	Sampel C memiliki perbedaan besar dengan sampel kontrol dalam hal tekstur. Tekstur dari sampel C lebih lebih berserat dan kasar, dengan rasa berpasir di mulut. Aromanya lebih kuat dibandingkan sampel kontrol, dan warnanya lebih kuning

Based on the results above, the heating process, both at higher temperatures and longer times, makes the texture of the bird's nest more fibrous and rough, and changes its structure. Bird's nest consumers generally prefer nests with finer fibers and a whiter color. Coarser and more structured fibers are less preferred by consumers.

Test results showed that the heating treatment did not alter sialic acid but did denature the protein, altering the functional properties of EBN. Higher heating treatment resulted in more significant changes in the treated EBN, as evidenced by a decrease in WHC and WAI values of almost 50%. The product's swelling capacity was clearly reduced, approximately 50% of its maximum swelling capacity.

Sensory analysis results showed significant differences between the control and treated samples, with heating negatively impacting the sensory attributes of EBN. The sensory and physicochemical analyses showed that heating significantly impacted the sensory and physicochemical properties of the EBN product.

The Indonesian Quarantine Authority (BKI) is responsible for the implementation of food supervision for the international distribution of animal-based commodities in the form of food. Article 4 of Law Number 21 of 2019 concerning Animal, Fish, and Plant Quarantine states that the scope of quarantine regulations includes: a. Quarantine implementation; b. State protection level based on risk analysis; c. Types of HPHK, HPIK, OPTK, and Carrier Media; d. Quarantine requirements; e. Quarantine actions; f. Quarantine documents; g. Supervision and/or control of food safety and quality, feed safety and quality, PRG, genetically modified organisms, biological agents, invasive alien species, wild plants and animals, and endangered plants and animals; h. Quarantine areas; i. j. Traceability; Quarantine information systems; k. Quarantine services; i. Intelligence, special police, and investigative functions; m. Quarantine cooperation; and n. Funding.

Supervision comes from the word "awas," which means "to see clearly, to have sharp eyesight, to have sharp insight, to be alert," and so on. Supervision, among other things, means to see and pay attention. Supervision is a process to ensure that a program is in accordance with what has been planned. According to Ndraha, supervision is the task of monitoring, comparing, evaluating, and taking preventive, educational, corrective, or repressive actions (Ndraha, 2003). Supervision is intended to prevent or correct errors, deviations, nonconformities, and abuses that are inconsistent with the objectives of predetermined authority (Rahmawati et al., 2020).

There are two main principles of supervision. The first is to provide a standard or measuring tool for the work performed by subordinates. The second principle is that clear authority and instructions must be given to subordinates because this is how it can be determined whether subordinates have carried out their duties properly. Based on the instructions given to subordinates, their work can be monitored (Manulang, 2002). Following these two basic principles, a system Supervision must contain the principles put forward by the following: 1) Supervision must be able to reflect the characteristics and needs of the activities that must be supervised. 2) Can immediately report deviations. 3) Supervision is flexible. 4) Supervision is reflective of organizational patterns. 5) Supervision must be economical. 6) Can be understood. 7) Supervision can guarantee the implementation of corrective actions. (Manulang, 2002).

Law Number 21 of 2019 in Article 9 (1) The implementation of Quarantine as referred to in Article 7 is the authority of the Central Government. (2\ To achieve the objectives as referred to in Article 7, Quarantine and supervision and/or control measures are carried out on Carrier Media which: a. are brought into the territory of the Unitary State of the Republic of Indonesia; b. are taken out of the territory of the Unitary State of the Republic of Indonesia; c. are brought into or taken out of one Area to another Area within the territory of the Unitary State of the Republic of Indonesia; or d. are transited within or outside the territory of the Unitary State Republic of Indonesia. (3) Supervision and/or control as referred to in paragraph (2) is carried out on Carrier Media in the form of Food, Feed, PRG, SDG, Biological Agents, Invasive Alien Species, Wild Plants and Animals, and Rare Plants and Animals.

CONCLUSION

Heating bird's nest (EBN) at 100 °C for one hour denatures the protein, thus altering the functional properties of EBN. This treatment also reduces swelling capacity by up to 50% and significantly impacts the sensory and physicochemical properties of EBN products, including color, taste, aroma, and texture. Heating bird's nest at 100°C for one hour affects the quality of EBN, while heating EBN in accordance with the requirements of the World Organization for Animal Health (WOAH), which is heating at 70°C for 3.5 seconds, does not affect the quality of EBN. Supervision of food traffic, in this case, bird's nest, for international transportation is carried out by the Quarantine Agency in accordance with Law Number 21 of 2019 concerning Animal, Fish, and Plant Quarantine.

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