

PENGETAHUAN PENGOLAHAN, PENGALAMAN MEMASAK, DAN EVALUASI SENSORI BAKSO AYAM YANG DIPROSES DENGAN PROSEDUR BERBEDA

PROCESSING KNOWLEDGE, COOKING EXPERIENCE, AND SENSORY EVALUATION OF CHICKEN MEATBALLS PREPARED USING DIFFERENT PROCESSING PROCEDURES

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Abstract. Chicken meatball processing requires an understanding of the technical principles involved in the development of product characteristics and sensory acceptance. This cross-sectional observational study with paired sensory evaluation aimed to assess respondents' knowledge of chicken meatball processing, compare the sensory characteristics of a sample produced according to recommended technical principles (742) with those of a sample produced using a suboptimal procedure (385), and analyses the relationships of cooking experience and processing knowledge with overall acceptance. Data were collected from 101 respondents using a structured questionnaire covering respondent characteristics, seven knowledge items, and sensory evaluations of both samples. The evaluated attributes included aroma, texture, chewiness, elasticity, homogeneity, hardness, perceived water-holding characteristics, perceived emulsion stability, colour, and overall acceptance. Data were analysed descriptively, followed by the Wilcoxon signed-rank test, Mann-Whitney U test, and Spearman's rank correlation. Respondents generally demonstrated low to moderate knowledge, with a mean score of 3.60 ± 1.36 out of 7. Sample 742 received significantly higher scores than sample 385 for aroma, texture, homogeneity, hardness, perceived water-holding characteristics, perceived emulsion stability, colour, and overall acceptance ($p < 0.001$), whereas chewiness and elasticity did not differ significantly. Cooking experience was not significantly associated with knowledge or overall acceptance. Knowledge showed only a weak negative correlation with acceptance of sample 385 ($\rho = -0.245$; $p = 0.013$). Overall, product acceptance was more consistently associated with perceived sensory characteristics than with respondents' cooking experience or processing knowledge.

Keywords: Consumer perception; Livestock product technology; Organoleptic characteristics; Overall acceptance; Rigor mortis

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INTRODUCTION

Meatballs are widely consumed processed meat products in Indonesia and are valued for convenience, sensory acceptability, and adaptable formulations (Purnomo & Rahardiyana, 2008; Hermanianto *et al.*, 2021). In the Indonesian food context, consumer perceptions may also extend beyond intrinsic product characteristics to broader considerations related to product assurance and halal certification (Magfiratun *et al.*, 2025; Muksalmina *et al.*, 2022). Product quality is influenced by raw materials and processing conditions, including salt concentration, temperature control, starch incorporation, water retention, emulsion stability, and heating (Fu *et al.*, 2026; Kang *et al.*, 2024; Li *et al.*, 2025; Zamzurin *et al.*, 2024). Consequently, successful meatball processing requires practical skill and processing knowledge of comminuted meat systems.

Sensory quality is central to product acceptance because respondents evaluate food through multiple attributes, including appearance, aroma, texture, juiciness, and overall eating quality (Cardona *et al.*, 2023; Pramudito *et al.*, 2025; Tura *et al.*, 2024). More broadly, food acceptance and consumer choice may reflect multiple product-related perceptions and beliefs rather than a single product attribute (Żakowska-Biemans, 2026; Żurek *et al.*, 2026). In meatball processing, ice helps control batter temperature, salt supports myofibrillar protein extraction, and starch contributes to water retention and structural stability

(Kang *et al.*, 2024; Li *et al.*, 2025; Xing *et al.*, 2017). However, sensory judgement and processing knowledge are conceptually distinct: a respondent may recognise an acceptable product without understanding the processing mechanisms that contribute to its characteristics.

Previous studies have largely examined formulation, physicochemical properties, emulsion stability, or sensory quality separately (Muksalmina *et al.*, 2022; Fu *et al.*, 2026; Muthukrishnan & Adeyeye, 2026; Zou *et al.*, 2024). Studies of food-processing knowledge also indicate that cognitive knowledge does not necessarily correspond with practice or product evaluation (Borghoff *et al.*, 2023; Bulochova *et al.*, 2024; Wang *et al.*, 2021). This creates a need to examine processing knowledge, practical experience, and sensory responses within the same observational framework.

This study therefore examined respondents' processing knowledge and cooking experience alongside their sensory evaluation of two coded chicken meatball samples produced under different conditions: sample 742, prepared according to recommended processing principles, and sample 385, prepared using a suboptimal procedure. The objectives were to evaluate processing knowledge, compare sensory characteristics and overall acceptance between the two samples, and analyse the relationships of cooking experience and processing knowledge with overall acceptance.

MATERIALS AND METHODS

This study used a cross-sectional observational design with a within-subject paired sensory evaluation. It was conducted at the Postharvest Technology Laboratory, Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia, between 08:00 and 10:00 a.m. A total of 101 respondents completed the knowledge assessment and evaluated both coded chicken meatball samples under the same conditions.

Respondents were purposively recruited from participants in a meatball-processing educational activity. Eligible respondents regularly consumed meatballs, voluntarily agreed to participate, had prior cooking experience, and possessed general processing knowledge production. Respondent characteristics included age, occupation, motivation, and cooking experience. Cooking experience was defined as the self-reported duration of food preparation in household, educational, or other practical settings. It was initially classified into <5, 5–10, and >10 years, and regrouped into <5 and ≥ 5 years for inferential analysis because only 5 respondents reported >10 years of experience. Standardised panellist-selection and evaluation procedures support the reliability of sensory data (Prachi & Maurya, 2024).

Data were collected using a structured questionnaire comprising respondent characteristics, seven processing-knowledge items, and sensory evaluations of both samples. Structured questionnaires and sensory methods are commonly used to examine cogni-

tive measures and food-product responses (Bulochova *et al.*, 2024; Imtiyaz *et al.*, 2021).

Two chicken meatball samples represented recommended and sub-optimal processing conditions. Sample 742 used chicken breast, ice during grinding, temperature control, grinding until the batter was sticky, smooth, and elastic, appropriate salt and tapioca incorporation, and processing before completion of rigor mortis. These conditions are consistent with principles supporting functional properties, water retention, and structural development in comminuted meat systems (Fu *et al.*, 2026; Kumar *et al.*, 2018; Li *et al.*, 2025; Weerasinghe *et al.*, 2021). Sample 385 intentionally deviated from these principles through a less appropriate chicken portion, inadequate ice and temperature control, premature termination of grinding, insufficient salt, inappropriate tapioca application, and processing outside the intended pre-rigor period. Such variations can affect emulsion formation, water retention, texture, and product stability (Wan Rusni Wan Ismail *et al.*, 2024; Zou *et al.*, 2024). Three-digit codes concealed processing conditions from respondents and minimised expectation bias (Tura *et al.*, 2024).

The sensory evaluation comprised attribute-specific sensory assessment and hedonic evaluation. Respondents assessed nine sensory and perceived physical attributes using attribute-specific five-point ordinal scales, while overall acceptance was assessed on a five-point hedonic scale (Table 2).

Table 1. Knowledge assessment items for chicken meatball processing

Code	Knowledge item	Correct answer used for scoring
KP1	Suitable chicken portion for meatball production	Breast
KP2	Function of ice during production	Prevent deterioration during processing
KP3	The batter should remain cold	Maintain processing quality
KP4	Indicator of completed grinding	Sticky, smooth, and elastic batter
KP5	Factors contributing to excessive hardness/softness	Insufficient salt
KP6	Function of tapioca flour	Increase meatball firmness
KP7	Borax-free processing principle	Grind meat before the completion of rigor mortis

Note: Each correct knowledge response was scored 1 and each incorrect response 0, giving a total score of 0–7. Knowledge percentage was calculated as total score/7 × 100. For descriptive purposes, knowledge was operationally classified as poor (0–3), moderate (4–5), or good (6–7); these cut-offs were study-specific and were not externally validated.

Table 2. Sensory attributes and five-point rating scales

Attribute	Assessment indicator	Scale anchors (1–5)
Texture	Softness/compactness	Very soft – very compact
Chewiness	Chewing resistance	Not chewy – very chewy
Elasticity	Smooth, sticky, elastic character	Coarse – very elastic
Homogeneity	Uniformity of ingredient mixing	Not homogeneous – very homogeneous
Hardness	Hardness/softness of final product	Very soft – very hard
Perceived water-holding characteristics	Perceived ability to retain water	Very low – very high
Perceived emulsion stability	Perceived stability of meat-fat-water mixture	Unstable/separated – very stable
Colour	Appearance after boiling	Pale/unattractive – bright/attractive
Aroma	Characteristic aroma without off-odours	Strong off-odour – characteristic aroma
Overall acceptance	Overall liking	Dislike very much – like very much

Data were analysed using IBM SPSS Statistics version 31. Descriptive statistics summarised respondent characteristics and knowledge. The Wilcoxon signed-rank test compared paired sensory ratings between samples 385 and 742. Mann-Whitney U tests compared knowledge scores and overall acceptance between respondents with <5 and ≥ 5 years of cooking experience. Spearman's rank correlation examined associations between knowledge score and overall acceptance of sample 385 (OAC385), sample 742 (OAC742), and Diff_OAC, calculated as $OAC385 - OAC742$. Statistical significance was set at $p < 0.05$. Non-parametric tests were used because the sensory responses were ordinal (Prachi & Maurya, 2024; Tura *et al.*, 2024).

Participation was voluntary. Respondents were informed about study objectives, procedures, anonymity, and research use of the data before participation. Names were excluded from the analytical dataset and results were reported in aggregate. The study did not undergo formal institutional ethics review because it involved a non-invasive educational activity and sensory evaluation of commonly consumed foods without collection of sensitive or personally identifiable information.

RESULT AND DISCUSSION

1. Respondent profile and processing knowledge

All 101 respondents were younger than 34 years and 97.0% were students. Most participated to increase knowledge (72.3%), and 77.2% reported less

than five years of cooking experience (Table 3). Occupation therefore described formal status rather than meat-processing competence. The homogeneous respondent profile is important when interpreting associations involving experience and knowledge.

Respondents generally demonstrated low to moderate processing knowledge. Although most participants joined the activity to increase their knowledge, motivation did not correlate with high technical scores. Meatball processing requires understanding of temperature control, salt-mediated protein extraction, starch functionality, water retention, and emulsion formation, concepts that are not necessarily acquired through routine cooking (Kang *et al.*, 2024; Li *et al.*, 2025; Xing *et al.*, 2017). General food preparation may develop practical familiarity without equivalent understanding of the physicochemical basis of meat processing (Borghoff *et al.*, 2023; Wang *et al.*, 2021).

The predominance of respondents with limited cooking experience may also have constrained variability in processing knowledge. These findings support the value of structured processing education that links practical steps with their technological rationale, particularly when consistent product quality is required (Kimaru *et al.*, 2025; Santos, 2026).

Table 3. Respondent profile and knowledge of chicken meatball processing

Variable	Category/indicator	Result n (%)
Age	<34 years	101 (100.0%)
Occupation	Student	98 (97.0%)
	Private employee/entrepreneur	1 (1.0%)
	Others	2 (2.0%)
Motivation	Start a business	12 (11.9%)
	Increase knowledge	73 (72.3%)
	Others	16 (15.8%)
Cooking experience	<5 years	78 (77.2%)
	5–10 years	18 (17.8%)
	>10 years	5 (5.0%)
Knowledge score	Mean $\pm$ SD; range	3.60 $\pm$ 1.36; 1–6
Knowledge percentage	Mean $\pm$ SD; range	51.49 $\pm$ 19.39%; 14–86%
Knowledge category	Poor / Moderate / Good	46 (45.5%) / 48 (47.5%) / 7 (6.9%)

Table 4. Wilcoxon signed-rank comparison of samples 385 and 742

Attribute	Neg.	Pos.	Ties	Z	p
Aroma	11	69	21	−6.542	<0.001
Texture	12	69	20	−6.403	<0.001
Chewiness	35	25	41	−1.205	0.228
Elasticity	43	30	28	−1.821	0.069
Homogeneity	13	52	36	−5.060	<0.001
Hardness	7	73	21	−6.896	<0.001
Perceived water-holding characteristics	14	54	33	−5.369	<0.001
Perceived emulsion stability	10	61	30	−5.842	<0.001
Colour	11	65	25	−6.553	<0.001
Overall acceptance	8	57	36	−6.422	<0.001

Note: Negative ranks indicate lower scores for sample 742 than 385; positive ranks indicate higher scores for 742. Perceived water-holding characteristics and emulsion stability were sensory perceptions, not instrumental measurements.

2. Sensory characteristics and overall acceptance

The two samples differed in processing procedure but were coded and presented under identical sensory conditions. The Wilcoxon signed-rank test showed significant differences for aroma, texture, homogeneity, hardness, perceived water-holding characteristics, perceived emulsion stability, colour, and overall acceptance (all $p < 0.001$), whereas chewiness ($p = 0.228$) and elasticity ($p = 0.069$) did not differ significantly (Table 4). Positive ranks predominated for all significant attributes, indicating consistently higher ratings for sample 742.

The higher ratings for sample 742 across eight attributes indicate that respondents perceived broad differences between the recommended and suboptimal processing conditions. Acceptance of processed meat reflects combined sensory cues rather than a single characteristic (Anagnostou *et al.*, 2025; Muthukrishnan & Adeyeye, 2026; Rodrigues *et al.*, 2024). The higher aroma, colour, perceived water-holding, and perceived emulsion-stability ratings for sample 742 are consistent with the possibility that more appropriate processing conditions produced a more favourable sensory profile (Gorbunova *et al.*, 2026; Shi *et al.*, 2026; Zhan *et al.*, 2025). Because these properties were not measured instrumentally, the findings are restricted to respondents' perceptions.

Chewiness and elasticity were similar between samples despite differences in most other attributes. This indi-

cates that greater overall acceptance was not accompanied by significant differences in every texture-related characteristic. Sensory perception may diverge from instrumental texture measurements (Munmun *et al.*, 2026; Okus-khanova *et al.*, 2026; Pematilleke *et al.*, 2022). Instrumental texture profile analysis, rheology, microstructure, colour measurement, and volatile profiling would be required to explain the physicochemical mechanisms underlying these sensory responses.

3. Relationships among knowledge, experience, and acceptance

Cooking experience was not significantly associated with knowledge score ($U = 853.000$, $p = 0.716$) or with overall acceptance of either sample and Diff_OAC (all $p > 0.05$; Table 5). Thus, general cooking experience did not explain differences in processing knowledge or overall acceptance. The predominance of students and respondents with <5 years of experience may have reduced between-group variability.

The absence of significant experience effects is consistent with the distinction between routine cooking and specific knowledge of meat-processing principles. The knowledge instrument addressed meat selection, ice use, temperature control, grinding, salt, tapioca functionality, and processing in relation to rigor mortis. These are specialised processing concepts rather than general indicators of time spent cooking (Borghoff *et al.*, 2023; Kang *et al.*, 2024; Wang *et al.*, 2021).

Table 5. Mann-Whitney U tests according to cooking experience

Outcome	<5 y mean rank	≥5 y mean rank	U	Z	p
Knowledge score	50.44	52.91	853.000	−0.364	0.716
OAC385	48.91	58.09	734.000	−1.359	0.174
OAC742	50.61	52.33	866.500	−0.279	0.780
Diff_OAC	49.71	55.39	796.000	−0.847	0.397

Table 6. Spearman correlations between knowledge score and overall acceptance

Variable	Spearman's ρ	p	N	Interpretation
OAC385	−0.245	0.013	101	Weak negative, significant
OAC742	−0.101	0.314	101	Not significant
Diff_OAC	−0.185	0.064	101	Not significant

Spearman analysis showed a weak negative correlation between knowledge score and overall acceptance of sample 385 ($\rho = -0.245$, $p = 0.013$), but no significant correlation with sample 742 or Diff_OAC (Table 6). Respondents with greater processing knowledge therefore tended to rate the sub-optimal sample slightly more critically, although the weak magnitude indicates that knowledge accounted for only limited variation in acceptance.

Taken together, the sensory comparison showed a more consistent pattern than the knowledge- and experience-based analyses: sample 742 received higher ratings for eight of ten attributes, while cooking experience showed no significant associations and knowledge showed only one weak correlation. Within this observational dataset, perceived sensory characteristics were therefore more consistently associated with overall acceptance than respondents' cooking experience or processing knowledge. This does not

establish that processing conditions or physicochemical quality caused acceptance, because the study did not experimentally isolate individual processing factors or measure physicochemical properties instrumentally.

CONCLUSION

Respondents demonstrated generally low to moderate knowledge of chicken meatball processing. Chicken meatballs prepared according to the recommended processing procedure showed a more favourable sensory profile and greater overall acceptance than those prepared using the suboptimal procedure, although differences were not evident for all sensory attributes. Cooking experience was not associated with processing knowledge or overall acceptance, while processing knowledge showed only a limited relationship with product acceptance. Overall, these findings indicate that perceived sensory characteristics were more consistently associated with the acceptance of chicken meatballs than respondents'

cooking experience or processing knowledge. Given the observational design of the study, these relationships should be interpreted as associations rather than causal effects.

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