Beyond the Published Record: A Two-Pass Formalization Audit of Tacit Culinary Knowledge on Musakka

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EXTENDED ABSTRACT

Computational formalization of culinary knowledge is an established research programme: food ontologies (formal, machine-readable models of a domain's concepts and relations) integrate food description across agriculture, nutrition, and safety (Dooley et al., 2018); food computing assembles large-scale recipe corpora for retrieval, recommendation, and health applications (Min et al., 2019); and computational gastronomy derives structural hypotheses from recipe and flavor-compound data (Ahn et al., 2011). These pipelines share one source substrate: the published, text-borne record — recipes, databases, and the scholarly literature. Where its coverage fails, the failure is standardly treated as sparsity: missing sources, remediable by better retrieval and integration. However, knowledge theory supplies grounds to doubt this. Polanyi's (1958, 1966) account of tacit knowing holds that skilled performance rests partly on knowledge its bearer cannot fully articulate, and Nonaka (1994) treats externalization (rendering tacit knowledge explicit) as a distinct, effortful, and inherently partial conversion. Culinary competence in particular has been argued to be substantially tacit and systematically under-captured by written instruction (Farmer & Hingst, 2025). If these accounts are correct, the culinary published record should be deficient in a specific kind of knowledge rather than a specific amount. To our knowledge, this implication has not been tested against formalization practice. The purpose of this study is such a test: an audit of what a structured formalization attempt finds missing when it reaches a prespecified stopping rule within a protocol-bounded published corpus for a single dish, and of what tacit-knowledge (TK) acquisition detects beyond it. The answer matters for food informatics, for gastronomy publication norms, and for culinary education and R&D.

Three research questions are posed. RQ1: After documented closure attempts conducted under a prespecified protocol against the bounded published record, does a non-negligible residual of unformalizable content remain? RQ2: Is that residual patterned onto tacit-knowledge categories (a type-deficiency of the record) rather than randomly distributed sparsity? RQ3: Does TK acquisition render gaps visible beyond what literature analysis alone exposes? The principal claim under test is that, because the published culinary/gastronomy literature systematically elides the tacit dimension, it is insufficient as the sole source substrate for formalizing culinary knowledge; TK acquisition (though not itself verified academic knowledge) is the necessary instrument for rendering these gaps visible and for directing the academic studies that must fill them. Two falsifiability conditions were committed at protocol level before the passes: the claim fails if (a) the residual proves negligible or closable by retrieval, or (b) elicitation adds nothing beyond literature analysis; either outcome was committed to publication.

The design is a two-pass formalization audit on one dish — Turkish patlıcan musakka, a preparation with substantial published documentation spanning food science, history and etymology, regional variation, and food safety; the dish is the audit's vehicle, not its subject. The formalization target is fixed at the requirements level of ontology-engineering practice, operationalized as competency questions (the questions the finished formalization must be able to answer; Grüninger & Fox, 1995). It organizes the required content into six slot families (a slot being one discrete information requirement): entities and materials; transformations and parameters; endpoint criteria; sequencing and dependency; conditional adaptation; and rationale. A slot counts as filled only at operational precision, a defined sufficiency criterion: the published content must allow an independent competent executor to perform and verify the step without unstated judgment. The criterion is deliberately strict, because procedural text characteristically elides argu-

ments and defers to the reader's world knowledge (Kiddon et al., 2015); it was applied by researcher judgment against the written criterion, with a recorded rationale per assignment. Pass 1 attempts to fill every slot from the published record alone: a vehicle corpus fixed in advance (e.g., Şen, 2020), extended by published recipe text and by open retrieval under a logged query grid with a stated stopping rule. Every slot left unfilled becomes a gap record carrying its documented closure attempt. A seven-class gap typology with an ordered decision procedure was fixed before any elicitation material was opened. It comprises a retrieval-closable control class (Type 0) and six deficit classes: parametric (P), sensory-endpoint (S), procedural-somatic (M), adaptive-conditional (A), causal-explanatory (E), and collective-contextual (C); the categories are anchored in the tacit-knowledge literature (Polanyi, 1958, 1966; Soler & Zwart, 2013; Cowan et al., 2000). Pass 2 applied protocol-guided semi-structured interviews with 17 practitioners who prepare the dish in domestic and professional settings, conducted in Turkish with informed consent and under the confidentiality and personal-data commitments of Law No. 6698 (KVKK). The study was approved by the Eskişehir Osmangazi University Social and Human Sciences Human Research Ethics Committee (Decision No. 2026-01). The instrument is a narrative walk-through of a complete preparation with probe families keyed to the same six slot families, following established elicitation methodology (Hoffman et al., 1995). Recordings were transcribed under a locally executed automatic-speech-recognition (ASR) plus full-human-verification protocol (Whisper; Radford et al., 2023) and coded against the same slots and typology. Throughout, elicited TK enters the analysis as raw, unvalidated externalized content: it marks where knowledge is and what must be studied, and is never itself entered as verified knowledge.

Findings are reported as preliminary: coding and consolidation are complete and internally recomputed, while the study's remaining verification steps — audit sampling of transcripts and full citation- and results-integrity checks — are scheduled ahead of the full paper. Pass 1 decomposed the preparation into 35 slots: 12 were filled at operational precision by citable sources; 4 slots proved retrieval-closable in full, and parameter components of 3 further slots closed likewise (Type 0, counted against the claim); 19 slots survived documented closure attempts as the residual. The residual was concentrated in the prespecified tacit-associated classes (sensory-endpoint 5, procedural-somatic 2, adaptive-conditional 6, collective-contextual 1 — 14/19, ≈74%), with the remainder parametric 4 and causal-explanatory 1. The record fills the dimensions scholarship has studied (frying parameters, safety endpoints, ingredient chemistry, substitution history) and fails at endpoint recognition, manner of execution, and adaptation: the executor's knowledge. In Pass 2, elicitation addressed all 19 residual gaps at least once (244 coded detection rows, yielding 251 gap-mappings because seven rows address two gaps each). Under explicit deduplication and fold rules, it further registered 38 emergent candidate slots that Pass-1 analysis had not surfaced, kept in a ledger separate from the frozen Pass-1 set; their composition shows a similar tacit-type-weighted distribution (≈63%). New-slot yield saturated within the interview set: the final three interviews added none. Contests (the parameter values, practices, endpoint vocabularies, and rationales on which practitioners systematically disagree) nonetheless continued to accumulate through the final interview, reaching 148 coded rows (≥11 in each of the final five interviews): "gaps close, contests accumulate," a pattern consistent with convention-type deficits. Elicitation also surfaced practices divergent from codified food-safety knowledge, each typed against the literature with an evidential warrant — an outcome consistent with the detector role assigned to elicitation.

The preliminary findings are consistent with the theoretical expectation: the record's failure behaves as a type-deficiency rather than sparsity. Where natural-language-processing work has shown that recipes elide arguments recoverable from context (Kiddon et al., 2015), the audit indicates a deeper stratum (perceptual endpoints, somatic manner, adaptation policies, collective convention) that the specified retrieval protocol could not recover: content the theoretical accounts predict is rarely written down at all. Participant-reported first articulations during the interviews are consistent with externalization in Nonaka's (1994) sense — practitioners putting into words, by their own report for the first time, knowledge they had not previously verbalized. If the pattern generalizes, literature-only pipelines inherit this deficiency invisibly; the audit procedure now makes that proposition testable on other preparations. The record is fullest where scholarship has looked and emptiest at the craft core — an observation gastronomy publication

norms can act on. For culinary education, the elicited contest structure (novice-calibrated endpoint articulation, supervised practice-and-repetition pedagogy) identifies testable priorities for instructional design.

Within a protocol-bounded corpus and a single case, the study offers four contributions. The first two are findings: insufficiency (19 of 35 initially specified requirements unresolved after documented retrieval attempts) and systematicity (preliminary evidence consistent with type-patterning, under a typology committed before elicitation). The other two are methodological: a role assignment (TK acquisition as detector and director of academic study, not as filler) and a documented audit procedure specified for independent re-execution on another preparation. The demonstration is bounded — one dish, one formalization attempt; neither the sufficiency of elicitation nor universality across culinary domains is asserted — and the findings remain preliminary pending the scheduled verification stage. The original contribution is the audit itself: to our knowledge, the first structured, falsifiable procedure for measuring what the published culinary record leaves unsaid, and for directing the studies that must say it.

This audit was conducted within the author's culinary-ontology programme (TÜBİTAK Project No. 125E691), for which literature-derived formalization is one input channel.

Keywords: *tacit knowledge; knowledge elicitation; culinary knowledge; formalization audit; food informatics*

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