

ABSTRAK

Kopi merupakan komoditas strategis yang nilai ekonomi dan mutunya sangat dipengaruhi oleh cita rasa. Pengembangan produk kopi saat ini cenderung berfokus pada peningkatan mutu fisikokimia dan sensoris, sementara kebutuhan afektif konsumen belum terintegrasi secara memadai. Penelitian ini bertujuan menghasilkan purwarupa produk kopi *Fine Robusta* Menoreh dengan cita rasa unik, kompleks, dan seimbang yang mampu memenuhi kebutuhan konsumen dan kebutuhan teknis melalui pendekatan Rekayasa Kansei Cerdas. Pendekatan ini mengintegrasikan Rekayasa Kansei untuk menerjemahkan kebutuhan emosional konsumen ke dalam parameter teknis terukur, *Fuzzy Analytical Hierarchy Process* (FAHP) untuk pembobotan multikriteria yang bersifat subjektif dan linguistik, serta metode *Taguchi* untuk optimasi kombinasi perlakuan berdasarkan *signal to noise ratio* (SNR). Penelitian dilaksanakan dalam tiga tahap. Tahap pertama menghasilkan profil kebutuhan konsumen dan kebutuhan teknis sebagai dasar penyusunan portofolio konsep berdasarkan 3 kopi *Fine Robusta* Menoreh dari pengolahan basah, semi-basah, dan hibrida. Kebutuhan verbal konsumen direpresentasikan oleh 25 *kansei words* yang diekstraksi dari 44 *kansei words* pada 160 responden, terbagi dalam dua klaster: kenyamanan pascakonsumsi serta cita rasa unik, kompleks, dan seimbang. Parameter non-verbal diukur melalui lima respon fisiologis, dengan detak jantung teridentifikasi berasosiasi signifikan terhadap kenyamanan (*Ordinal Logistic Regression* (ORL): $p = 0,000$; $\beta = 0,368$; *odd ratio* (OR) = 1,445). Urutan prioritas kebutuhan konsumen adalah kenyamanan emosional dan relaksasi, pengalaman aroma dan sensoris, serta stimulasi dan karakter produk. Kebutuhan teknis meliputi: 1) karakteristik fisik (*green bean* yang memenuhi standar SNI 01-2907-2008), biokimia meliputi kandungan lemak (6,46 – 7,76%); abu (4,12 – 4,35%); protein (14,24 – 14,72%); serat kasar (17,90 – 19,96%); karbohidrat (63,86 – 65,55%); glukosa (0,05 – 0,17%); fruktosa (0,29 – 0,78%); sukrosa (4,96 – 5,47%); pH (4,75 – 5,17); asam klorogenat (0,21 – 0,48%); kafein (2,21 – 2,80%); aktivitas antioksidan berdasarkan nilai IC_{50} metode DPPH (7,51 – 109,30 mg/L); total flavonoid (96,68 – 139,45 QE mg/g), dan total fenolik (125,37 – 181,22 GAE mg/g). Selain itu, senyawa volatil aroma dominan berasal dari kelompok furan, pyrazine, dan fenolik. 3) karakteristik sensoris dengan skor *cupping test* 82,80–84,40. Selain itu teridentifikasi tiga isolat khamir beraktivitas pektinolitik tinggi, yaitu *M. caribbica* J1 dan *W. anomalus* I1 dan I2 sebagai agen fermentasi terkontrol. Tahap kedua mencakup penyusunan, pengujian, dan seleksi konsep desain terbaik. Dari 33 responden diekstraksi 13 *kansei words* yang lebih terarah pada relaksasi emosional dan kualitas cita rasa. Kebutuhan konsumen diterjemahkan ke dalam bobot terukur: skor kenyamanan *fuzzy inference system* (FIS) (0,60), cita rasa (0,16), aroma (0,12), *overall liking* (0,08), dan stimulan kafein (0,04). Aplikasi isolat khamir berkontribusi signifikan terhadap peningkatan karakteristik fisik, biokimia, dan sensoris dibandingkan kontrol. Senyawa volatil aroma dominan dari kelompok furan, pirazin, dan fenolik membentuk profil *smoky*, rempah, coklat, manis, dan karamel. Kenyamanan pascakonsumsi secara signifikan dipengaruhi oleh perubahan tekanan darah sistolik ($p = 0,020$; OR =



0,977) dan diastolik ($p = 0,017$; OR = 0,967), mengindikasikan sensibilitas respon kenyamanan terhadap perlakuan fermentasi. Tahap ketiga memvalidasi purwarupa terpilih melalui uji konfirmasi. Kopi Robusta Menoreh yang difermentasi selama 36 jam dengan isolat *M. caribbica* J1 berada dalam rentang *confidence interval* 95% dan 99%, serta terbukti memenuhi kebutuhan konsumen dan kebutuhan teknis sehingga ditetapkan sebagai purwarupa produk kopi *Fine Robusta* Menoreh.

Kata kunci: kopi Robusta Menoreh, pengembangan produk, fermentasi, cita rasa, rekayasa *Kansei* cerdas, kebutuhan konsumen, kebutuhan teknis

ABSTRACT

Coffee is a strategic commodity whose economic value and quality are strongly influenced by flavor. Current coffee product development tends to focus on physicochemical and sensory quality improvement, while consumer affective needs remain inadequately integrated. This study aimed to develop a prototype of *Fine Robusta* Menoreh coffee product with a unique, complex, and balanced flavor profile that simultaneously meets consumer needs and technical requirements through an Intelligent Kansei Engineering approach. This approach integrates Kansei Engineering to translate consumers' emotional needs into measurable technical parameters, Fuzzy Analytical Hierarchy Process (FAHP) for multi-criteria weighting of subjective and linguistic judgments, and the Taguchi method to optimize treatment combinations based on signal-to-noise ratio (SNR). The study was conducted in three stages. The first stage produced consumer needs and technical requirements profiles as the basis for concept portfolio development, derived from three *Fine Robusta* Menoreh coffees processed using wet, semi-wet, and hybrid methods. Consumer verbal needs were represented by 25 Kansei words extracted from 44 Kansei words collected from 160 respondents, grouped into two clusters: post-consumption comfort, and unique, complex, and balanced flavor. Non-verbal parameters were measured through five physiological responses, with heart rate identified as significantly associated with comfort level (Ordinal Logistic Regression: $p=0.000$; $\beta=0.368$; $OR=1.445$). Consumer need priorities were ranked as emotional comfort and relaxation, aroma and sensory experience, and stimulation and product character. Technical requirements included: (1) physical characteristics of green beans meeting SNI 01-2907-2008 standards; (2) biochemical characteristics comprising fat content (6.46–7.76%), ash (4.12–4.35%), protein (14.24–14.72%), crude fiber (17.90–19.96%), carbohydrates (63.86–65.55%), glucose (0.05–0.17%), fructose (0.29–0.78%), sucrose (4.96–5.47%), pH (4.75–5.17), chlorogenic acid (0.21–0.48%), caffeine (2.21–2.80%), antioxidant activity based on IC_{50} DPPH (7.51–109.30 mg/L), total flavonoids (96.68–139.45 QE mg/g), and total phenolics (125.37–181.22 GAE mg/g), with dominant aroma volatile compounds from furan, pyrazine, and phenolic groups; and (3) sensory characteristics with cupping scores of 82.80–84.40. Three yeast isolates with high pectinolytic enzyme activity, namely *M. caribbica* J1 and *W. anomalus* I1 and I2, were selected as controlled fermentation agents. The second stage encompassed the development, testing, and selection of the best design concept. Thirteen Kansei words were extracted from 33 respondents, oriented toward emotional relaxation and flavor quality. Consumer needs were translated into measurable weights: comfort score from fuzzy inference system (FIS) (0.60), flavor (0.16), aroma (0.12), overall liking (0.08), and caffeine stimulant effect (0.04). Yeast isolate application contributed significantly to improvements in physical, biochemical, and sensory characteristics compared to the control. Dominant aroma volatile compounds from furan, pyrazine, and phenolic groups generated smoky, spicy, chocolate, sweet, and caramel profiles. Post-consumption comfort was significantly influenced by



changes in systolic blood pressure ($p = 0.020$; OR = 0.977) and diastolic blood pressure ($p = 0.017$; OR = 0.967), indicating the sensitivity of comfort responses to fermentation treatment. The third stage validated the selected prototype through confirmation testing. Robusta Menoreh coffee fermented for 36 hours with *M. caribbica* J1 isolate fell within the 95% and 99% confidence intervals and was confirmed to meet both consumer needs and technical requirements, thus establishing it as the *Fine Robusta* Menoreh coffee prototype.

Keywords: Robusta Menoreh coffee; product development; fermentation; flavour; Intelligent Kansei Engineering; consumer needs; technical requirements.



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Pengembangan Produk Kopi Fermentasi Dengan Rekayasa Kansei Cerdas
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Universitas Gadjah Mada, 2026 | Diunduh dari <http://etd.repository.ugm.ac.id/>