

Smart Pantry Tracker

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Abstract

Food management at home is constrained by two persistent issues: wasted ingredients and uncertainty around meal choices. Items commonly reach their expiration date and recipes are disrupted by minor gaps in ingredient availability. While existing pantry apps focus on logging what's on hand, they rarely connect that data to usable recipes. On the other hand, recipe platforms generally assume full ingredient access with limited flexibility for substitutions. Smart Pantry Tracker addresses these issues by combining a digital pantry with real-time tracking information and a recipe engine that separates fully cookable meals from near matches supported by evidence-based substitutions. The system is designed to deliver practical values such as reducing waste and lowering household costs, with decision-making support for easier meal choices. Transparency is ensured through an evidence drawer that grounds recommendations in authoritative sources, while the design also establishes a foundation for future enhancements.

Project Pitch: Smart Pantry Tracker

Problem

Households often struggle with food waste and meal selection challenges. Ingredients routinely expire before use and planned recipes are derailed by a single or two missing items. Current pantry apps focus more on inventory management but fall short on guiding and translating that information into actionable cooking decisions. Similarly, recipe platforms are widely available and built on the assumption of perfect ingredient availability, with minimal substitution options.

Smart Pantry Tracker closes this gap through 1) a digital pantry tracking with real-time visibility into ingredient status 2) intelligent recipe matching that incorporates systematic substitutions. The problem is both practical (maximizing ingredient use and minimizing waste) and cognitive (streamlining decision-making through immediate, relevant recipe suggestions).

This system connects digital pantry tracking with intelligent recipe matching and substitutions to reduce waste, cut costs, and increase user confidence in everyday cooking

Stakeholders

Individual home cooks: Users seeking straightforward meal options from on-hand ingredients.

Families/households: Groups looking to reduce waste and streamline shared meal planning.

Budget conscious users: Cooks who need to maximize grocery value through efficient ingredient use.

Recipe contributors: Creators who share adaptable recipes with substitution guidance.

Culinary learners: Individuals building skills by experimenting with substitutions and pantry-driven meals.

Time-pressed professionals: Users who want fast, reliable recipe suggestions with minimal planning effort.

Scope

In-Scope:

- **Digital pantry (CRUD):** add/edit/delete ingredients, quantity, and expiration date.
- **Recipe suggestion engine:** filter recipes into
 - Cook Now (100% match) recipes you can make immediately.
 - Near Match (1-2 items missing) with substitution suggestions
- **Substitution rules module:** curated dataset of common ingredient swaps.
- **Recipe data:** Seeded set of recipes in the database (no scraping needed).
- **AI Summarizer (lightweight touchpoint):** formats Near Match results into a 2-3 sentence, user-friendly plan, using only curated substitutions and citations.
- **Evidence drawer:** Panel that discloses substitution sources, expiration guidance, and matching assumptions.
- **Project documentation in /docs/:** captures assumptions (e.g., substitution rules, expiration logic), formulas (matching algorithm), and iteration notes.

Out-of-scope (MVA):

- Barcode scanning or automated grocery ingestion.
- Personalized nutrition or diet planning.
- Grocery delivery/shopping list integration.
- User accounts, profiles, or authentication

Success Metrics

- **Usability:** $\geq 70\%$ of first-time users can add ingredients, view expiration status, and receive at least one recipe suggestion without guidance.
- **Decision clarity:** At least 60% of sessions result in one recipe being viewed or saved (“Cook Now” or “Near Match”).
- **Substitution helpfulness:** $> 60\%$ of Near Match substitutions are rated “helpful” by users.
- **Evidence transparency:** $\geq 80\%$ of substitution explanations show linked authoritative sources in the Evidence Drawer.

Minimal Viable Artifact

The MVA includes three deliverables:

1. A working pantry CRUD system with expiration and quantity tracking
2. A recipe filtering engine that classifies recipes into Cook Now (100% Match) and Near match (1-2 items missing with substitutions)
3. An evidence drawer that discloses substitution sources, expiration guidance, and matching assumptions.

This initial build balances simplicity with utility, enabling useful meal choices and laying the groundwork for future features and enhancements.

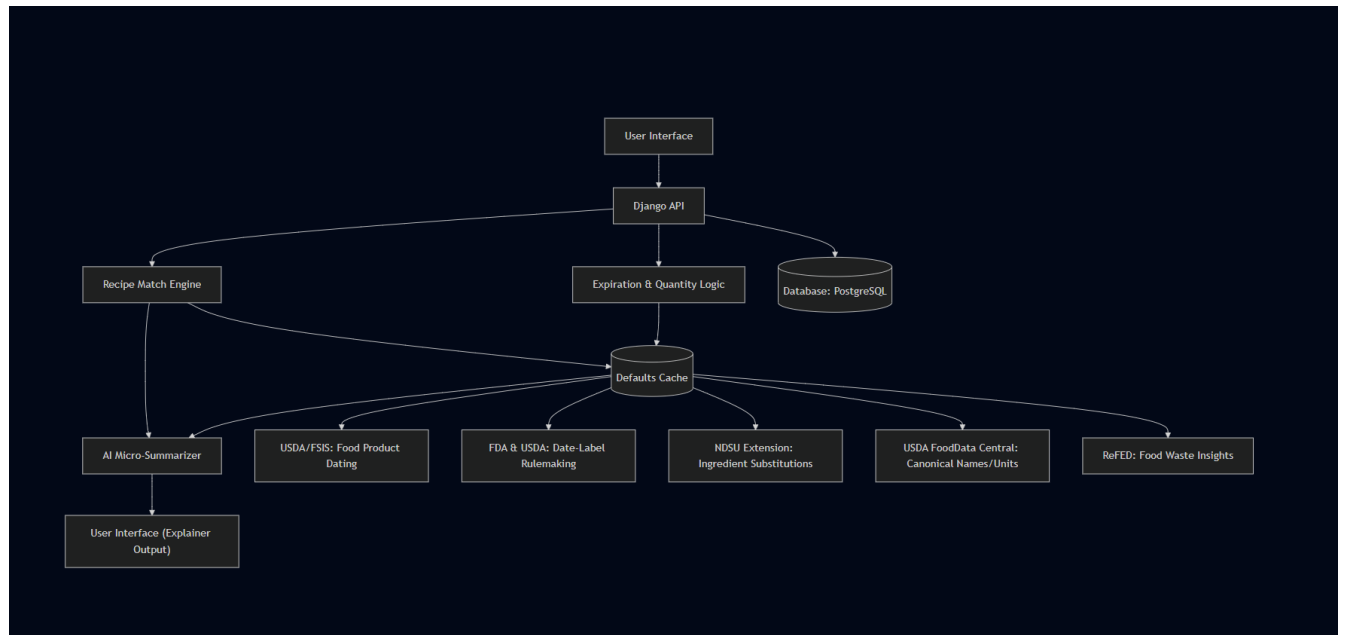
Iterative Design Approach

Development proceeds in short cycles through a repeatable loop: Planning and requirements → Analysis and design → Implementation → Testing → Evaluation and review, then back to Planning. Each cycle ends with a review against success metrics, which governs scope for the next pass.

- **Cycle 1:** Implement pantry CRUD with expirations and seed the recipe database.
- **Cycle 2:** Add recipe suggestion engine for *Cook Now* and *Near Match* with curated substitutions.
- **Cycle 3:** Enable the evidence drawer to show sources for substitutions, expirations, and assumptions.

This staged approach delivers immediate utility while keeping the system transparent and extensible.

System Sketch



Evidence Base

U.S. Department of Agriculture (2024). Food Product Dating.
<https://www.fsis.usda.gov/food-labeling/food-product-dating>

U.S. Food and Drug Administration & USDA (2024). Proposed rule on food date labeling. <https://www.federalregister.gov/>

ReFED (2025). Food Waste Insights Engine. <https://refed.org/>

Harvard Food Law & Policy Clinic (2025). Consumer perceptions of date labels and food waste. <https://chlpi.org/>

North Dakota State University Extension (2024). Ingredient Substitutions.
<https://www.ndsu.edu/agriculture/extension>

U.S. Department of Agriculture (2025). FoodData Central. <https://fdc.nal.usda.gov/>

Risk Register

Risk	Impact	Likelihood	Mitigation
Incomplete recipe or ingredient coverage	High	Medium	Seed database with common recipes; expand library incrementally
Inaccurate or unhelpful substitutions	Medium	Medium	Rely on curated substitutions from trusted sources; collect user feedback for refinement; show evidence sources in drawer.
Evidence drawer lacks clarity or citations	Medium	Medium	Require each substitution and expiration rule to include source metadata; user testing on drawer readability.
Scope creep relative to MVA	Medium	High	Use review gates to confirm or defer features; track enhancements in a public roadmap; keep core flows stable.