CSC440 Project 1 - Database Design Report

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Database Design Modeling Choices

User Authentication System

We implemented a separate USER entity with role-based mapping to MANUFACTURER and SUPPLIER entities. This design supports the "Login → Select role" flow described in Appendix A while enforcing the business rule that "a user holds exactly one role." The role field in USER determines which business entity (if any) the user is associated with, with VIEWER roles requiring no additional entity since they have read-only access.

Supplier Ownership of Ingredients

The INGREDIENT entity includes supplier_id as the owner because the functional requirements specify that suppliers "Define/Update Ingredient (Atomic or Compound)" rather than just providing existing ingredients. This means multiple suppliers can create ingredients with the same name (for example, "Seasoning Blend"), but they are distinct entities with different ingredient_ids. This design supports the business scenario where different suppliers offer different formulations of similarly named ingredients.

Versioned Formulations

We separated ingredient definitions (INGREDIENT) from pricing/packaging information (FORMULATION) to support supplier formulation versioning over time. The FORMULATION entity handles pack sizes, unit prices, and temporal validity periods while keeping the core ingredient definition stable. This enables suppliers to update pricing without breaking traceability links and supports the requirement for "non-overlapping effective periods."

Recipe Plan Versioning

Recipe versioning uses explicit version numbers with an is_active flag rather than date-based selection. This design reflects the requirement that "the plan used in production is selected

explicitly" by manufacturers, giving them full control over which recipe version to use in production regardless of creation dates.

Lot Number Strategy

We used VARCHAR primary keys for lot numbers with the format enforced by triggers rather than computed columns. This maintains the required traceability format (ingredientId-supplierId-batchId for ingredients, productId-manufacturerId-batchId for products) while allowing flexible batch identifier formats. The approach prioritizes readability and audit trail requirements over query performance.

Traceability Through Batch Consumption

The BATCH_CONSUMPTION bridge entity captures the essential requirement that "the database must remember exactly which ingredient lots were consumed to make it." This simple many-to-many relationship with quantity_consumed supports partial consumption of ingredient lots and multi-ingredient recipes while maintaining complete supply chain visibility from raw materials to finished products.

Constraints Not Captured in E-R Notation

One-Level Composition Acyclicity: Materials in compound ingredients cannot themselves have materials, preventing a hierarchy deeper than parent → children as specified in the requirements.

Lot Number Format: INGREDIENT_BATCH follows "ingredientId-supplierId-batchId" and PRODUCT_BATCH follows "productId-manufacturerId-batchId" to ensure traceability.

90-Day Expiration Rule: Ingredient batches must have expiration dates at least 90 days from received date, implemented as a CHECK constraint.

Non-Overlapping Formulation Periods: The same ingredient cannot have overlapping effective date ranges from the same supplier, preventing pricing conflicts.

Role-Entity Mapping: Users with role='MANUFACTURER' must have exactly one MANUFACTURER record, and users with role='SUPPLIER' must have exactly one SUPPLIER record, enforced by application logic.

Active Recipe Constraint: Only one recipe plan per product can have is_active = TRUE at any time, ensuring clear production guidance.