# UniFood: A Unified Food Dataset for Comprehensive Food and **Nutrition Analysis**

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# A Prompt Design

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The prompt template is as follows:

"[input image] In this image, [known information1]. [known information2]... Please tell me the [missing information1], [missing information2]... Return N/A if you don't know the answer. please offer numerical estimates for the quantity, calories, mass, fat, carbohydrate, and protein content of each ingredient without any explanatory reasoning. Use common sense for uncertain quantities to ensure the response remains solely numerical. Format as follows: [example]."

Here, "[input image]" is the food image, "[known information]" represents the annotation from the source dataset, "[missing information]" is the lacking information that the source annotation cannot provide for comprehensive food and nutrition analysis, and "[example]" provides an example of the response format.

Figures 1, 2, and 3 illustrate examples of prompts and responses from ChatGPT-4V on Food-101 [1], VireoFood-251 [2], and Recipe1M [4]. The instances are randomly sampled.

### Effectiveness of Vocabulary Standardization

Table 1 presents the performance with and without vocabulary standardization. The results indicate that applying vocabulary standardization improves overall performance across multiple tasks.

# **Dataset Quality Analysis**

# **Quality analysis on Nutrition Anotation**

As manually checking the nutritional reliability of the entire Uni-Food dataset is costly, we sampled a subset to test the nutritional reliability. We randomly selected 1000 samples from the humanchecked subset (please refer to Sec. 3,6) and used ChatGPT-4V to regenerate nutritional information for these samples. We then calculated the mean absolute error (MAE) and percent Mean Absolute Error (pMAE) between the human annotations and the ChatGPT-4V annotations. The results are shown in Table 2. It is clear that ChatGPT-4V can provide accurate nutrition estimations given the food images and quantified ingredient list (see Figure 3 for details), with only slight differences from human annotations.

### C.2 Performance Comparison with ChatGPT-4V

We modified our annotation collection code to enable querying ChatGPT-4V for information related to a given image. However, conducting a comprehensive evaluation would be resource-intensive. To balance feasibility and insight, we randomly sampled 100 instances from the precise nutrition test set and queried ChatGPT-4V for both recipe and nutritional information. Titles and ingredients

In this image, the food is beet salad. Please tell me the ingredients, recipe and nutrition information of the food, return N/A if you don't know that anwser. For nutrition, please offer numerical estimates for the quantity, calories, mass, fat, carbohydrate, and protein content of each ingredient without any explanatory reasoning. Use common sense for uncertain quantities to ensure the response remains solely numerical.

For example:
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-sugar

\*Recipe#

1.cut tomato; 2.spread sugar on the tomato.

\*Rutrition#
name; amount; mass; calories; fat; carbs; protein

Tomato; 4 slices; 98g; 22kcal; 0.42g; 3.84g; 0.7g



Figure 1: Prompt and Response Example on Food-101.

were excluded to minimize additional vocabulary normalization. The results are presented in Table 3.

### C.3 Case Study

We present some instances from the UniFood dataset and compare them with recipes from the internet, as illustrated in Figures 4, 5 and 6.

# C.4 Nutrition Annotation Comparison with Recipe1M+

We conduct a comparison of shared samples between UniFood and Recipe1M+[3], as illustrated in Figure 7 and Figure 8. The potentially inaccurate source annotation in Recipe1M could affect the nutritional analysis. As shown in Figure 7, the incorrect ingredient amount annotation in Recipe1M led to overcalculated nutrition values for "salt" and "pepper" in the Recipe1M+ dataset. However, in the case of UniFood, the ChatGPT4V has the capability to identify and correct errors, thereby producing more reliable annotations.

### D Quality Results

To offer a more comprehensive understanding of our approach and its performance, we present several example cases in Figure 9. s

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Food Classification (Acc) Ingredient Recognition (IoU) Ingredient Recognition (F1) Recipe Generation (ScareBLEU) Recipe Generation (Rouge-L) Nutrition Estimation (pMAE) w/o standardization 44.47 47.04 68.30 34.03 5.55 35.69 w standardization

Table 1: Effect of standardization on model performance across multiple tasks

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Title: apple pie. Nutrition:					
Ingredient	Mass(g)	Calorie(kcal)	Fat(g)	Carbohydrate(g)	Protein(g)
Apple	65	52	0.2	13.8	0.3
Sugar	12.5	48	0	12.5	0
Pie crust	57	125	8	11	1
Lemon juice	5	1	0	0.3	0
Ground cinnamon	2.6	6	0.1	2.1	0.1

ngredients from the Internet; apples, sugar, pie dough, lemon, spices, flour and egg.

Instructions from the Internet: Tuck the dough into ep-dish pie plate. Refrigerate as you prepare the filling. Stir wl. Pile the filling into the pie dish. Add the st and flute the edges. Brush with egg wash. Egg wash is a combination of egg and milk, and it's what gives the pie crust its golden sheen. For a little crunch and sparkle, I always add a sprinkle of coarse sugar on top, too, Bake the appl

UniFood Ingredients: apples, sugar, pie crust, lemon juice, ground\_cinnamon, nutmeg, flour and egg.

UniFood Instructions: preheat oven to a typical baking temperature (often around 425°F or 220°C). peel, core, and roll out your pie dough and place one sheet in your pie dish to create the bottom crust, fill the crust with and make slits in the top to vent, beat an egg and brush it cool before serving to allow the filling to set.

Figure 4: Α Comparison between UniFood Its Corresponding Recipe https://sallysbakingaddiction.com/apple-pie-recipe/. The source dataset for this instance is Food-101.



Nutrition:					
Ingredient	Mass(g)	Calorie(kcal)	Fat(g)	Carbohydrate(g)	Protein(g)
Pizza dough	170	400	1.5	84	12
Tomato sauce	85	140	1	7	2
Mozzarella cheese	100	300	22	2	22
Fresh basil	2	1	14	0	0
Olive oil	15	120	14	0	0

Ingredients from the Internet: pizza dough. oes, fresh mozz fresh basil, red pepper flakes, olive oil.

Instructions from the Internet: Place the canned tomatoes and their juices, olive oil, garlic, and salt in a food processor. Blend until smooth. Next, stretch the dough. Dust a baking sheet with cornmeal and stretch the dough into a large oval. Then, add the toppings. Spread a heaping 1/2 cup of the tomato sauce over the pizza dough, leaving a 1-inch border ransfer the pizza to a 500°F oven and bake for 10 to 12 minutes, or until the cheese is melted and the crust is golden brown. Remove the pizza from oven and top it with the fresh basil leaves, pepper flakes, and a drizzle of olive oil. Slice and

UniFood Ingredients: pizza\_dough, tomato\_sauce,

UniFood Instructions: preheat your oven to its highest emperature, typically between 475°F(245°C) to 500°F(260°C) roll out your pizza dough to create a 12-inch base and place it on a pizza stone or a baking sheet. spread the tomato sauce evenly across the dough, leaving a small border around the edges for the crust. sprinkle the shredded mozzarella cheese ozzarella, place the pizza in the oven and bake for about 10-15 minutes, or until the crust is golden brown and the cheese is bubbling and sli ven and let it cool for a few minutes, slice and serve while hot.

Figure 5: A Comparison between a UniFood Its Corresponding and Recipe https://www.loveandlemons.com/margherita-pizza/. The source dataset for this instance is Food-101.

Title: easy clam pasta



Ingredient	Mass(g)	Calorie(kcal)	Fat(g)	Carbohydrate(g)	Protein(g)
Pasta	100	158	0.8	31	5
Manila clams	150	126	1.5	4.5	21
Olive oil	13.5	119	13.5	0	0
Garlic	3	4	0	1	0.2
White wine	49	39	0	1.2	0.1
Butter	14	102	12	0	0.1
Soy sauce	5	2	0	0.3	0.2
Black pepper	0.3	0.8	0.01	0.2	0.03

olive oil, garlic, pepper, white wine, pa

Instructions from the Internet: Add spaghetti to lightly salted boiling water, and cook until slightly underdone; pasta will finish cooking in sauce. Meanwhile, place a large saucepan over medium-low heat, and add olive oil, garlic and chili pepper. Add vermouth and clams, and cover. Clams should open in about 2 minutes. Add hot drained pasta, cover, and shake pot gently. Add half the parsley, and shake pan to distribute evenly. Transfer to a plate or bowl, and sprinkle with

white\_wine, boiling\_water, butter, soy\_sauce and black\_pepper

UniFood Instructions: put the clams in salt water while we prepare the pasta. clean the clams of sand and salt. if you are making a large amount, you can freeze the leftovers for later. in a pan, heat olive oil and garlic and over low. when the garlic becomes aromatic, pour start to open, remove the lid. when they look ready, add in the plate with a sprinkle of pepper.

Figure 6: A Comparison between a UniFood Instance and Its Corresponding Recipe https://cooking.nytimes.com/recipes/11952-spaghettiwith-clams. The source dataset for this instance is Recipe1M.



Title: Mama's Creamed Peas for Sick Tummies

The ingredients are 4 cups peas, fresh,frozen or canned, 1 cup milk, 2 tablespoons flour, 2 tablespoons butter, 14 teaspoon salt and 18 teaspoon

Uni-Food						
Ingredient	Mass	Calories	Fat	Protein		
Peas	532g	420kcal	2g	28g		
Milk	244g	150kcal	8g	8g		
Flour	16g	55kcal	0.1g	1.5g		
Butter	28g	200kcal	23g	0.2g		
Salt	1.5g	0kcal	0g	0g		
Pepper	0.3g	1kcal	0g	0g		

Recipe1M+						
Ingredient	Mass	Calories	Fat	Protein		
Peas	536.0g	412.0kcal	2.16g	27.96g		
Milk	244.0g	102.0kcal	2.37g	8.22g		
Flour	15.625g	56.88kcal	23.04g	0.24g		
Butter	28.4g	204.0kcal	23g	0.2g		
Salt	84g	0kcal	0g	0g		
Pepper	41.4g	108.0kcal	1.26g	4.32g		

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Figure 7: Comparison of Nutrition Annotation between Uni-Food and Recipe1M+

Table 2: Error between Human and ChatGPT-4V Annotations

Metric	Mass (g)	Calories (kcal)	Fat (g)	Protein Value (g)
MAE	13.22	54.42	2.67	2.39
pMAE	1.77%	2.7%	2.59%	6.91%

In this picture. The food is Braised Pork. The ingredients are chopped green onion, Meat. Please tell me the nutrition and recipe information of the food. For nutrition, please offer numerical estimates for the quantity, calories, mass, fat, carbohydrate, and protein content of each ingredient without any explanatory reasoning. Use non sense for uncertain quantities to ensure the response remains solely

name amount mass calories fat carbs protein Tomato; 4 slices; 98g; 22kcal; 0.42g; 3.84g; 0.7g 1.cut tomato; 2.spread sugar on the tomato



# #nutrition#

Pork; 500g; 500g; 1296kcal; 78.5g; 0g; 136.5g Green onion; 1 tbsp; 6g; 1.72kcal; 0.01g; 0.39g; 0.06g'

- 1. Sear pork chunks in a hot pan until browned.
  2. Add soy sauce, sugar, rice wine, and enough water to cover the pork.
  3. Simmer for at least 2 hours until meat is tender.
  4. Add chopped green onions before serving.

Figure 2: Prompt and Response Example on VireoFood-251.

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ChatGPT4-vision

UniFood

### Title: Chef Joey's Oatmeal, Fruit & Nut Bars

The ingredients are 12 cup vegan margarine (or 1/2 cup light oil), 23 cup packed brown sugar, 1 12 cups oats (not instant), 12 cup spelt flour (white), 1 cup hazelnuts (toasted and chopped fine), 1 cup golden raisin and 12 cup tart jam preserves.

Ingredient	Mass	Calories	Fat	Protein	Ingredient
Vegan margarine	112g	814kcal	91g	0g	Vegan marga
Brown sugar	145g	571kcal	0g	0g	Brown sugar
Oats	120g	450kcal	7.5g	15g	Oats
Spelt flour	60g	200kcal	1.5g	8g	Spelt flour
Hazelnuts	135g	861kcal	84g	20g	Hazelnuts
Golden raisins	165g	498kcal	0g	5g	Golden raisin
Jam preserves	140g	383kcal	0g	0g	Jam preserve

Recipe1M+						
Ingredient	Mass	Calories	Fat	Protein		
Vegan margarine	2726.4g	19584kcal	2200.3g	3.84g		
Brown sugar	3312.0g	12144kcal	0g	0g		
Oats	234g	910.5kcal	16.14g	39.5g		
Spelt flour	1500g	5460kcal	14.76g	154.9g		
Hazelnuts	115.0g	722.0kcal	69.86g	17.19g		
Golden raisins	165.0g	488.0kcal	0.89g	4.16g		
Iam preserves	3840o	9216kesl	7.680	26.880		

### Figure 8: Comparison of Nutrition Annotation between Uni-Food and Recipe1M+

Frompt:
In this picture. The food is Kombu Tea Grilled Chicken Thigh The ingredients are 2
Chicken thighs, 2 top Kombu tea and 1 White pepper. Please offer numerical
setimates for the quantity, calories, mass, fat, carbohydrate, and protein content of
each ingredient without any explanatory reasoning. Use common sense for uncertain
quantities to ensure the response remains solely numerical.
For example:

35.68

name amount mass calories fat carbs protein Couscous; 1/3 cup; 58g; 220kcal; 0.5g; 45g; 7g Orange extract; 1 teaspoon; 5g; 0kcal; 0g; 0g; 0g



62.39

70.62

name; amount; mass; calories; fat; carbs; protein Chicken thighs; 2 thighs; 520g; 660kcal; 42g; 0g; 60g Kombu tea; 2 tsp; 6g; 5kcal; 0g; 1g; 0g White pepper; 1 tsp; 3g; 8kcal; 0.1g; 2g; 0.3g

### Figure 3: Prompt and Response Example on Recipe1M.

### References

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- [3] Javier Marin, Aritro Biswas, Ferda Ofli, Nicholas Hynes, Amaia Salvador, Yusuf Aytar, Ingmar Weber, and Antonio Torralba. 2019. Recipe1M+: A Dataset for Learning Cross-Modal Embeddings for Cooking Recipes and Food Images. IEEE Trans. Pattern Anal. Mach. Intell. (2019).
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The ingredients inculde: bacon, cheese, potato, dressing, parsley.

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The mass of this dish is 1107.80 grams, the energy content is 1609.00 kcal, the fat content is 77.90 grams, the protein content is 45.60 grams, and the carbohydrate content is 177.20 grams.

The cooking instruction are as follow: heat oven to 350f. mix first 3 ingredients in large bowl. add potatoes; toss to coat. spoon into 13x9-inch baking dish sprayed with cooking spray, cover, bake 55 min. or until potatoes are tender, uncovering after 40 min. sprinkle with parsley.

### UniFood Fintuned Model

The ingredients inculde: cheese, potato, bacon, pepper, onion.

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The mass of this dish is 1017.00 grams, the energy content is 1110.00 kcal, the fat content is 20.00 grams, the protein content is 28.00 grams, and the carbohydrate content is 180.00 grams.

The cooking instruction are as follow: cook potatoes in boiling water until tender; drain. meanwhile, cook bacon in large skillet on medium-high heat until crisp, drain bacon on paper towels; crumble, add potatoes to bacon in skillet; toss to coat, add onions and cheese; toss to coat. cook and stir until cheese is melted and onions are tender.



The ingredients inculde: vinegar, oil, flour, sugar, baking\_soda, salt, vanilla, milk, baking\_powder.

The mass of this dish is 944.20 grams, the energy content is 2753.00 kcal, the fat content is 113.10 grams, the protein content is 27.20 grams, and the carbohydrate content is 404.50 grams.

The cooking instruction are as follow: preheat oven to 350 degrees f (175 degrees c). grease and flour a 9x13 inch baking pan. in a large bowl, mix together the oil, sugar and 2 teaspoons vanilla until well blended. combine the flour, 1/2 cup cocoa baking soda and salt; stir into the sugar mixture. fold in the zucchini and walnuts, spread evenly into the prepared pan. bake for 25 to 30 minutes in the preheated oven, until brownies spring back when aently touched. to make the frosting, melt together the 6 tablespoons of cocoa and margarine; set aside to cool. in a medium bowl, blend together the confectioners' sugar, milk and 1/2 teaspoon vanilla, stir in the cocoa mixture, spread over cooled brownies before cutting into squares.

The ingredients inculde: egg, clove, oil, flour, sugar, cinnamon, salt, nutmeg, vanilla, milk, baking\_powder.

The mass of this dish is 1117.00 grams, the energy content is 2410.00 kcal, the fat content is 62.00 grams, the protein content is 28.00 grams, and the carbohydrate content is 421.00 grams.

The cooking instruction are as follow: preheat oven to 350 degrees fahrenheit. grease a 9x9-inch baking pan. in a medium bowl, mix together brownie mix, water, oil, and eggs. spread batter into prepared pan. bake for 25 minutes. remove from oven and let cool, in a medium bowl, mix together cream cheese, sugar, and vanilla. spread over cooled brownies. refrigerate until set. cut into squares and serve.



The ingredients inculde: sesame, sauce, oil, beans.

The mass of this dish is 502.00 grams, the energy content is 390.50 kcal, the fat content is 26.10 grams, the protein content is 12.50 grams, and the carbohydrate content is 34.90 grams

The cooking instruction are as follow: warm a large skillet or wok over medium heat, when the skillet is hot, pour in canola and sesame oils, then place whole green beans into the skillet, stir the beans to coat with oil. cook until the beans are bright green and slightly browned in spots, about 10 minutes. remove from heat, stir in soy sauce, cover, and let sit about 5 minutes. transfer to a serving platter, and sprinkle with toasted sesame seeds.

The ingredients inculde: garlic, oil, sugar, ginger, beans, pepper, onion, sauce.

The mass of this dish is 108.00 grams, the energy content is 100.00 kcal, the fat content is 0.00 grams, the protein content is 2.00 grams, and the carbohydrate content is 24.00 grams.

The cooking instruction are as follow: wash and trim green beans, cut beans into 2-inch pieces. heat oil in a pan over medium heat. add beans and stir-fry until tender. season with salt and pepper to taste, serve hot.