



Immaterials and Methods: Reagents for the Total Laboratory Synthesis of the Chocolate Chip Cookie

Cannot Goodenough

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Scientists have long wondered what laboratory reagents they might consume and survive on in the event of entrapment in the laboratory (resulting from natural disaster or zombie apocalypse, not just being in academia).¹ Tragically, this is not a hypothetical scenario. This year, a PhD student starved to death when a delivery of solvent drums from 2020 was placed across the doorway to his lab. His corpse was found three weeks later, still clutching a flask of tryptophan. The coroner ruled that the student had died while attempting to construct a scotch fillet by peptide coupling.

If asked "what would you eat first if you were trapped in here?" most scientists would choose the humble LB broth, and reagent-grade glucose and sodium chloride for seasoning. Traditionally, the holy trinity of disallowed lab consumables includes MilliPure water, 200 proof ethanol, and the aforementioned LB. Here, I propose a fourth member of the quadrinity, and present the following list of reagents necessary to perform the chocolate chip cookie reaction and discuss associated costs and benefits.



Figure 1: One (1) chocolate chip cookie. (Source: [Evan-Amos CC BY-SA 3.0](#) via Wikimedia Commons)

One notable limitation of the laboratory synthesis of chocolate chip cookies (historically known as ChoChiCO, or fraction 1 cookie) (Fig. 1) is the lack of availability for fresh ingredients, primarily dairy (e.g. butter). I have found a protocol from the literature that describes the butterless synthesis of chocolate chip cookies,² though I speculate that the recently discovered debutterification reaction may have significant implications for the performance of this reaction.³ Nevertheless, the dairy-free ingredient list is presented in (Table 1). Values for ingredients that are measured in nonstandard units (ex. one egg) are best approximations according to Google Search.

Ingredient	Amount
Coconut oil	177 mL (3/4 cup)
Vanilla extract	8.68g (2 tsp)
Eggs	56.7g (2 eggs, rehydrated)
White sugar	300g (1 1/2 cup)
Flour	340g (2 1/2 cups)
Salt	4.5g (3/4 tsp)
Baking Soda	5g (1 tsp)
Chocolate	170g (1 cup)
Water	118.29 mL (1/2 cup for eggs)

Table 1: Reagent list for chocolate chip cookies, accompanied by amounts necessary from.² Units converted from freedom units to the more useful units for readability.

With the list of ingredients compiled, a comprehensive computational search was conducted across all publicly available Si/g//ma-*ldrich products to find acceptable representatives for each of the ingredients. As previously mentioned, one notable limitation of this methodology is the requisite use of powdered egg, as a carton of one dozen eggs was not available from scientific suppliers and would probably cost one gajillion dollars if it was anyways. From these reagents, the total cost of the multiples of each necessary has been summed, giving us a value of \$30031.70, representative of a theoretical yield of 25-30 cookies² (Table 2).

Description	SKU	Unit price	Total price
Coconut oil, 1000 mg	46949	\$94.70	\$16761.90
Vanillin, ReagentPlus 99%, 2g	V1104-2G	\$31.40	\$314.00
Whole egg powder, NIST, 5x 10g	NIST1845A	\$1,960	\$3920.00
Sucrose, molecular biology >99.5%, 500g	S0389-500G	\$45.00	\$45.00
Wheat flour, NIST, 50g	NIST1567B	\$971.00	\$6797.00
Sodium chloride, molecular biology >99%, 500g	S3014-500G	\$48.20	\$48.20
Sodium bicarbonate, ReagentPlus >99.5%, 500g	S8875-500G	\$42.90	\$42.90
Baking chocolate, NIST, 5x 91g	NIST2384	\$2,040.00	\$2040.00
Water, nuclease-free, 1L	W4502-1L	\$62.70	\$62.70
			\$30031.70

Table 2: Descriptions, stock keeping unit (SKU) numbers, unit prices, and total prices of reagents for the synthesis of laboratory grade chocolate chip cookies. Total price includes the minimum number of units necessary for the required amounts shown in Table 1. Prices were recorded on 3/15/2022.

Conclusion

Though I have not discussed the means by which to bake the cookie reactions, it is not outside the realm of possibility to find communal laboratory equipment capable of sustaining the output necessary for a perfectly chewy, gooey cookie. This line of reasoning has been recently explored by an Italian group of scientists that have utilized an autoclave to make yeast-free pizza crusts, going to show that anything is possible.⁴



A potential follow-up experiment would entail quenching the products of the cookie reaction in resuspended powdered milk, which is likely present in large quantities around protein biochemists or anyone with the misfortune of running Western blots. While I would anticipate the results of quenching to be somewhat delicious, I further postulate that this would still be better than drinking LB to survive.

Further refinement of this recipe is most certainly possible in order to optimize the reagents used and to reduce cost. However, \$30031.70 is a small price to pay for a freshly baked laboratory cookie, and I will die on this hill.

Acknowledgements

The author would like to thank C.O.B. for consuming all cookies and biscuits during the preparation of this manuscript.

Author Contributions

All presented information has been compiled by C.G. during a bout of late-night hunger in the lab.

About the Authors

C.G. is a former Ph.D. candidate who has now moved into sales.

Conflicts of Interest

C.G. has stolen unintellectual property from Ligma-Aldrich.

Notes and references

- 1 Ask your coworker, they've probably thought about this already
- 2 <https://www.lifeasastrawberry.com/butterless-chocolate-chip-cookies/>
- 3 "Debutting: Not With That Attitude" Boop D.G., Stilles N.P., Harbor, C.S. 2022, *J. Immat. Sci.* **2**. 43–44.
- 4 P. R. Avallone, P. Iaccarino, N. Grizzuti, R. Pasquino, E. Di Maio, Rheology-driven design of pizza gas foaming. *Physics of Fluids*. **34**, 033109 (2022).

