

Trading Flavour for Speed Works Only When Two Temperature Coefficients Differ

— Reaching the same rise takes **9.8492** hours at **4°C** against **1.1487** at **35**, a factor of **8.5742** — with a flavour Q_{10} of **1.5** the cold accumulates **2.44** times as much, with **2.5** the heat wins — the boundary is where the flavour coefficient equals the growth coefficient — [Paper 457]

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September 2026

— *From thinking to syncing.* —

Abstract

A long cold ferment is said to build flavour. This paper shows that this holds only when the two temperature coefficients differ—make them equal and the difference cancels exactly. No new theorem or law is claimed. First, with $Q_{10} = 2$, 4°C takes **4.9246** times as long as **27** (Section 2). Second, reaching the same rise takes **9.8492** against **1.1487** hours, a factor of **8.5742** (Section 2). Third, this is the core of the paper. With a flavour Q_{10} of 1.5 the cold wins 3.8760 to 1.5888; with 2.5 the heat wins 2.3909 to 1.1971 (Section 3). Fourth, at the boundary both come to exactly 2.000000000000 (Section 3). Fifth, the time ratio **8.5742** matches the closed form $2^{3.1}$ (Section 2). Sixth, the separator is whether the two temperature coefficients are equal or not (Section 4). **Keywords:** Q_{10} temperature coefficient, fermentation, yeast, breadmaking, cold fermentation.

Scope of this paper (scope note): No new theorem or law is claimed—the temperature coefficient Q_{10} , the temperature dependence of yeast growth and long cold fermentation are all standard. No recipe is given—formulation, mixing and baking are not the subject. No flavour compound is named—esters, organic acids and alcohols are not distinguished; what is treated is “something that accumulates with time”. The Q_{10} values are assumptions—growth is set at 2.0 and flavour at 1.5 or 2.5; these are chosen to show a direction, not measured. Sensory evaluation is excluded—palatability, preference and judging are not the subject; only the amount accumulated. Death and inhibition are excluded—yeast death at high temperature and inhibition by alcohol are not the subject. Relation to earlier papers: Paper 456 showed that the distance needed to halve noise differs by 3.16 with the shape of the source—there too, the difference between two exponents was the heart of it. Paper 300 showed that common root and distinct root can be decided—“the temperature dependence of growth” and “of flavour formation” are distinct roots by that criterion. Paper 450 showed that equal days carry unequal maturity—there too, temperature changed what time meant. What is added is giving the rate ratio at four temperatures, giving the time to equal rise as 9.8492 against 1.1487 hours, showing the ratio 8.5742 to match $2^{3.1}$, showing the winner to flip across three flavour coefficients, confirming exact cancellation at the boundary, and placing the separator at whether the coefficients are equal.

1. Notation and the Question

Setting: Write the rate of a process at temperature T in terms of a reference T_r and a temperature coefficient Q_{10} as

$$v(T) = Q_{10}^{(T-T_r)/10}$$

with $T_r = 27^\circ\text{C}$ below. Take $Q_{10} = 2.0$ for yeast growth (the rise) and $Q_{10} = q$ for flavour formation, and vary q . Measure the flavour accumulated on reaching the same rise by

$$F = t \cdot q^{(T-T_r)/10}$$

where t is the time taken to get there.

Observation 1.1

A long cold ferment is said to build flavour. More time means more accumulation—easy enough as an intuition.

Observation 1.2

But the flavour reactions are slower in the cold too. More time, less produced per unit time—so why do they not cancel.

Question: Under what condition does the cold win.

2. A Factor of 8.5742 in Time to the Same Rise

Computation 2.1: Take the growth rate ratio and the time factor at four temperatures.

Temperature	Rate ratio	Time factor
4°C	0.2031	4.9246
20°C	0.6156	1.6245
27°C	1.0000	1.0000
35°C	1.7411	0.5743

Observation 2.2

It returns to exactly 1.0000 at the reference. $Q_{10}^0 = 1$ —a check that the expression is set up correctly.

Computation 2.3: Take the time to reach two hours' worth of rise at 27, at both extremes.

Temperature	Time required [h]
4°C	9.8492
35°C	1.1487

Observation 2.4

9.8492 hours fits into a night. This number is why a cold ferment is “leave it overnight”—1.1487 hours at 35 is a wholly different thing to handle.

Observation 2.5

The time ratio is **8.5742**. And it matches $2^{(35-4)/10} = 2^{3.1}$ —numerical and closed form agree to within 10^{-9} relative.

Observation 2.6

The product of time and rate is conserved. Both come to 2.000000000000—the condition “the same rise” is doing its work correctly.

3. The Winner Flips with the Flavour Coefficient

Computation 3.1: Take the flavour accumulated at equal rise, for three flavour coefficients.

Flavour Q_{10}	4°C	35°C	Winner
1.5	3.8760	1.5888	cold
2.0	2.0000	2.0000	tie
2.5	1.1971	2.3909	hot

Observation 3.2

When the flavour coefficient is below the growth coefficient, the cold wins. 3.8760 against 1.5888, a factor of 2.44—flavour formation is insensitive to temperature, so the long time counts straight through.

Observation 3.3

When they are equal, the difference vanishes exactly. 2.000000000000 against 2.000000000000—not approximately zero but identically so.

Observation 3.4

When it is above, the heat wins. 2.3909 against 1.1971—confirmed on the far side of the boundary too.

Observation 3.5

So “long and cold builds flavour” is not an unconditional claim. It holds only when the flavour coefficient is below the growth coefficient—and that is settled by measurement, not by experience.

Observation 3.6

The factor of 8.5742 in time does not itself decide the winner. At $q = 2.0$ the result is the same however different the times—what acts is not the length of time but the gap between two coefficients.

4. The Separator

The separator: are the two temperature coefficients equal, or not.

Observation 4.1

If equal, temperature changes nothing. Speed and formation move by the same proportion—the same thing results at any temperature.

Observation 4.2

If unequal, temperature changes the composition. Which one is the more sluggish decides which temperature is favoured—temperature is not a speed control but a composition control.

Observation 4.3

These are distinct roots by the criterion of Paper 300. Both are called “what temperature does”—one the rate of one process, one the ratio of two rates.

Observation 4.4

This stands where Paper 456 stands. There, the exponent split into 2 and 1 between point and line sources—here Q_{10} splits between two processes. In both, the gap between two exponents makes the answer.

Observation 4.5

It overlaps Paper 450 as well. There, equal days carried maturity differing threefold—here, equal rise takes times differing by 8.57. In both, temperature changes what time means.

Observation 4.6

So when a cold ferment is recommended, ask whether the two coefficients were compared. “Because it took longer” is not yet a reason—length of time produces nothing when the coefficients match.

Observation 4.7

To be honest—the Q_{10} values are assumptions. Growth at 2.0 and flavour at 1.5 or 2.5—real flavour compounds are many, each with its own Q_{10} . So even the single word “flavour” is something that ought to be broken apart and measured.

5. Roll Call and Closing

1. 4°C takes 4.9246 times as long (Computation 2.1): at $Q_{10} = 2$.
2. 1.0000 at the reference (Observation 2.2): a check on the setup.
3. 9.8492 against 1.1487 hours (Computation 2.3): a night and an hour.
4. A time ratio of 8.5742 (Observation 2.5): matching $2^{3.1}$.

5. At $q = 1.5$ the cold gives **3.8760** (Computation 3.1): **the core**.
6. At $q = 2.5$ the heat gives **2.3909** (Computation 3.1): **the far side**.
7. At $q = 2.0$ they are exactly equal (Observation 3.3): **identically zero**.
8. The time gap does not decide (Observation 3.6): **the coefficient gap does**.
9. The separator is equal coefficients (Observation 4.3): **distinct roots by Paper 300**.
10. The Q_{10} values are assumed (Observation 4.7): **flavour needs breaking apart**.

Closing: A long cold ferment is said to build flavour—more time means more accumulation, which is easy enough as an intuition. But the flavour reactions are slower in the cold too: more time and less produced per unit time, so why do they not cancel. The gap in time is certainly large—with $Q_{10} = 2$, 4°C takes **4.9246** times as long as 27, and the expression returns to exactly 1.0000 at the reference. Reaching two hours' worth of rise at 27 takes **9.8492** hours at 4 and **1.1487** at 35. This is why a cold ferment is “leave it overnight”, and why 35 is a wholly different thing to handle. The time ratio is **8.5742**, matching $2^{(35-4)/10} = 2^{3.1}$ to within 10^{-9} relative, and the product of time and rate is conserved at 2.000000000000 on both sides, so the condition “the same rise” is doing its work correctly. But the gap in time is not what decides—with a flavour Q_{10} of 1.5, the cold gives **3.8760** against 1.5888 and wins by 2.44: flavour formation is insensitive to temperature, so the long time counts straight through. At 2.0 the two come to 2.000000000000 each and the difference vanishes—not approximately but identically. At 2.5 the heat gives 2.3909 against 1.1971 and wins, confirming the far side of the boundary. So “long and cold builds flavour” is not an unconditional claim: it holds only when the flavour coefficient is below the growth coefficient, and that is settled by measurement, not by experience. The factor of 8.5742 does not itself decide the winner—at $q = 2.0$ the result is the same however different the times, because what acts is the gap between two coefficients and not the length of time. One thing separates them—are the two temperature coefficients equal, or not. If equal, temperature changes nothing: speed and formation move by the same proportion and the same thing results at any temperature. If unequal, temperature changes the composition, and which one is the more sluggish decides which temperature is favoured—temperature is not a speed control but a composition control. They are distinct roots by the criterion of Paper 300, one the rate of one process and one the ratio of two rates. This stands where Paper 456 stands, where the exponent split into 2 and 1 between point and line sources: in both, the gap between two exponents makes the answer. It overlaps Paper 450 too, where equal days carried maturity differing threefold: in both, temperature changes what time means. So when a cold ferment is recommended, ask whether the two coefficients were compared—“because it took longer” is not yet a reason, and length of time produces nothing when the coefficients match. To be honest—the Q_{10} values are assumptions, growth at 2.0 and flavour at 1.5 or 2.5. Real flavour compounds are many, each with its own Q_{10} , so even the single word “flavour” is something that ought to be broken apart and measured.

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