

THE SCOVILLE SPLICE LIBRARY · VOLUME LI · SHELF VII — CUISINES

Engineered Ethiopian

A cuisine built on layering. *Read berbere as a chord.*

The complete account of Ethiopian flavor read on eight axes — berbere decomposed to its receptors, niter kibbeh and injera as the two carriers, and the whole wat codex rebuilt around cultivars we designed gene by gene.

SCOVILLE SPLICE · GROWN BY OUR FAMILY. ENGINEERED FROM SCRATCH.

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Opening essay · The Basket and the Hand

There is no plate. At the center of the table sits a *mesob* — a woven basket the color of straw and clay, lifted at its lid — and inside it a single round of injera, pale and soft and wide as the table itself, laid down like a cloth. The stews go straight onto the bread: a dark red mound of *doro wat*, a slick of *misir wat*, a fan of greens, a pale drift of split peas, each in its place, bleeding slowly into the sponge beneath. You eat with your right hand. You tear a piece of injera, you fold it over a pinch of stew, and the bread — sour, cool, holed like coral — carries the heat to your mouth. And sometimes someone tears a larger piece, loads it, and reaches across to feed *you*, directly, by hand. That is *gursha*, and it is not a courtesy. It is a sentence spoken in food: *I want you to be nourished, and I want to be the one who does it.*

We came to this cuisine the way we come to all of them — hungry first, curious second. And what curiosity found was a kitchen that had already solved, by ten centuries of patience, the problem our whole company exists to solve: how do you build a flavor out of many flavors so that it reads as *one*? Berbere is not a spice. It is sixteen spices, sun-dried and ground and aged, and when it is right it does not taste of any single one of them. It tastes of itself. A chord, not a note.

The geography made the cuisine inevitable. The Ethiopian highlands are a cool, high, isolated plateau — much of the inhabited land sits above 2,000 metres — and that altitude, with its own endemic grains and spices, grew a food culture that owes almost nothing to the kitchens around it. Teff grows here and essentially nowhere else at scale; korarima and besobela and koseret are highland plants with no clean supermarket substitute; and the long religious calendar of fasting and feasting turned cooking into a discipline practised across the whole year. A cuisine that spends roughly half its days eating no meat, no dairy, and no eggs, and the other half feasting, is a cuisine that has had to learn, more rigorously than most, exactly what makes a plant-forward plate satisfying — and exactly how to make a feast feel like one. That makes it, for a company that measures flavor, close to an ideal subject: the two hardest poles of the craft, held in one tradition, on one piece of bread.



The founders in the research greenhouse at dawn — the walk where a conversation about berbere became a question about receptors.

This book reads that chord. The Iyengar Flavor Index gives every quality a plant can carry a single number, anchored to the point at which a stimulus drives its receptor to half of full response:

> $\mathrm{IFI}(\text{candidate}) = 1{,}000 \times \mathrm{EC}_{50}(\text{reference}) \div \mathrm{EC}_{50}(\text{candidate})$

Invert a half-activation concentration against a fixed reference, scale by a thousand, and *loudness* becomes a score — not how much of a compound a food holds, but how insistently that compound speaks to the nerve. Eight axes: heat at TRPV1, pungency at TRPA1, cool-burn at TRPM8, umami at mGluR1, sweetness at TAS1R2·R3, kokumi at the calcium-sensing receptor, astringency at the salivary proteins, bitterness-attenuation at TAS2R38. Berbere lights up at least six of them at once. We can now say by how much, and — because the one spice we grow ourselves can be tuned residue by residue — we can build a berbere to a target and hold it there batch after batch.

We write as *we* because the work is a family's, and the table is a family's — the computing was one pair of hands at a keyboard, but the harvest, the grinding, the long slow onion, the reaching across to feed someone: that was never one person's. What follows is reverent about all of it. It is also exact. In this cuisine the two were never opposed. A grandmother roasting berbere until the fenugreek turns and the room fills is running a reaction she could draw if you asked her the right way. We are only drawing it, and then asking what it would take to build the plant that makes it come out the same every time.



PART I OF V

The Grammar of Berbere

the blend decomposed · TRPA1 · TRPV1 · CaSR · the sixteen-spice specification

Chapter 1 · Berbere, Read as a Chord — *the blend is already a composition.*

Open a jar of good berbere and the first thing that arrives is not heat. It is depth — a dark, resinous, faintly sweet, faintly bitter red that smells the way a cathedral looks. Heat comes second, and even then it does not spike; it builds, rolls, settles into a long warmth across the whole tongue and the back of the throat. This is the defining fact of the blend, and it is a receptor fact: berbere does not hammer one channel. It plays several at once, each at a moderate level, and the brain integrates them into something that feels unified and deep rather than sharp and loud.

We can state this precisely. Every spice in the blend is, to the tongue, a set of molecules; every molecule is an agonist (or an antagonist) at one or more receptors; every agonist has an EC_{50}, the concentration at which it drives its receptor to half-maximal response. The Index turns each of those into a number, and the blend's profile is the composition of all of them. Where a single chili is a solo on TRPV1, berbere is scored for an ensemble.

There is history folded into that ensemble. Berbere as we know it is a palimpsest of trade: the chili at its center is a New World plant, *Capsicum*, which reached the Horn of Africa only after 1500, and was grafted onto a much older highland heat built from grains of paradise, long pepper, and korarima. When capsaicin arrived it did not replace that older architecture so much as move into it, taking the heat chair while the indigenous aromatics kept their seats. That is why berbere feels simultaneously ancient and sharp — the frame is a thousand years old and the brightest string on it is five hundred. A blend is a record of where a people have traded and what they chose to keep.

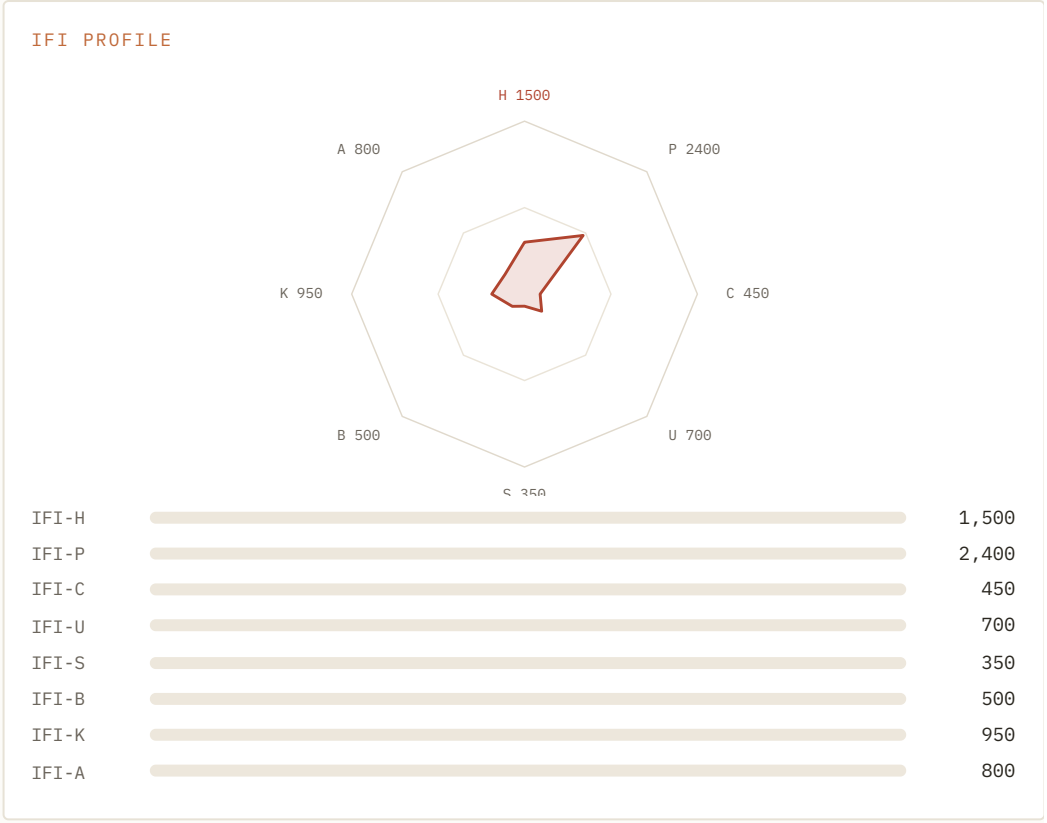


A cut berbere chili — the heat is in the placenta and the cross-walls, not the flesh, and not the seeds.

Decompose the blend by axis, and the architecture appears:

AXIS	RECEPTOR	CARRIED IN BERBERE BY
P · Pungency	TRPA1	fenugreek, ginger, garlic, cinnamon, clove, ajwain, black pepper
H · Heat	TRPV1	dried red chili, black pepper (piperine), clove (eugenol), korarima paradol
K · Kokumi	CaSR	garlic, aged and fermented notes
C · Cool-Burn	TRPM8	korarima and cardamom (1,8-cineole)
A · Astringency	salivary PRPs	fenugreek saponins, nigella polyphenols
U · Umami	mGluR1	(contributed by the dish, not the dry dust)

Notice what dominates. For most cuisines built on chili, the loudest axis is H. For berbere it is **P** — the sharp, electrophilic TRPA1 channel driven by fenugreek and the two alliums and the warm barks. That is why this book's accent is pungent rust and not heat red, and why berbere feels *sharp-deep* rather than *hot-bright*. The chili matters enormously, but it is the floor of the chord, not the melody.



Read that block as the dry blend alone — berbere off the spoon, before it meets a stew. The umami and kokumi values climb once it hits the onion and the legume; the dry number is the blend's own voice. And the shape of it — P over H, a whisper of C, a real floor of K and A — is a fingerprint. No single spice produces it. The composition does.

But "the composition" is not a sum, and this is the single most important thing to understand before we try to design one. If you knew each spice's solo IFI and added them, you would badly

overestimate the blend, because receptors saturate. A receptor's response to a ligand follows a saturating curve — in the simplest model, response rises with concentration toward a ceiling it can never pass, so that doubling an agonist near the top of its range barely moves the signal. Put two agonists at the same channel and they do not stack; they share one pool of receptors and compete for it. Add the perceptual layer on top — sweetness and aroma that *mask* heat without touching the capsaicin — and the blend's felt profile is a nonlinear function of its parts, closer to a constrained optimization than to arithmetic. This is why a cook who simply adds more of everything gets mud, and why a great berbere is a balance rather than a maximum. Each axis has a capacity; the art is in how the compounds are let to fill it.

There is one more transformation the blend undergoes before it is ever cooked: it ages. Traditional berbere is not just ground and used. The chilies are sun-dried, often for days; the blend is sometimes left to ferment and mellow; the whole mixture rests and marries. Drying concentrates and converts — it is during drying that ginger's gingerol becomes the hotter shogaol, that volatile top-notes soften, that the raw edges round. A fresh-ground berbere and a rested one are different entries on the Index even from the same recipe. When we characterize a berbere we characterize it *at a defined age*, because an undated spice blend is, in measurement terms, a moving target. The chord is not only composed. It is cured.

Chapter 2 · The Chili at the Center — *heat that is built, not peaked.*

Strip berbere to one ingredient and it is a dried red chili. In Ethiopia this is not a superhot; it is a moderate, fruity, deeply colored *Capsicum* — the fresh *karia* and the landrace peppers such as *mareko fana*, chosen for color and sweetness as much as for burn. The heat of a proper berbere is real but middling, and that is the point: it is a floor broad enough for the other fifteen spices to stand on. A chili that peaked too hard would blow the chord apart.

Heat is capsaicin at TRPV1, a non-selective cation channel on the trigeminal endings of the tongue — the same channel gated by temperatures above 43 °C and by acid. Capsaicin does not warm the tissue. It binds to a pocket on the channel's intracellular side and lowers the channel's thermal threshold, so the nerve reports a fire that is not there. Anatomically the molecule is not spread through the fruit evenly: it is synthesized in the glands of the *placenta*, the pale cross-walls that hold the seeds, which is why the pith burns and the flesh barely does, and why a cook who scrapes the placenta controls the heat directly. The common belief that the heat is "in the seeds" is a near-miss; the seeds are merely the placenta's neighbors.



FIG. 4 — the engineered chili at the extreme end of the ladder, the reservoir berbere draws down from.

"Capsaicin" is also a simplification. The burn is a family of capsaicinoids, and their proportions set the *character* of the heat as much as its amount:

CAPSAICINOID	SHARE (TYPICAL)	BURN CHARACTER
Capsaicin	~69%	sharp, mid-tongue and throat, fast
Dihydrocapsaicin	~22%	the hardest, longest, back-of-throat
Nordihydrocapsaicin	~7%	fast, front, fades quickly — "fruity" heat
Homocapsaicin · homodihydrocapsaicin	~2%	slow, low, lingering

The capsaicin-to-dihydrocapsaicin ratio is set upstream, at the acyl chain that condenses with vanillylamine: its length and saturation decide which capsaicinoid the plant makes most of. This is a lever, not an accident. A chili tuned toward nordihydrocapsaicin gives a bright, forgiving, fruit-forward heat ideal for a berbere; one tuned toward dihydrocapsaicin gives a punishing, slow throat-burn better suited to an extract. The IFI-H axis scores total loudness, but behind the single number is a shape we can design.

The relationship between the chef's familiar Scoville number and the Index is simple and worth stating once. Scoville Heat Units measure concentration — parts of capsaicinoid by dilution. The Index measures loudness — the inverse of an EC_{50} against the wild-type reference, anchored so that IFI-H 1,000 corresponds to that reference's half-activation. The two track together but are not the same: Scoville is how much is there, IFI-H is how hard it speaks. The ten flagship superhots show the top of both scales:

CULTIVAR	SKU	SHU	IFI-H	AXES
Ember	SS-0087	866K	1,570	2/8
Blaze	SS-0091	1.72M	2,630	4/8
Wildfire	SS-0092	1.96M	2,930	5/8
Firestorm	SS-0094	2.47M	3,490	6/8
Solara	SS-0095	2.72M	3,980	6/8
Phoenix	SS-0096	2.95M	4,200	8/8

A berbere does not want any of these at full strength. What it wants is the *control* they taught us to build. The reservoir is useful precisely because it is dialable: the same genetics that reach 2,937,948 SHU can be tuned down to a steady, fruity 30,000–50,000 and — this is the real gift — held there. In wild chili, peak capsaicin varies batch to batch with a coefficient of variation near 42%; a berbere blended from wild chili is therefore a berbere whose heat you cannot promise. Our engineered lines hold a CV of ≤7%. For a solo pepper that is a nicety. For a sixteen-spice blend where one component's variance ripples through the whole chord, it is the difference between a recipe and a hope.

And the chili carries more than heat. The berbere pepper's fruit esters — the acetates and butanoates that read as berry, plum, and dried-fruit — and its sugars add a sweet-red front the blend needs; a chili bred only for Scovilles would make a berbere that is hot and hollow. When we design a berbere chili we hold heat flat on purpose and push fruit and color, routing more of the plant's carbon toward carotenoids (the deep red of a good berbere is capsanthin and

capsorubin) and volatile esters. The result is a chili whose IFI-H sits exactly where the recipe wants it and whose sweetness and color climb around that fixed point. The heat is the floor. We spend our cleverness making the floor level, and painting it red.

Chapter 3 · The Pungent Triad — *fenugreek, ginger, garlic.*

If the chili is the floor, the triad is the architecture. Fenugreek, ginger, and garlic are what make berbere *berbere* and not merely chili powder — and all three speak, above all, to one receptor: TRPA1, the pungency channel, the sharp irritant sense that the Index scores as IFI-P and this book takes as its spine.

TRPA1 is gated differently from TRPV1, and the difference is the whole reason pungency and heat feel like cousins rather than twins. Many of TRPA1's strongest agonists are *electrophiles* — molecules reactive enough to form a covalent bond with specific cysteine residues on the channel's cytoplasmic N-terminus. Allicin from garlic, cinnamaldehyde from cassia, 6-shogaol from dried ginger, the isothiocyanates from mustard: each does not merely fit a pocket, it chemically modifies the channel, latching on and holding the gate open until the adduct is cleared. That covalent mechanism is why pungency feels *sharp* and slightly stinging where capsaicin's reversible binding feels *hot*, and why a strong pungent hit lingers in a different way — the channel has to be chemically reset, not just vacated. The sensations are neighbors on the trigeminal nerve. The chemistry that opens them is not.



Ginger in cross-section — the oleoresin cells that hold the gingerols are densest just under the skin.

Fenugreek (*abesh*) is the back-note no one can name and everyone would miss. Its signature is **sotolon**, a lactone so potent the nose reads it at a few parts per billion — the maple-and-curry aroma that gives berbere its brown, savory depth, and the same molecule that makes fenugreek and lovage and aged sake smell the way they do. Alongside it come steroidal saponins, which carry a quiet bitterness and a real astringency at the salivary proteins (feeding IFI-A), and galactomannan mucilage, which is why fenugreek-heavy blends thicken a sauce slightly and cling. Toast fenugreek a shade too far and the sotolon tips toward acrid and burnt-sugar; stop a shade too

soon and the blend smells flat and raw. The whole blend's roast is, in practice, timed to the fenugreek — it is the thermometer the cook reads by nose.

Ginger (*zinjibil*) is a shape-shifter, and its transformations are a small lesson in reaction kinetics. Fresh, its heat is **6-gingerol**, an agonist at both TRPV1 and TRPA1. Dry it — as berbere demands — and a retro-aldol dehydration converts gingerol to **6-shogaol**, which is *hotter* and sharper; the name even records it (*shoga* is Japanese for ginger). Cook it long and gentle, with moisture, and the balance tips instead toward **zingerone**, which is rounder, warmer, and faintly sweet. So the same rhizome is three different entries on the Index depending on heat and water: raw gingerol, dried shogaol, braised zingerone. The berbere blender, drying ginger in the highland sun, is deliberately steering the molecule toward the shogaol end — choosing the hotter, sharper form on purpose.

Garlic (*nech shinkurt*) does double duty, and its chemistry is a switch thrown by damage. Intact, the clove holds odorless **alliin** and, in a separate compartment, the enzyme **alliinase**; crush the cell and the two meet, and within seconds alliin becomes **allicin**, the volatile electrophile that hits TRPA1. That is pure pungency, and it is why garlic's bite is made by the knife, not by the plant. But garlic also carries **γ-glutamyl peptides** — γ-glutamyl-S-allyl-cysteine chief among them — built through a γ-glutamyl transpeptidase pathway, and these are positive modulators of the calcium-sensing receptor: kokumi, IFI-K, the richness-and-continuity axis. Garlic is the one spice in the triad that lands on two channels at once, sharp and round in the same clove, which is why long-aged garlic (the black garlic of slow warm storage) loses its allicin bite entirely and keeps only a deep, sweet, kokumi body — the pungency gone, the richness concentrated.

COMPOUND	SOURCE	CHANNEL	AXIS
sotolon	fenugreek	(aroma) + saponin astringency	A
6-shogaol	dried ginger	TRPA1 / TRPV1	P/H
allicin	crushed garlic	TRPA1 (electrophilic)	P
γ-glutamyl-S-allyl-cysteine	garlic	CaSR	K
diallyl disulfide	cooked garlic	TRPA1 (mild)	P



Garlic — the kokumi peptides are in the clove's flesh; the pungency is made only when the cell wall breaks.

Three of the five organisms named in this chapter are in our engineered library — pepper, ginger, garlic — and garlic (560 constructs, axes K/P) is where we have pushed hardest on the kokumi peptides, because a garlic that carries more γ-glutamyl richness lets a cook reach the same depth of wat with a shorter, gentler cook. The triad is the reason berbere is pungent before it is hot. Everything after this chapter is aromatics laid over this frame — and the frame is sharp, alive, and made partly by the cook's own knife.

Chapter 4 · Korarima and the Warm Aromatics — *the spices with no English name.*

Some of berbere's most important voices do not translate. **Korarima** (*Aframomum corrorima*, sometimes "Ethiopian cardamom" or "false cardamom") is the keystone aromatic, a pod-bearing member of the ginger family native to the southwestern highlands and harvested from the wild and from shade gardens. It is a cousin of the West African grains of paradise, *A. melegueta*, and like them its seeds carry **6-paradol** and **6-gingerol** — so korarima quietly reinforces the triad's warmth — while its oil is rich in **1,8-cineole**, eucalyptol, which is not only a top-note aromatic but a modulator of TRPM8, the cold receptor. That is the source of the faint, almost imperceptible coolness threaded through a hot berbere: a whisper of IFI-C hidden inside a blend no one would ever call cooling. Nothing bought as green cardamom substitutes for korarima cleanly; the pod is more camphorous, more resinous, a little smoky, and a berbere without it is recognizably missing its spine.



Ethiopian basil — *besobela* — grown in our reference house; the estragole and linalool are in the glands on the underside of the leaf.

Around korarima sits a ring of warm aromatics, each adding a note and almost none adding real heat:

- **Cardamom** (*hil*) — more 1,8-cineole plus α-terpinyl acetate; the green, resinous top that makes a berbere smell expensive, and a second, deliberate dose of TRPM8-side coolness.
- **Cinnamon / cassia** (*qerfa*) — **cinnamaldehyde**, the textbook TRPA1 electrophile; sweet-sharp, and a pungency contributor that reads as warmth rather than bite because it is folded into so much

else. True cinnamon (*Cinnamomum verum*) is more delicate and floral; the hardier cassia is bolder and more common, and the two are not quite the same entry.

- **Clove** (*krinfud*) — **eugenol**, agonist at both TRPV1 and TRPA1 and a genuine local anesthetic that blocks voltage-gated sodium channels. The numbing roundness at the edge of a strong berbere is clove quieting the very nerves the chili excites — a built-in brake on the heat.
- **Nigella** (*tikur azmud*, black cumin) — **thymoquinone** and p-cymene; a faintly bitter, oregano-adjacent sharpness and a little more astringency.
- **Ajwain** (*nech azmud*) — almost pure **thymol**; a thyme-like, medicinal pungency, TRPA1 again, with a cooling edge of its own.
- **Coriander** (*dimbilal*), **cumin** (*kemun*), **nutmeg**, **allspice** — the linalool, cuminaldehyde, myristicin, and (again) eugenol that fill the aromatic middle so the blend has no gaps.
- **Besobela** (*Ocimum basilicum* var.) and **koseret** (*Lippia adoensis*) — the herbal, verbena-and-anise lift (methyl chavicol, linalool) that a dried berbere keeps as a green memory of the fresh plant.
- **Rue** (*tena adam*) — a trace; bitter, musky, divisive, and in the right hand indispensable.

The lesson of this ring is subtle and important: *aromatics change the perceived shape of heat without changing its amount.* The cineole coolness, the clove's anesthesia, the linalool sweetness — none of them reduces the capsaicin at TRPV1, but all of them reframe how the brain reads it. Some of this is retronasal: as you chew and swallow, these volatiles rise into the nasal cavity from behind, and the brain binds that aroma to the taste into a single percept, so a "cool, sweet, resinous" smell literally makes the same heat *feel* cooler and sweeter. On the Index this shows up two ways — as a low but non-zero IFI-C inside a hot blend, and as a heat that panels of tasters consistently rate "rounder" and "more tolerable" at the same measured SHU. Ethiopian cooks discovered thermomodulation by palate centuries before we gave the receptor a name. Our contribution is only to have measured how much, and to have learned to build it on purpose — to know that a half-gram more korarima buys a specific, repeatable softening of a heat we did not reduce.

Chapter 5 · The Berbere Specification — *sixteen spices, eight axes, one number.*

Now assemble the chord. What follows is a representative berbere spec — parts by mass, the compound that matters most in each, the axis it feeds, and whether it is a spice we *grow and tune* or one we *source and measure*. Recipes vary by region, by house, by the cook's own hand; this is a reference skeleton, not a decree.

COMPONENT (AMHARIC)	BOTANICAL	KEY COMPOUND	AXIS	PARTS	PLATFORM
Dried red chili (*berbere/karia*)	*Capsicum spp.*	capsaicin · dihydrocapsaicin	H	45	**engineered**
Fenugreek (*abesh*)	*Trigonella foenum-graecum*	sotolon · saponins	P/A	6	sourced
Ginger (*zinjibil*)	*Zingiber officinale*	6-shogaol	P	6	**engineered**
Garlic (*nech shinkurt*)	*Allium sativum*	allicin · γ-glutamyl peptides	P/K	5	**engineered**
Korarima	*Aframomum corrorima*	1,8-cineole · 6-paradol	C/P	5	sourced
Coriander (*dimbilal*)	*Coriandrum sativum*	linalool	aroma	4	sourced
Cardamom (*hil*)	*Elettaria cardamomum*	α-terpinyl acetate	C	3	sourced
Black pepper (*kundo*)	*Piper nigrum*	piperine	H/P	3	sourced
Cinnamon (*qerfa*)	*Cinnamomum spp.*	cinnamaldehyde	P	3	**engineered**
Cumin (*kemun*)	*Cuminum cyminum*	cuminaldehyde	P	3	sourced
Clove (*krinfud*)	*Syzygium aromaticum*	eugenol	P/H	2	sourced
Nigella (*tikur azmud*)	*Nigella sativa*	thymoquinone	P/A	2	sourced
Ajwain (*nech azmud*)	*Trachyspermum ammi*	thymol	P	2	sourced
Besobela	*Ocimum basilicum*	methyl chavicol	aroma	2	**engineered**
Nutmeg · allspice	*Myristica · Pimenta*	myristicin · eugenol	P	2	sourced
Rue (*tena adam*)	*Ruta chalepensis*	2-undecanone	bitter/aroma	0.5	sourced

Five of those sixteen we build in our own houses: chili, ginger, garlic, cinnamon, besobela. The other eleven we buy, characterize on the Index, and lot-match so the blend holds. This division is the honest shape of the work — we are not pretending to grow nutmeg. We are controlling the five that move the chord most and measuring the eleven that fill it in.

The measuring is not a formality. A sourced spice is a biological product with its own variance: one lot of korarima can carry half again the cineole of another, one crop of fenugreek more sotolon than the last. So every incoming lot is profiled — its key compounds quantified, its contribution to each axis scored against the reference — and blends are assembled to hit a target vector, not a fixed recipe by weight. If this season's cinnamon runs strong, it comes down a gram; if the fenugreek runs mild, it goes up. The written recipe is the starting point; the Index is the set point. This is ordinary quality control in a flavor house, but it is the difference between "sixteen spices in these proportions" and "this chord, every time."

Assembling the chord is a modeling problem, and it is worth being exact about why it is not addition. Each receptor channel has a finite capacity and a saturating response; multiple agonists at one channel compete for that capacity rather than summing; and perception adds masking and enhancement on top. So we do not total the rows — we solve for the blend's IFI vector the way we solve a metabolic network, treating each channel as a node with a throughput limit and each compound as a flux into it under competition. The output is the vector the eater actually perceives, and it is always *less* than the naive sum on the busiest channels (P and H, where many spices crowd) and roughly additive on the lonely ones (C, where only the cineole-bearers contribute). Then we taste, because the last few percent lives in a perceptual space the model only approximates, and because a chord is finally judged by an ear, not a spreadsheet.

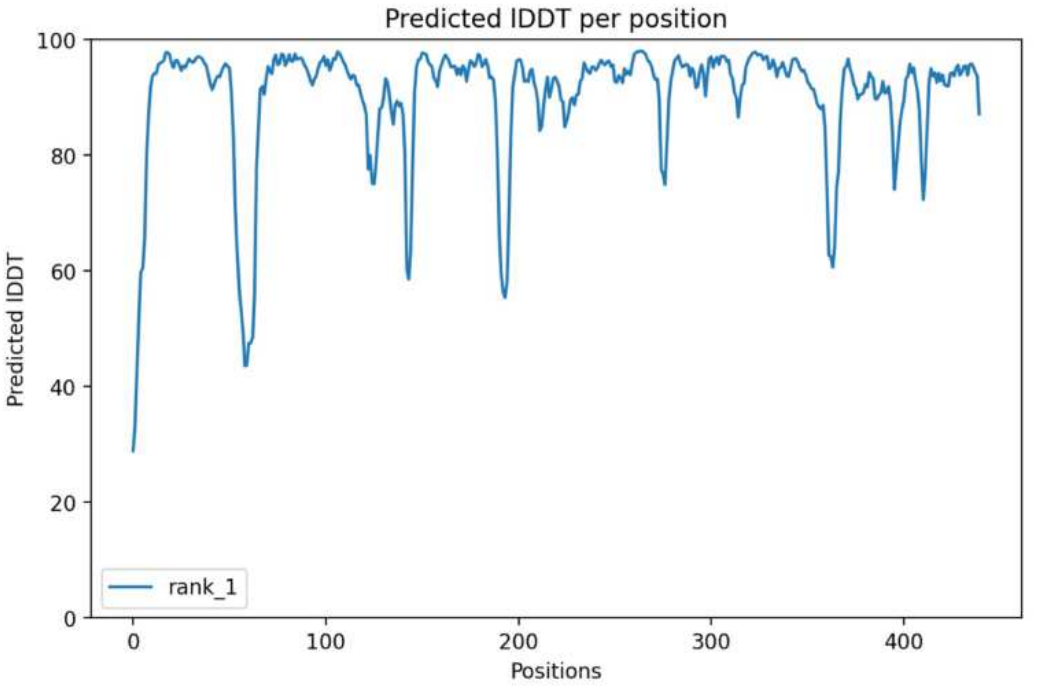


FIG. 7 — Pun1/AT3 coloured by pLDDT confidence; the binding cleft where the one spice we grow is tuned, residue by residue.

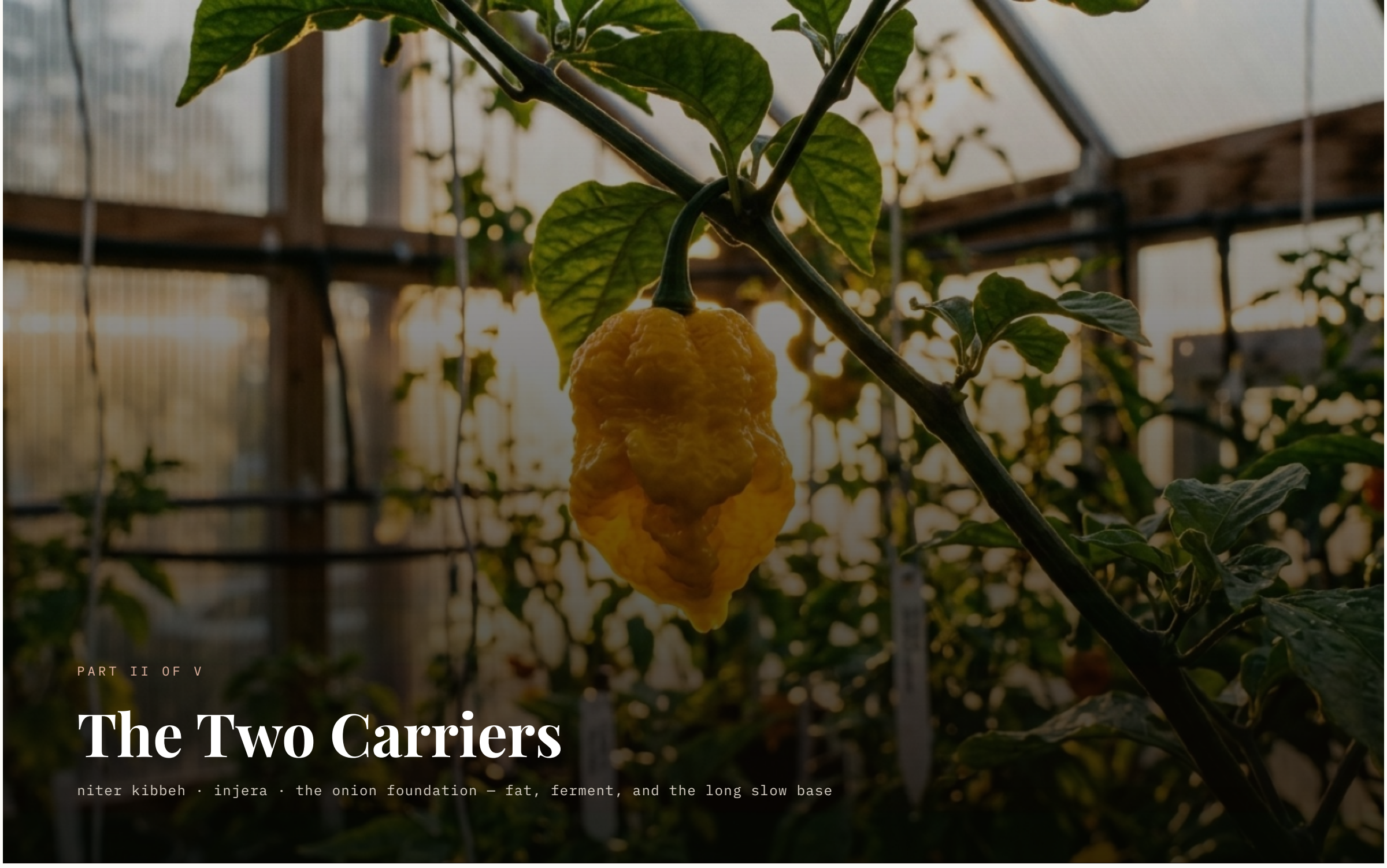
Two practical variables sit outside the compound table and move the result as much as any of them: *roast* and *grind*. Berbere is toasted, and toasting is a reaction — it drives the gingerol-to-shogaol shift, tips fenugreek's sotolon toward or past its sweet spot, volatilizes the lightest top-notes, and builds new Maillard browning. A blend roasted darker reads hotter in P and deeper in the low aromatic register; one roasted lighter stays brighter and greener. And grind sets extraction: a finer powder gives up its lipophilic actives faster and more completely into the cooking fat, so the same blend, ground finer,

reads louder in the dish. When we specify a berbere we specify it roasted to a defined endpoint and ground to a defined particle size, because an unroasted, uncut spec is only two-thirds of a recipe.

```
BERBERE · the blend, from whole spices · makes ~2 cups
──────────────────────────────────────────────────────
dried mild red chilies, stemmed        150 g
fenugreek seed                          2 tsp
coriander seed                          2 Tbsp
cumin seed                              1 Tbsp
korarima (or green cardamom) pods       8
black peppercorns                       1 Tbsp
whole cloves · ajwain · nigella         1 tsp each
cinnamon · allspice · nutmeg            to taste
dried garlic · dried ginger             2 Tbsp · 1 Tbsp
salt                                    1 Tbsp
```

1. Toast each whole spice **separately** over low heat until just fragrant — seconds, not minutes — and keep the fenugreek pale; let it darken and the whole blend turns bitter.
2. Cool completely, then grind the chilies and toasted spices to a fine, even powder.
3. Blend with the dried alliums and salt; rest sealed a day before use, and keep airtight away from light. Its readout is the dry-blend block of Chapter 1.

The payoff of growing even five of sixteen is leverage at the point of greatest variance. The chili alone is nearly half the blend by mass and the whole of its heat; a chili held to CV ≤7% stabilizes the single rowdiest term in the equation, the one whose swing would otherwise detune everything downstream. Tune the chili, lot-match the rest, roast and grind to spec, and a berbere becomes reproducible — the same chord, struck the same way, every batch. That reproducibility is the bridge from this part, which took the blend apart, to the last part, which puts a designed one back together.



PART II OF V

The Two Carriers

niter kibbeh · injera · the onion foundation — fat, ferment, and the long slow base

Chapter 6 · Niter Kibbeh — *fat is the solvent flavor travels in.*

Before a single wat is built, the Ethiopian kitchen makes its fat. **Niter kibbeh** is butter melted and held at a bare simmer with garlic, ginger, korarima, besobela, koseret, fenugreek, cumin, cardamom, cinnamon, nutmeg, and turmeric, until the milk solids fall out golden to the bottom of the pan and the fat above them turns clear, nutty, and profoundly fragrant. It is strained and kept, and it is the medium almost every savory dish is built in. Understanding why it matters requires one piece of chemistry the whole cuisine turns on: *most of berbere's loudest molecules are oil-soluble, and so are their receptors' neighborhoods.*

Capsaicin has a partition coefficient — logP — of about 3.8, which means that given a choice between oil and water it partitions into the oil by roughly six thousand to one. Eugenol, cinnamaldehyde, 6-gingerol, curcumin, the terpene aromatics of korarima and cardamom: all lipophilic, all happier in fat than in broth. And the receptors these molecules target are themselves embedded in the lipid membrane of the nerve cell; capsaicin even reaches TRPV1's binding pocket from within the membrane. Fat, then, is doing two jobs at once. It is the *solvent* that pulls these compounds out of the ground spice, and it is the *vehicle* that carries them to a receptor sitting in a membrane that is chemically like the fat itself. Cook berbere in water alone and much of its character stays locked in the powder, passes through the pot, and is poured down the drain uneaten. Bloom it in niter kibbeh and the blend opens — the color deepens, the aroma blooms, the heat distributes evenly instead of flaring in dry hot specks.



Garlic in cross-section — in niter kibbeh its oils and the warm aromatics are extracted into the fat and held there.

Clarifying matters too, and for more than tradition. Removing the water and the milk solids raises the smoke point from butter's roughly 150 °C to well above 200 °C, so niter kibbeh can carry the long, hot onion cook without scorching; the brief Maillard browning of the solids *before* they are strained donates a toasted, nutty depth the fat keeps; and taking out the water takes out the main agent of rancidity, so a well-made niter kibbeh keeps for months without

refrigeration — a real consideration in a highland kitchen. What remains is a shelf-stable, spice-charged cooking fat that is, in Index terms, a carrier with its own modest profile: kokumi-forward from the garlic and the browned solids, lightly pungent, with korarima's cool thread.

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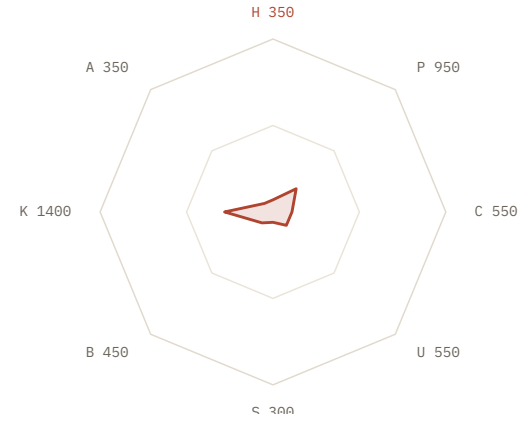


IFI-H	350
IFI-P	950
IFI-C	550
IFI-U	550
IFI-S	300
IFI-B	450
IFI-K	1,400
IFI-A	350

CHARGE SPICE	LIPOPHILIC COMPOUND CARRIED	LOGP
chili (from the wat's berbere)	capsaicin	3.8
ginger	6-gingerol	3.9
cardamom	α-terpinyl acetate	3.5
turmeric	curcumin	3.2
nutmeg	myristicin	3.0
besobela	methyl chavicol	3.0
korarima	1,8-cineole	2.8
garlic	diallyl disulfide	2.5
cinnamon	cinnamaldehyde	1.9

The logP column is the whole argument in one list. Everything on it is comfortably lipophilic, and the higher the number the more completely the fat extracts and holds it — which is why a spice steeped in warm fat gives up more of its character than the same spice simmered in a watery sauce, and why niter kibbeh tastes of far more than the sum of a spoonful of each spice would in a cup of water. The one quiet exception is fenugreek's sotolon, which is only mildly lipophilic and partitions both ways; that is part of why fenugreek is used in the fat *and* reaches the sauce, bridging the two phases.

NITER KIBBEH · spiced clarified butter · makes ~400 g

unsalted butter	500 g
garlic, crushed · ginger, sliced	6 cloves · 1 Tbsp
korarima, cracked	4 pods
fenugreek · cumin · cardamom	1 tsp each
cinnamon stick · besobela leaves	1 · a few
turmeric · nutmeg	½ tsp · a grating

1. Melt the butter slowly; as the foam rises, add all the aromatics.
2. Hold at the barest simmer 20–30 min — never a true boil — until the milk solids fall golden to the bottom and the fat above is clear and deeply fragrant.
3. Strain through cloth and cool; it keeps for months. For **ye'tsom niter**, steep the identical aromatics in 400 ml of gently warmed nug or safflower oil, with no butter at all.

For the fasting table — and this cuisine fasts for much of the year — the same logic runs on oil. **Ye'tsom niter kibbeh** steeps the identical spice charge in a neutral plant oil, traditionally *nug* (niger seed, *Guizotia abyssinica*, an oilseed of the highlands) or safflower, with no butter at all. The vehicle changes; the physics does not. Capsaicin's logP of 3.8 does not care whether the triglyceride came from a cow or a seed, and a vegan wat built on ye'tsom niter delivers the lipophilic chord every bit as fully as a feast-day one. This is the first of many places in this cuisine where the plant-forward version is not a compromise but a parallel, equally complete, path — and it is worth saying plainly, because a great deal of the world still hears "vegan" as "the lesser version." Here it is simply the other carrier, chosen by the calendar, carrying exactly the same flavor by exactly the same means.

Chapter 7 · Injera — *the ferment that is also the plate.*

Injera is the plate, the utensil, and the staple carbohydrate at once, and it is made from the smallest cultivated grain on earth. **Teff** (*Eragrostis tef*) is so tiny — around 150 seeds to the weight of a single wheat kernel — that it cannot practically be refined; it is always milled whole, bran and germ and all. The flour is slurried with water and a spoonful of *ersho*, the reserved sour liquid skimmed from the last batch, and left to ferment for two to three days. What happens in that crock is the heart of the bread, and it is a microbiology experiment that runs itself.

Wild lactic acid bacteria and yeasts colonize the batter in succession — *Lactobacillus* and *Pediococcus* species among the bacteria, *Candida* and *Kluyveromyces* among the yeasts. The bacteria convert the flour's sugars to **lactic and acetic acid**, dropping the pH from near 6 toward 3.6 and building the clean, deep sourness that defines injera; the acidity also preserves the batter, holding spoilage organisms at bay the way it does in any sourdough. The yeasts throw off carbon dioxide. Many cooks add a further step called *absit*: a portion of the fermenting batter is cooked into a thin gelatinized porridge and stirred back in, which pre-swells the starch, feeds the final fermentation, and gives the bread a softer, more uniform crumb. When the batter is at last poured in a spiral onto a hot clay *mitad* and covered to steam, the trapped gas erupts into the thousand tiny craters — the *eyes*, *ebalbala* — that make injera a sponge. One side cooked, never flipped: soft, pliable, cool, and sour, built to be torn and to soak.

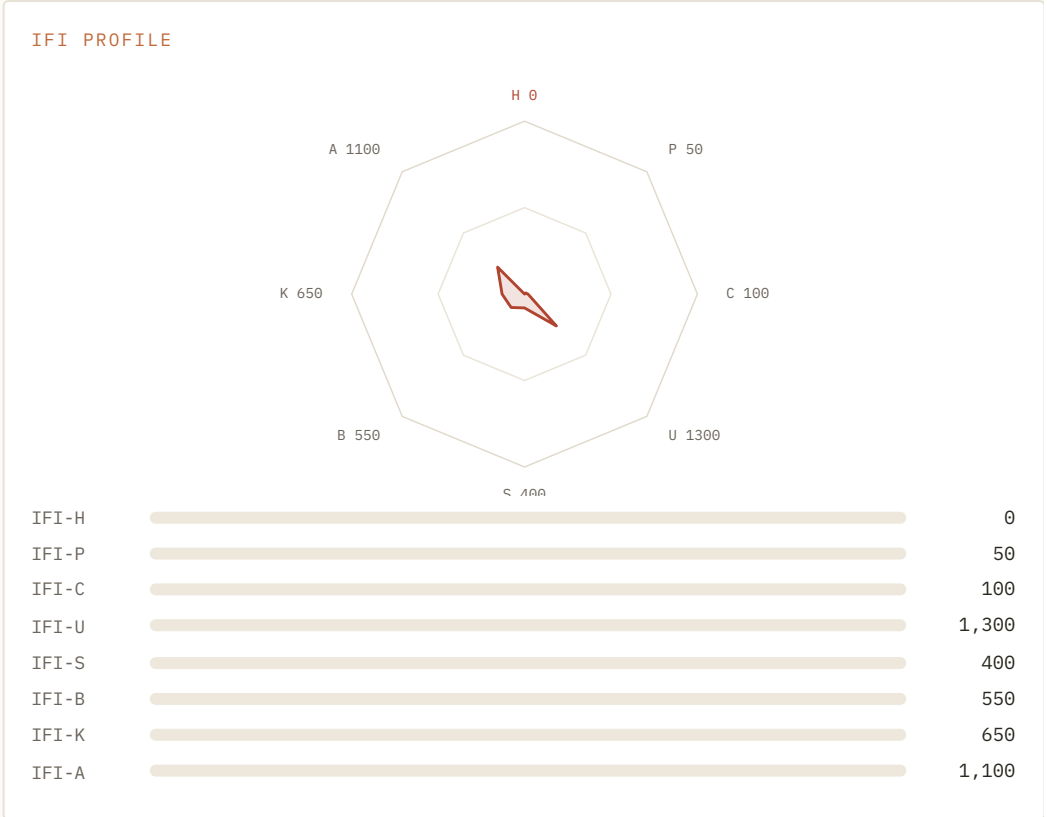


Sorghum in our reference house — the sequenced grass whose polyphenol chemistry we work as the proxy for teff.

That teff holds together at all, with no gluten, is itself worth a moment. Wheat breads are scaffolded by a gluten network; injera has none, and relies instead on gelatinized starch and the gas-trapping viscosity of the fermented batter to build and hold its open structure. It is, in other words, a leavened bread that works on

entirely different physics — which is exactly why it is naturally suited to anyone who cannot eat gluten, a property of the grain we note as fact and leave there.

Here the Index must be honest about its own edges. Injera's signature is *sour*, and sourness — the direct detection of protons by the acid-sensing taste cells — is not one of the eight axes. The IFI does not score it, and we will not pretend otherwise; the acid of injera is the bed the eight axes are read *against*, not one of them. What the Index does read in the bread is two things. First, **umami**: fermentation and the breakdown of the grain's proteins liberate free glutamate and nucleotides, so injera carries a quiet savory depth that makes it taste of more than starch. Second, **astringency**: teff is rich in polyphenols, and those tannin-like compounds precipitate the proline-rich proteins in saliva, giving the bread its faint grip — IFI-A, the same axis that structures wine and tea.



Teff is not yet in our engineered library, and we say so plainly. The grain we work as its proxy is **sorghum** (120 constructs; primary axis A; a frontier organism) — another ancient African grass whose chemistry gives us a validated handle on the astringency axis. Sorghum's grip comes from condensed tannins (proanthocyanidins), oligomers of flavan-3-ols that cross-link the salivary proteins; learning to tune that polyphenol load up for structure or down for

softness is learning the same lever teff's astringency runs on, even as teff stays the authentic, irreplaceable article. What we learn tuning sorghum we would one day bring to the smaller grain.

HOUR	STAGE	DRIVING MICROBES	PH	ON THE TONGUE
0	mix teff · water · *ersho*	—	~6.0	flat, grassy
12–24	onset	yeasts · early *Lactobacillus*	~4.6	faint sour, first gas
36–48	peak	LAB dominant	~3.9	clean sour, bubbling
60–72	ripe · *absit* step	LAB · acetic rise	~3.6	full sour, ready to bake

INJERA · fermented teff flatbread · makes ~10 · 3 days

teff flour	500 g
water	~750 ml, plus more
ersho (reserved sour starter)	a ladle, if you have it
salt	a pinch

1. Whisk the teff and water to a smooth, pourable batter; cover loosely and leave warm 2–3 days, until it smells cleanly sour and a thin liquid stands on top — that liquid is the next batch's *ersho*.
2. Pour off and reserve the clear liquid. For a softer crumb, cook a cup of the batter with water to a thin porridge (*absit*), cool, and stir it back in; loosen to a light pouring batter.
3. Heat a wide pan or *mitad*; pour the batter in a spiral from the edge inward, cover at once, and cook **without flipping** 2–3 min, until the top sets and holes and the edges lift. Cool on cloth, never stacked hot.

The pairing logic falls out of the numbers. Injera brings sour, umami, and astringency — an acid-savory-grippy bed with almost no heat of its own. The wat brings heat, pungency, deeper umami, and kokumi. The bread is the counterpoint that keeps the stew from overwhelming, its acid cutting the fat and resetting the palate between bites; the stew is the voice the bread is built to carry. And because teff is milled whole, the bed is also where much of the meal's iron, calcium, and resistant starch live — a fact we state as what it is, a property of the grain, and leave there.

Chapter 8 · The Onion Foundation — *an hour of patience before anything else.*

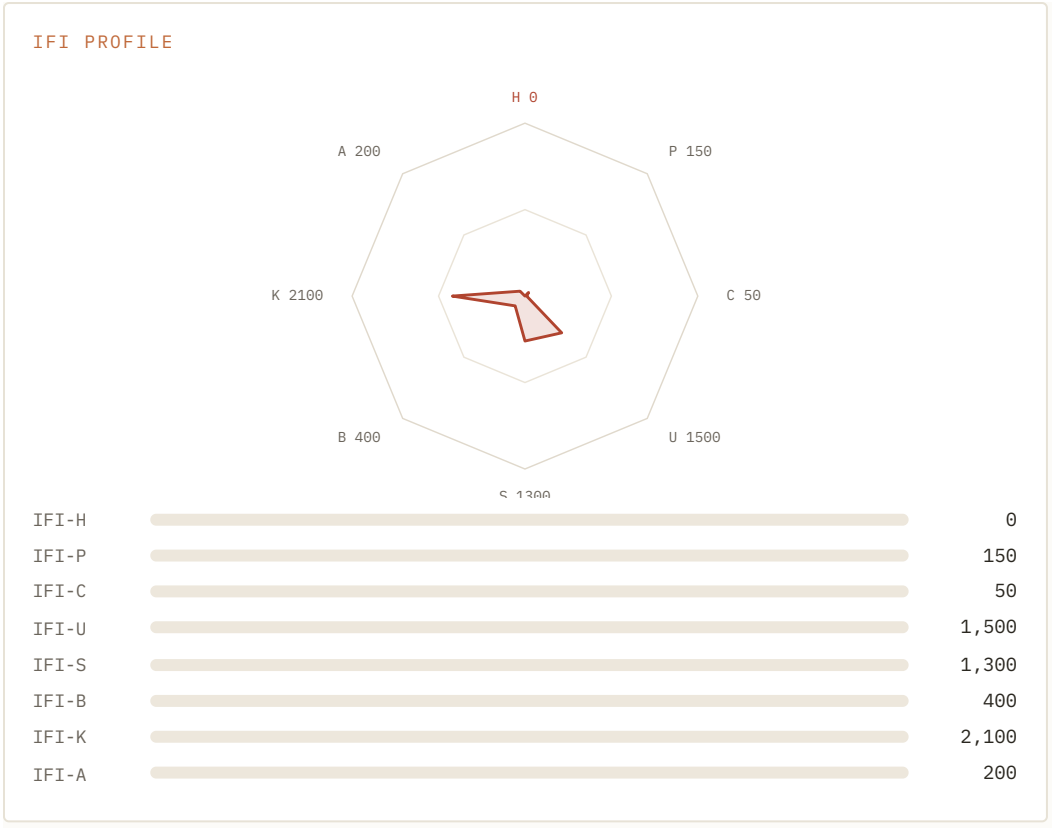
Watch a wat begin and you will see something that looks, at first, like a mistake: a mountain of finely diced red onion going into a dry pan with no fat at all. No oil, no butter, nothing — just onion over low heat, stirred, for half an hour or more, until it slumps and darkens and collapses into a soft, sweet, almost jammy paste. Only then does the niter kibbeh go in. Only then the berbere. The dry onion is the foundation every wat is built on, and it is one of the most quietly sophisticated techniques in world cooking.

The chemistry explains the patience. Cooked in fat from the start, onion effectively *fries* — the fat conducts heat fast and unevenly, the surface browns before the inside has given up its water, and the result is patchy and quick and shallow. Cooked dry, the onion first *sweats*: its cells rupture, its water leaves as steam, and its long storage carbohydrates — fructans, chains of fructose — hydrolyze slowly to free fructose and glucose, so the mass sweetens from within. Only once the water is mostly gone does the surface reach the temperatures where **Maillard** browning (sugars reacting with amino acids) and **caramelization** (sugars browning alone) proceed, and now they proceed slowly and evenly across the whole paste rather than scorching one edge. The sharp sulfur compounds that made your eyes water mellow and round. What you are left with is not a flavoring but a *structure* — the body and backbone of the finished stew.



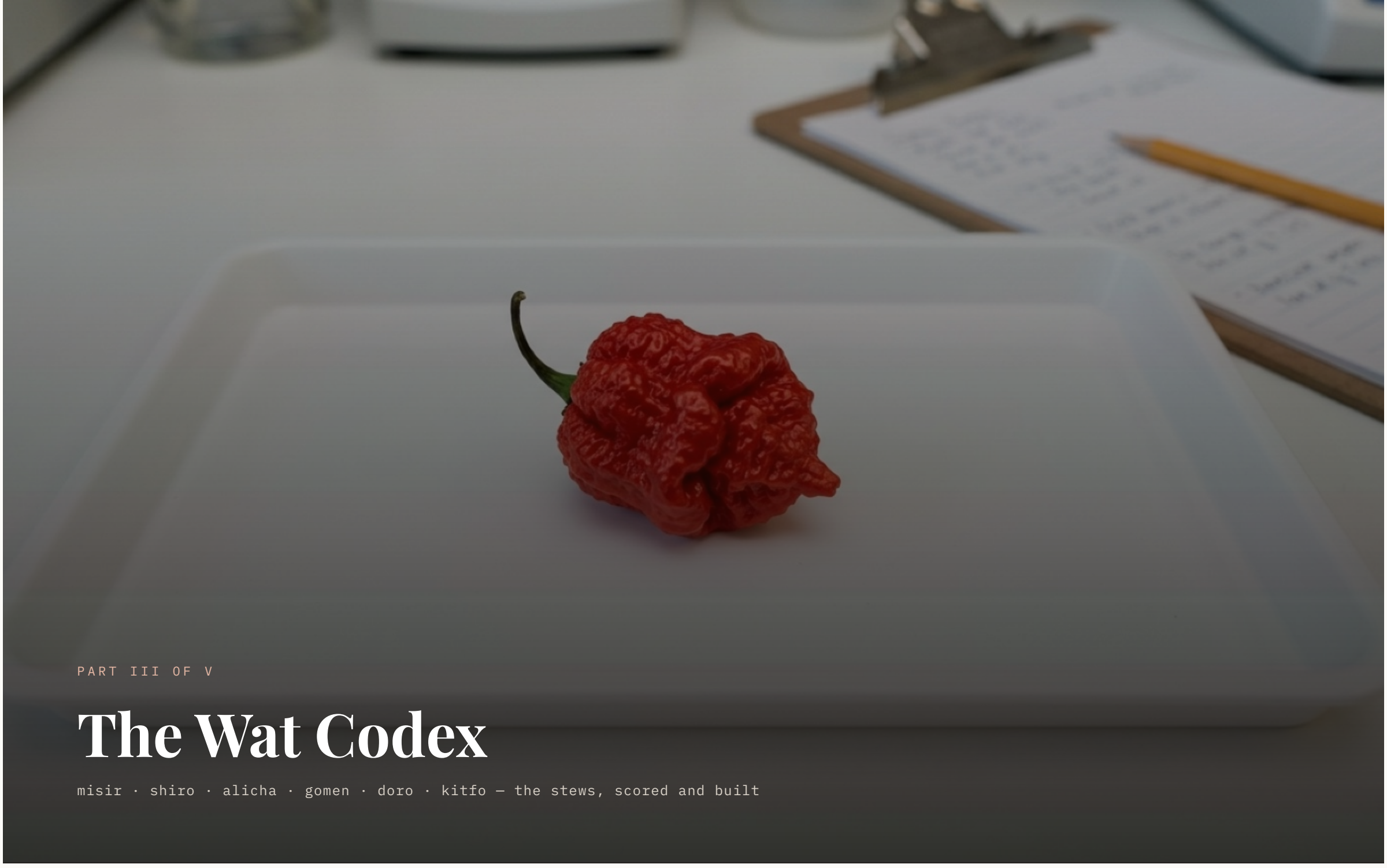
Red onion in cross-section — the concentric scales whose fructans sweeten and whose peptides turn to kokumi over the long dry cook.

On the Index the dry onion base reads as three axes braided together. **Sweetness**, from the liberated sugars. **Umami**, from free glutamate. And above all **kokumi** — IFI-K, the hardest axis to describe and the one this base exists to build.



Kokumi is the richness-and-continuity axis, and its receptor is CaSR, the calcium-sensing receptor — the same receptor that monitors blood calcium elsewhere in the body, here repurposed on the tongue. Its agonists — glutathione, γ-glutamyl-valyl-glycine, and the γ-glutamyl peptides that alliums are rich in — bind at the receptor's large extracellular "Venus flytrap" domain and act as *positive allosteric modulators*: they taste of almost nothing on their own, but they tune the receptor so that the sweet, umami, and salty signals arriving alongside them are read louder, longer, and more continuously. The effect is less a flavor than a *gain* — as if someone turned up the resolution and the sustain on everything else without adding a note of their own. A long dry onion cook does two things to feed this axis at once: it concentrates the onion's native γ-glutamyl peptides as the water leaves, and it generates new CaSR-active species through the Maillard chemistry. That is why a wat built on a rushed onion base tastes thin no matter how much berbere you pile on — the gain stage is missing — and why an hour of stirring tastes, in the finished dish, like generosity.

This is the one place in the base where our library leans in directly. Our **onion** (40 constructs; primary axis K) is engineered for exactly these peptides — more γ-glutamyl richness per bulb — so a cook reaches the same depth of foundation in less time and with more certainty, the plant having pre-loaded what the long cook would otherwise have to build. Red onion is the traditional choice for its balance of sugar and sulfur, and its anthocyanin color cooks away under the berbere regardless. The dry onion is where the wat gets its soul. We are simply trying to make the soul easier to reach.



PART III OF V

The Wat Codex

misir · shiro · alicha · gomen · doro · kitfo — the stews, scored and built

Chapter 9 · Misir Wat — *the red lentil, the everyday feast.*

If there is one dish that teaches this cuisine, it is misir wat — red lentils cooked down with the onion base, berbere, and niter kibbeh into something glossy, deep, and quietly complete. It is a fasting staple, a weeknight dish, and, done well, a thing you would serve anyone. The red lentil is the right legume because it is split and skinless: with no seed coat to hold its shape, it surrenders, breaking down into a silky purée that takes the berbere into itself rather than sitting beneath it.

```
MISIR WAT · red lentil wat · serves 4–6 · about 55 min
──────────────────────────────────────────────
red lentils (misir), rinsed          400 g
red onion, very fine dice             3 large (~600 g)
niter kibbeh (or ye'tsom niter)       60 g
berbere                               3–4 Tbsp
garlic, grated                        6 cloves
ginger, grated                        1 Tbsp
tomato paste                          1 Tbsp
hot water or light stock              ~700 ml
salt                                  to taste
```

1. Cook the onion **dry** in a heavy pot over low-medium heat, stirring, 25–35 min, until collapsed, deeply softened, and beginning to catch — no fat yet.
2. Add the niter kibbeh and let it melt into the onion; stir 2–3 min until the fat runs red-gold.
3. Stir in the berbere and bloom it in the fat for 2 minutes — it should smell toasty, not raw — then the garlic, ginger, and tomato paste; cook 2 minutes more.
4. Add the lentils and stir to coat. Add hot water a ladle at a time, as for a risotto, keeping a loose simmer.
5. Simmer 25–30 min, stirring often, until the lentils break down into a glossy purée. Salt near the end. Finish with a last teaspoon of niter kibbeh off the heat.

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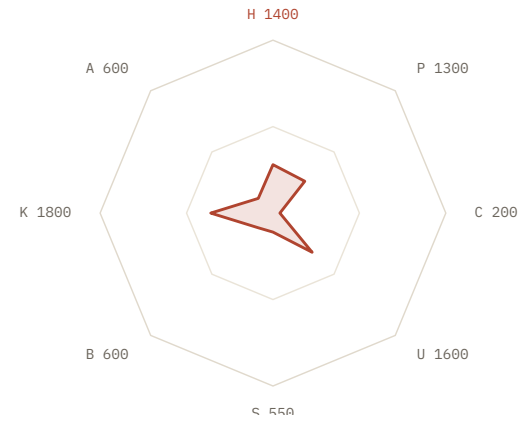

IFI-H	1,400
IFI-P	1,300
IFI-C	200
IFI-U	1,600
IFI-S	550
IFI-B	600
IFI-K	1,800
IFI-A	600

The science of why it satisfies is in the convergence of carriers. The lentils bring their own free glutamate and, broken down, a protein-dense body; the onion base brings sweetness and kokumi; the berbere, bloomed in fat, delivers its lipophilic heat and pungency *dissolved*, so it coats every spoonful evenly instead of flaring in hot spots. Read the block: kokumi and umami lead, heat and pungency sit just behind, and nothing spikes. That balance is the whole aspiration of a wat — a dish where six axes are all present and none of them shouts. A chili bred for color and a steady 35,000 SHU, held at CV ≤7%, is what lets this exact block land the same on a Tuesday as it did the Sunday before.

The dish also carries the cuisine's quiet nutritional logic without announcing it. A skinless split lentil cooks fast and digests easily; it brings plant protein and iron to a plate whose bread brings more of both; and the long onion means the depth comes from vegetables and time rather than from any animal product — which is exactly why misir wat anchors the fasting table. For a feast-day version, it is built on butter niter kibbeh and sometimes enriched further; for the fasting version, ye'tsom niter on nug oil, and the block barely moves. It is the same dish wearing the calendar's two coats.



FIG. 9 — the heat reservoir: an engineered chili dialed far down and held flat is what keeps a weeknight misir wat reproducible.

Its cool fasting-day companion is **azifa**, a lentil salad served chilled — the sharp, raw counterpoint to the long-cooked wats, its heat coming not from chili but from ground mustard, pure TRPA1 pungency:

```
AZIFA · chilled green lentil salad · serves 4 · fasting
──────────────────────────────────────────────────────
green or brown lentils, cooked firm     300 g
onion, very fine dice                    ½
green chili, minced                      1
ground mustard · lemon juice             1 tsp · 3 Tbsp
oil (nug or olive)                       3 Tbsp
salt                                     to taste
```

1. Cool the cooked lentils so they keep their shape — azifa is about distinct grains, not a purée.
2. Fold through everything else; the ground mustard is the heat here, standing in for berbere with a sharp, bright isothiocyanate pungency.
3. Rest 20 min and serve cool, against the hot wats.

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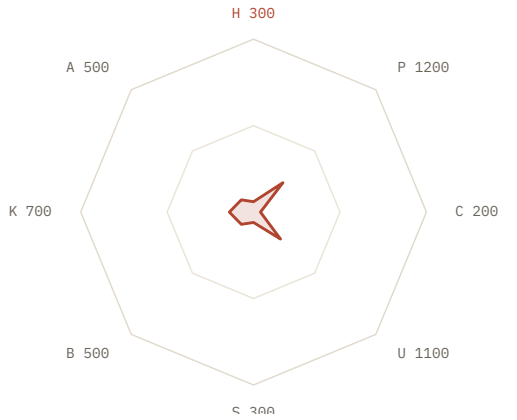

IFI-H	300
IFI-P	1,200
IFI-C	200
IFI-U	1,100
IFI-S	300
IFI-B	500
IFI-K	700
IFI-A	500

Chapter 10 · Shiro — *flour, fat, fire — the most forgiving stew.*

Shiro is the dish of the lean week, the long road, the monastery, and the impatient weeknight, because it is nearly instant and nearly foolproof. It begins not with a whole legume but with legume *flour* — chickpeas, or the broad beans the Amharic calls *bakela*, roasted and milled, very often pre-blended with berbere and spices into a ready *shiro* powder that a household buys by the kilo. Whisked into a hot onion-and-fat base with water, it thickens in minutes into a smooth, rust-colored, intensely savory stew that you eat the instant it is done — a *tegabino* shiro, served still bubbling in its little clay pot, is the quickest complete meal this cuisine makes.

SHIRO WAT · spiced legume-flour stew · serves 4 · about 25 min

shiro flour (chickpea or broad bean)	150 g
red onion, fine dice	1 large (~200 g)
niter kibbeh (or ye'tsom niter)	45 g
berbere (if flour is unspiced)	2 Tbsp
garlic, grated	4 cloves
hot water	~600 ml, plus more
tomato, fine dice (optional)	1 small
salt	to taste

1. Cook the onion dry 12–15 min until soft, then melt in the niter kibbeh; bloom the berbere and garlic 2 min.
2. Whisking constantly, rain in the shiro flour a little at a time to avoid lumps — treat it exactly as you would a roux.
3. Add hot water in a steady stream, still whisking, to a loose, pourable consistency — it thickens as it cooks.
4. Simmer very gently 8–12 min, stirring, until it smooths and the raw-bean taste cooks out. Loosen with more water as needed; salt to finish.

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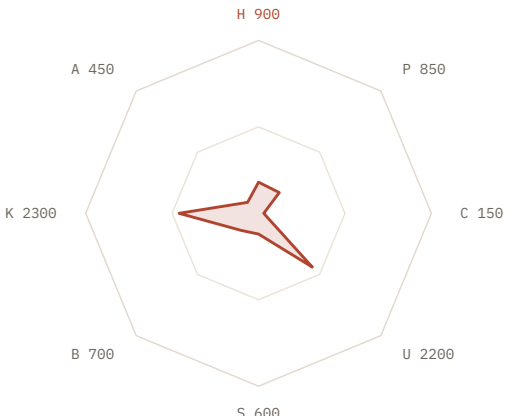

IFI-H	900
IFI-P	850
IFI-C	150
IFI-U	2,200
IFI-S	600
IFI-B	700
IFI-K	2,300
IFI-A	450

Shiro is the cuisine's purest umami-kokumi expression, and the block shows it: U and K both well over two thousand, heat and pungency present but deliberately in the back. The reason is concentration, and it starts before the pot. Roasting the legume before milling runs the Maillard reaction in the dry bean, building nutty, savory, brown-toned compounds that a boiled whole bean never develops; milling then packs that roasted protein and its glutamate into a flour where every gram is dense with savor. Disperse that flour in fat and you carry the berbere and the legume's depth in the same medium to the same receptors at the same instant, with no textural distraction — no whole bean, no lentil skin — only pure, smooth depth. It is, in a sense, the most "designed" of the traditional dishes: a legume pre-processed for maximum umami per spoonful.



Soybean in cross-section — the legume we engineer for umami and kokumi, our platform proxy for the shiro family.

Our legume work runs through **soybean** (360 constructs; axes U/K; a frontier organism), the model legume for amplifying exactly the two axes shiro lives on. A shiro built from a legume carrying more free glutamate and more CaSR-active peptide would reach this block with less fat and less salt — the savor coming from the bean itself rather than from the seasoning around it. That is the quiet ambition under the whole library: let the plant carry more of the flavor, so the kitchen has to add less, and so the simplest, cheapest, most everyday dish on the table is also, without trying, one of the deepest.

Chapter 11 · The Mild Side — Kik Alicha & Atkilt — *turmeric, not berbere.*

Not every dish on the injera is red. A well-set table is a conversation between the fiery berbere wats and the gentle *alicha* dishes — the mild family, built on turmeric, ginger, garlic, and fresh green chili, with no red chili heat at all. Alicha is not blandness; it is deliberate contrast, a cool golden counterweight that lets the hot wats hit harder by giving the palate somewhere to rest. A plate of all berbere would exhaust the tongue; the alicha is the rest built into the composition, the silence between the loud bars.

Turmeric (*erd*) is the signature. Its color and much of its character come from **curcumin**, which is itself a mild TRPA1 agonist and carries a gentle, clean bitterness, while the aroma — earthy, faintly resinous — is ar-turmerone and its relatives. In an alicha, turmeric's job is warmth-without-heat: a yellow depth and a faint earthy pungency that asks nothing of the TRPV1 channel. The green chili, slit and left whole, adds a fresh, grassy top-heat that is mostly aroma and only a little burn — a different kind of heat entirely from the dried, built heat of berbere.

KIK ALICHA · mild yellow split peas · serves 4 · about 50 min

yellow split peas (kik), rinsed	300 g
onion, fine dice	1 large
garlic, grated	4 cloves
ginger, grated	1 Tbsp
turmeric	1½ tsp
niter kibbeh or oil	45 g
green chili (mild), slit	1–2
water	~900 ml
salt	to taste

1. Simmer the split peas in water until very soft, 30–40 min; skim, and keep them loose.
2. Separately, soften the onion in the fat, add garlic, ginger, and turmeric, and cook 3–4 min until fragrant and golden — no browning past gold.
3. Fold the softened peas into the aromatics, add the green chili, loosen with the cooking water, and simmer 10 min. Salt to finish.

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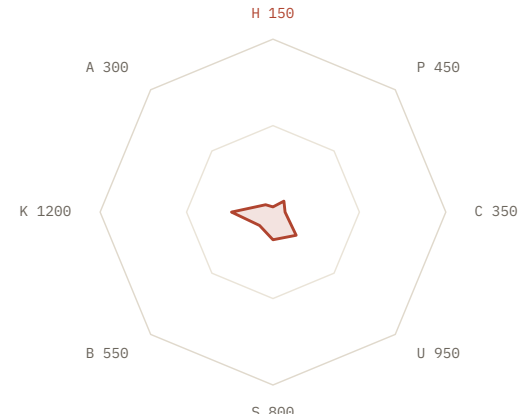

IFI-H		150
IFI-P		450
IFI-C		350
IFI-U		950
IFI-S		800
IFI-B		550
IFI-K		1,200
IFI-A		300

Its everyday partner is **atkilt wat** — cabbage, carrot, and potato stewed gently with the same turmeric-ginger-garlic aromatics. Here sweetness climbs (carrot and long-cooked cabbage both run sweet) and a bitterness-attenuation note enters from the brassica:

ATKILT WAT · cabbage, carrot & potato alicha · serves 4–6 · 40 min

green cabbage, thick sliced	½ head
carrots, oblique cut	3
waxy potatoes, chunked	3
onion, sliced	1 large
garlic · ginger · turmeric	4 cloves · 1 Tbsp · 1 tsp
oil or niter kibbeh	45 g
water	just to steam
salt	to taste

1. Soften onion in fat with garlic, ginger, and turmeric, 4 min.
2. Add carrots and potato, a splash of water, cover, steam 10 min.
3. Add cabbage, cover, steam 12–15 min until everything is tender and glazed, not boiled. Salt to finish.

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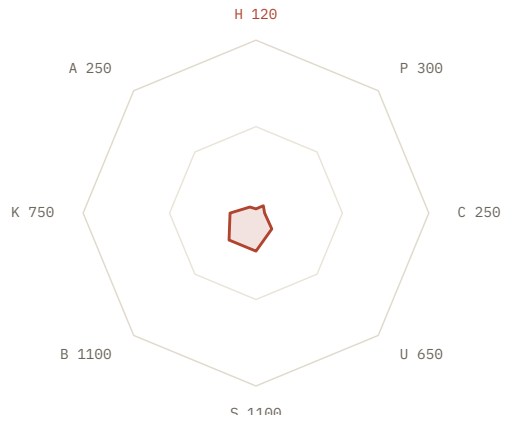


IFI-H	120
IFI-P	300
IFI-C	250
IFI-U	650
IFI-S	1,100
IFI-B	1,100
IFI-K	750
IFI-A	250



Turmeric — the curcumin that gives alicha its gold is a mild TRPA1 agonist and a quiet bitterness.

The atkilt block is worth reading closely, because it inverts the berbere dishes point for point. Its loudest axes are sweetness and *bitterness-attenuation* — IFI-B, the TAS2R38 axis — where the berbere wats lead with P and H. Cabbage, like all brassicas, carries bitter glucosinolates, and a long gentle steam partly degrades them while the carrot's and cabbage's sugars come forward; the dish gets milder and sweeter the longer it goes. Our brassica lines (cabbage and potato both sit at the easier end of the engineering ladder) target that same 20–65% bitterness knockdown at the gene level, so the vegetable arrives already gentled and the cook's steam has less work to do. Between them, kik alicha and atkilt are the plate's exhale — the mild side that makes the fire legible, and the proof that "mild" in this cuisine means *composed*, not absent.

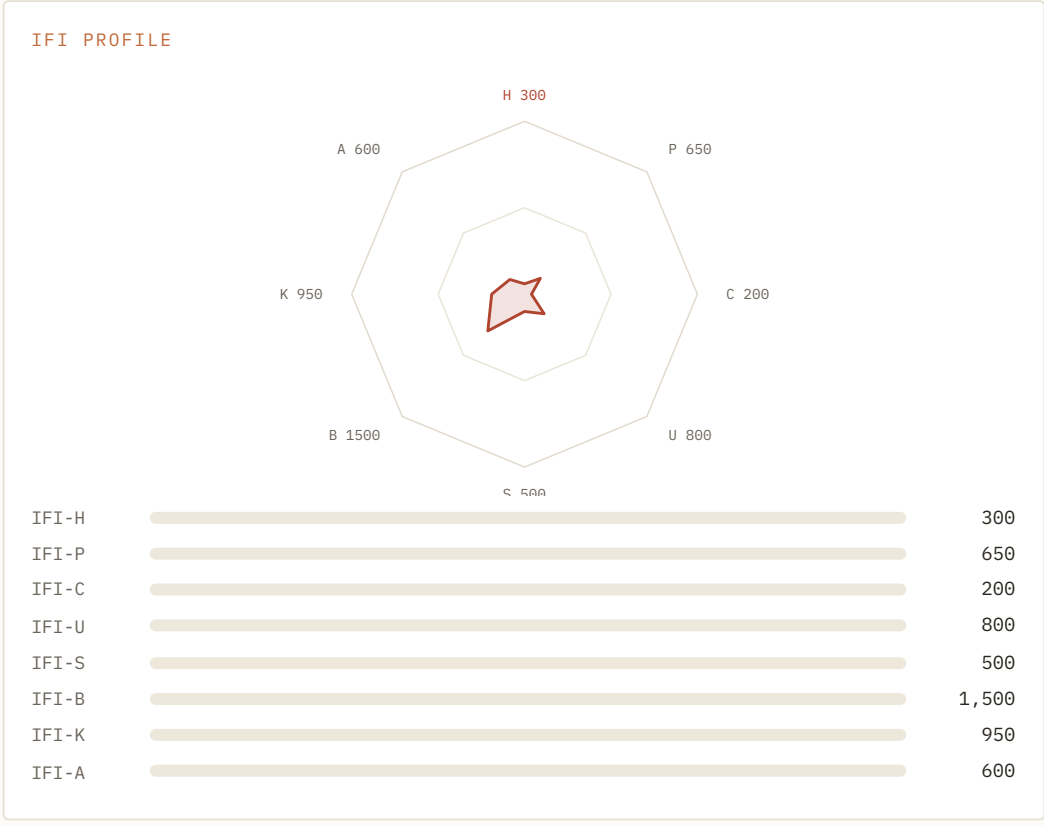
Chapter 12 · The Greens — Gomen & Tikil Gomen — *bitterness, tamed.*

Greens are the third color on the injera, and they bring a problem the Index is unusually good at describing. **Gomen** — collard or mustard greens, *ye'abesha gomen* — and **tikil gomen** — the cabbage-potato-carrot braise that is the alicha family's green cousin — are brassicas, and brassicas are built by their own biology to be a little bitter and a little sharp on purpose, as a chemical defense. The cook's task is to keep the good part of that and lose the rest, and the two parts come from the same molecules.

GOMEN · braised collard greens · serves 4 · about 35 min

collard greens, stemmed, ribboned	2 large bunches
onion, fine dice	1
garlic, grated	4 cloves
ginger, grated	1 Tbsp
green chili, slit	1
niter kibbeh or oil	40 g
water	a splash
salt	to taste

1. Soften onion in the fat, add garlic and ginger, 3 min.
2. Add the greens in handfuls, letting each wilt, with just enough water to steam.
3. Cover and braise gently 20–25 min until silky and sweet, adding the green chili in the last 5. Salt to finish.



The chemistry is a two-sided ledger kept by a single enzyme. Brassica cells store **glucosinolates** in one compartment and the enzyme **myrosinase** in another; break the cell — by chopping, chewing, or the first heat — and myrosinase cleaves the glucosinolate's thioglucoside bond, releasing **isothiocyanates**. And

isothiocyanates are themselves TRPA1 agonists, the same electrophilic pungency family as mustard and wasabi and horseradish. That sharp green bite is *wanted*; it reads on the Index as a real IFI-P contribution, the brassica's own built-in pungency. What is not wanted is the accompanying bitterness — sinigrin, progoitrin, and the goitrin that progoitrin yields, all read as harsh at the TAS2R bitter receptors. So the dish wants to *keep* the pungent isothiocyanate note and *shed* the bitter precursors, and the long gentle braise does roughly that: sustained moist heat denatures myrosinase and leaches and degrades the bitter glucosinolates, while the brief, volatile isothiocyanate note made early in the cook has already done its sharp work.

Beside the greens on a fasting plate sits **fosolia**, green beans and carrots stewed gently with turmeric — sweet, soft, and mild, the vegetable arc's quiet member:

FOSOLIA · green beans & carrots · serves 4 · fasting

green beans, trimmed	400 g
carrots, julienned	2
onion, sliced	1
garlic · ginger · turmeric	3 cloves · 1 tsp · ½ tsp
oil or ye'tsom niter	40 g
salt	to taste

1. Soften the onion in the fat with garlic, ginger, and turmeric, 4 min.
2. Add the carrots, then the beans, with a splash of water; cover and steam 12–15 min until tender-crisp and glazed.
3. Salt to finish; serve warm or at room temperature.

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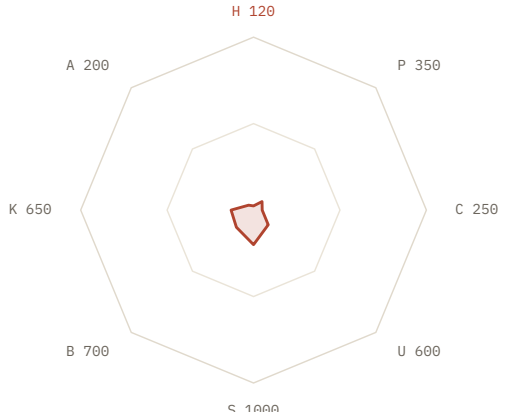

IFI-H	120
IFI-P	350
IFI-C	250
IFI-U	600
IFI-S	1,000
IFI-B	700
IFI-K	650
IFI-A	200



Kale in our reference house — a brassica engineered toward the bitterness-attenuation axis that gomen's long braise chases by hand.

Read the gomen block and the strategy is explicit: IFI-B (bitterness attenuation) is the single loudest axis, with a real P underneath it and a supporting K from the onion and fat. How bitter any eater finds the raw green in the first place is partly genetic — the TAS2R38 receptor comes in taster and non-taster variants, which is why the same collards are "pleasantly sharp" to one person and "harsh" to another — and this variability is exactly what a bred-in attenuation smooths out, delivering a green that lands mild across the whole table rather than only for the lucky non-tasters. Our brassica library — kale, cabbage, broccoli, and their relatives, spread across the easy-to-hard range of our organisms — carries constructs aimed squarely at that TAS2R38 lever, a 20–65% reduction in perceived bitterness, so the raw green starts where a long braise would otherwise have to drag it. A gomen made from an already-gentled green keeps the sharp pleasure and needs less time and less fat to lose the bitter. The Index names the goal the braise was always reaching for; the library hands the cook a head start.

Chapter 13 · Doro Wat — *the Sunday feast, the twelve-egg stew.*

Doro wat is the dish a fast is broken with, the dish of weddings and holidays and Sundays, and by common assent the national dish. Chicken — traditionally cut into twelve pieces, one for each of the apostles, with hard-boiled eggs scored and folded in near the end — simmered for hours in the deepest, longest onion base and the most generous berbere of any wat in the repertoire. It is the cuisine at full volume, and we write it with the reverence it is given at the table it crowns, not as an exception to a plant-forward book but as the feast those everyday fasting dishes make room for. A tradition that fasts so much earns its celebrations, and doro wat is the celebration.

DORO WAT · berbere chicken & egg stew · serves 6 · about 2½ hours

chicken, 12 pieces, skin off	~1.5 kg
red onion, very fine dice	6 large (~1.2 kg)
niter kibbeh	120 g
berbere	6–8 Tbsp
garlic · ginger, grated	1 head · 3 Tbsp
hard-boiled eggs, scored	6–8
lemon	1, for the chicken
water	as needed
salt	to taste

1. Rinse the chicken in water with lemon; drain. Cook the onion **dry** over low heat, stirring, a full 45–60 min until it is a dark, collapsed paste — this is the one base you do not rush.
2. Melt in the niter kibbeh, then bloom the berbere 3–4 min until it is toasty and the fat runs deep red; add garlic and ginger.
3. Add the chicken, turning to coat, and just enough water to make a thick sauce. Simmer, barely bubbling, 60–90 min, until the sauce is dark and glossy and the chicken is falling tender.
4. Fold in the scored eggs in the last 15 min so they take the color. Salt to finish; rest before serving.

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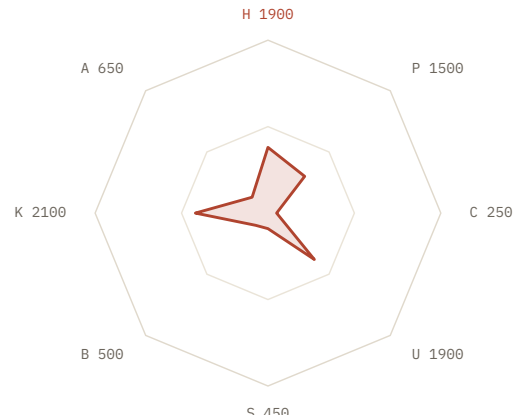

IFI-H	1,900
IFI-P	1,500
IFI-C	250
IFI-U	1,900
IFI-S	450
IFI-B	500
IFI-K	2,100
IFI-A	650

Hours are the active ingredient. The long, low braise is a slow conversion: the chicken's connective-tissue collagen, insoluble and tough, hydrolyzes above roughly 70 °C over time into gelatin, which dissolves into the sauce and gives it the lush, lip-coating body that distinguishes a great doro wat from a merely spicy one — a mouthfeel contribution that reads, on the Index, as a large part of that towering kokumi score. The meat's own glutamate and inosinate (and inosinate and glutamate are synergists — together they amplify umami far beyond their sum) stack with the onion's glutamate; the berbere, bloomed in all that fat, pushes heat and pungency higher than any everyday wat would dare, and the gelatin and the slow onion carry it so it lands deep rather than hot. The egg is not decoration. It is a cool, mild, rich foil, scored so the sauce penetrates its surface — a built-in pause in the hottest dish on the table, the bite you reach for when the berbere has made its point.

This is the one wat where we would reach up our heat ladder, to a chili dialed to a confident 80,000–120,000 SHU, still held flat at CV ≤7%, so that a feast cooked a few times a year tastes the way the last feast did — because a celebration dish carries memory, and a memory you cannot reproduce is a poor gift. The same control that lets a weeknight misir wat stay gentle lets a holiday doro wat stay exactly, reliably fierce.



FIG. 13 — the fierce end of the engineered line; doro wat is where a cook draws real heat and asks the slow onion to carry it.

Doro wat's everyday sibling is **key wat** (*sega wat*) — beef built the same way, the berbere stew a household makes when the feast is smaller but the depth is not:

KEY WAT · beef in berbere · serves 6 · about 2 hours

stewing beef, cubed	1 kg
red onion, very fine dice	5 large
niter kibbeh	100 g
berbere	5–6 Tbsp
garlic · ginger	8 cloves · 2 Tbsp
red wine or water	as needed
salt	to taste

1. Build the dark dry-onion base, 40–50 min; melt in the niter kibbeh and bloom the berbere until the fat runs deep red.
2. Add the beef, turning to coat, then enough liquid to make a thick sauce.
3. Simmer gently 75–90 min, until the beef is tender and the sauce is dark and glossy. Salt to finish, and set awaze alongside.

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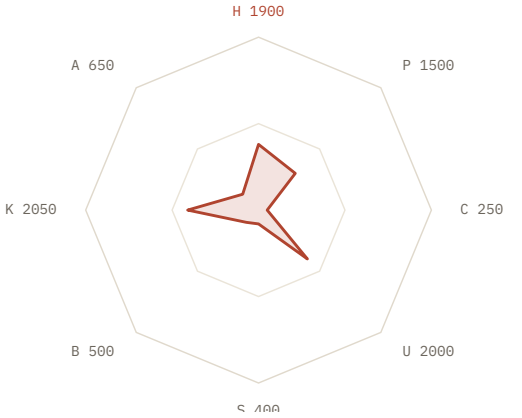

IFI-H	1,900
IFI-P	1,500
IFI-C	250
IFI-U	2,000
IFI-S	400
IFI-B	500
IFI-K	2,050
IFI-A	650

Chapter 14 · Kitfo & Tibs — *mitmita, raw heat, the seared edge.*

Two meat dishes stand at the opposite poles of fire: one raw and warm, one seared and hot, and both built on a different, sharper spice than berbere.

Kitfo is lean beef minced very fine and dressed — not cooked, or only just warmed to blood temperature, *leb leb* — with molten niter kibbeh and **mitmita**, the hotter, simpler cousin of berbere, and served with fresh *ayib* cheese and gomen. It is a dish about temperature and fat and heat meeting cold protein, prized for exactly that intimacy of textures; a close relative, *gored gored*, uses cubed rather than minced beef for more chew. As with any raw-meat dish, it lives or dies on sourcing — it is made from impeccably fresh beef and eaten at once — and we treat that the way the cuisine does, as a matter of respect for the animal and the eater, not as a thrill.

KITFO · minced beef with mitmita & spiced butter · serves 4 · 15 min

very fresh lean beef, hand-minced	500 g
niter kibbeh, warm and liquid	60 g
mitmita	1–2 tsp, to taste
korarima, ground	¼ tsp
ayib (fresh cheese) & gomen	to serve
salt	to taste

1. Warm the niter kibbeh until just liquid, not hot.
2. Work the mitmita, korarima, and salt into the warm butter, then fold through the minced beef until it is glossed and evenly seasoned. Serve at once, *tere* (raw) or briefly warmed, with ayib and gomen.

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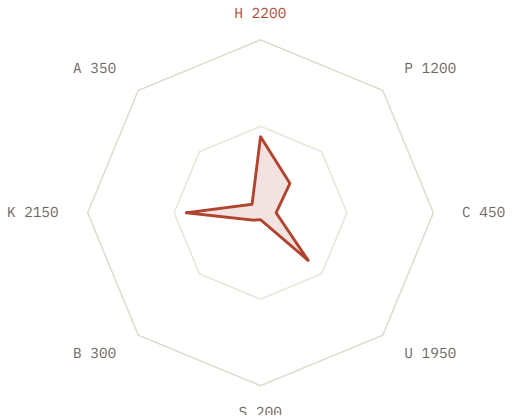

IFI-H		2,200
IFI-P		1,200
IFI-C		450
IFI-U		1,950
IFI-S		200
IFI-B		300
IFI-K		2,150
IFI-A		350

Tibs is the sear — cubes of beef or lamb thrown into a scorching pan with onion, garlic, rosemary, slit green chili, and berbere or awaze, cooked hard and fast so the outside caramelizes and the inside stays

pink.

TIBS · seared cubed beef · serves 4 · 20 min

beef, cubed	600 g
onion, wedged	1
garlic, sliced · rosemary	4 cloves · 1 sprig
green chili, sliced	1–2
niter kibbeh	40 g
berbere or awaze	1–2 Tbsp
salt	to taste

1. Get the niter kibbeh smoking-hot in a wide pan. Sear the beef in a single layer, undisturbed, to brown hard.
2. Add onion, garlic, rosemary, and chili; toss 2–3 min so the onion keeps a little crunch.
3. Stir through the berbere or awaze for the last minute. Salt and serve sizzling.

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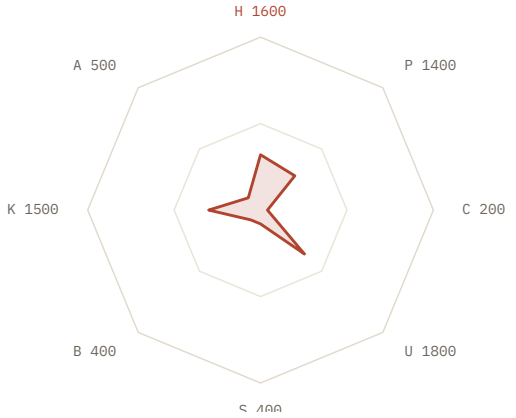

IFI-H	1,600
IFI-P	1,400
IFI-C	200
IFI-U	1,800
IFI-S	400
IFI-B	400
IFI-K	1,500
IFI-A	500

The science splits along temperature, and the two dishes are almost a controlled experiment in it. Kitfo's heat must reach *cold* protein, and warm spiced fat is the only vehicle that can — the mitmita's capsaicin, dissolved in liquid niter kibbeh, coats the raw mince so the burn is even and the fat keeps it from flaring; a dry spice on cold meat would sit in sharp, uneven specks. Mitmita itself is sharper and hotter than berbere because it is stripped to the loud notes: bird's-eye chili, korarima, clove, salt, with little of berbere's aromatic ballast — a blend that leads with H (and, from the korarima cineole, a cold-

channel C) where berbere leads with P. Tibs is the opposite experiment: a hard, dry sear runs the Maillard reaction on the meat's surface at well over 140 °C, building hundreds of new roasted and savory compounds in seconds, and the berbere's fat-bound heat then lays over that caramelized crust. Both dishes are meat written at full respect, each a different answer to the same question the whole cuisine keeps asking — how do you get fire to land exactly where you want it, and nowhere else?



FIG. 14 — the heat source for the sharp dishes; mitmita leads with TRPV1 where berbere leads with TRPA1.



PART IV OF V

The Wider Table

awaze · mitmita · the condiments · and buna, the ceremony where coffee began

Chapter 15 · Awaze, Mitmita & the Condiments — *the sharp accents.*

If berbere is the built chord played through a whole dish, the condiments are the single struck notes set beside it — the accents a diner reaches for to turn one bite up. They are to a wat what a squeeze of lime is to many cuisines: not the flavor, but the thing that makes the flavor move, and the device by which a shared plate lets every eater set their own heat.

Awaze is the table's great condiment, berbere slaked into a smooth, spreadable paste with liquid — traditionally *tej*, the honey wine, or red wine, or simply water and oil — and left to meld. It accompanies tibs, dips kitfo, glosses grilled meat. What the liquid does is more than loosen. The honey or wine brings **sweetness**, and sweetness is a genuine suppressor of perceived heat: a sugar at TAS1R2·R3 does nothing to the capsaicin molecule at TRPV1, but the brain, integrating the two signals, weighs the burn down against the sweet and reads the whole as rounder, more pleasurable, less of an assault. This is the *swicy* mechanism — the heat-sweet intersection that an entire shelf of our library is built on — and awaze is its Ethiopian form, the reason a very hot paste can taste almost jammy and keep you coming back to it.

AWAZE · berbere condiment paste · makes ~1 cup · + 30 min rest

berbere	6 Tbsp
tej, red wine, or water	4–5 Tbsp
oil or niter kibbeh	2 Tbsp
garlic, grated (optional)	1 clove
honey (if not using tej)	½ tsp
salt	to taste

1. Whisk the berbere with the liquid to a smooth, thick paste.
2. Beat in the oil and the garlic and honey if using.
3. Rest at least 30 minutes — longer is better — so the raw edge rounds and the chord melds. Loosen to taste.

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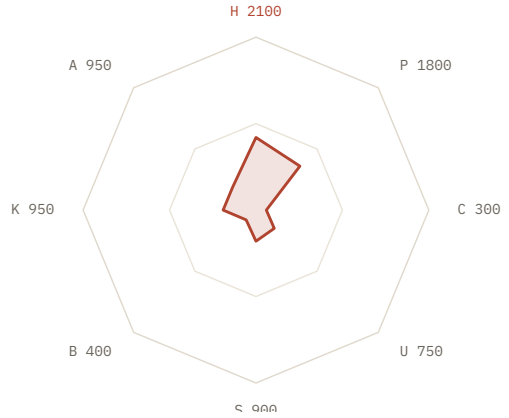

IFI-H	2,100
IFI-P	1,800
IFI-C	300
IFI-U	750
IFI-S	900
IFI-B	400
IFI-K	950
IFI-A	950

Mitmita is the dry fire — bird's-eye chili (*Capsicum frutescens*), korarima, clove, and salt, coarse and hot, the blend that dresses kitfo and sits on the table for anyone who wants more. Where berbere's loudest axis is pungency, mitmita's is heat, with korarima's cineole giving it a sharp, slightly cold top and clove's eugenol a numbing tail:

MITMITA · hot chili & korarima blend · makes ~½ cup

dried bird's-eye chili, ground	6 Tbsp
korarima, ground	1 tsp
clove, ground	½ tsp
cardamom · salt	¼ tsp · 1 tsp

Toast the whole spices lightly, cool, grind coarse, and keep airtight. Use sparingly; it is meant to be the loudest thing on the table.

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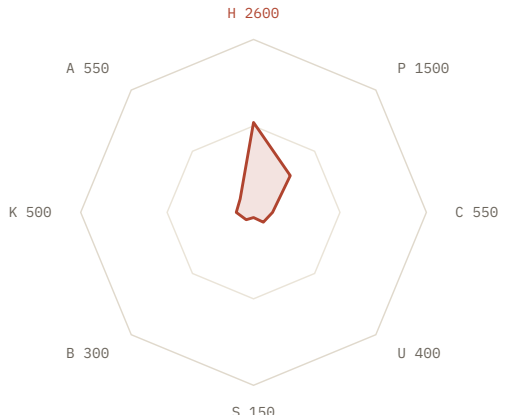


IFI-H	2,600
IFI-P	1,500
IFI-C	550
IFI-U	400
IFI-S	150
IFI-B	300
IFI-K	500
IFI-A	550

Beside these sit the fresher accents — *datta*, a pounded green-chili relish bright with raw heat and herb, and the lemon and raw onion that cut a rich plate. Together they externalize the heat axis entirely.

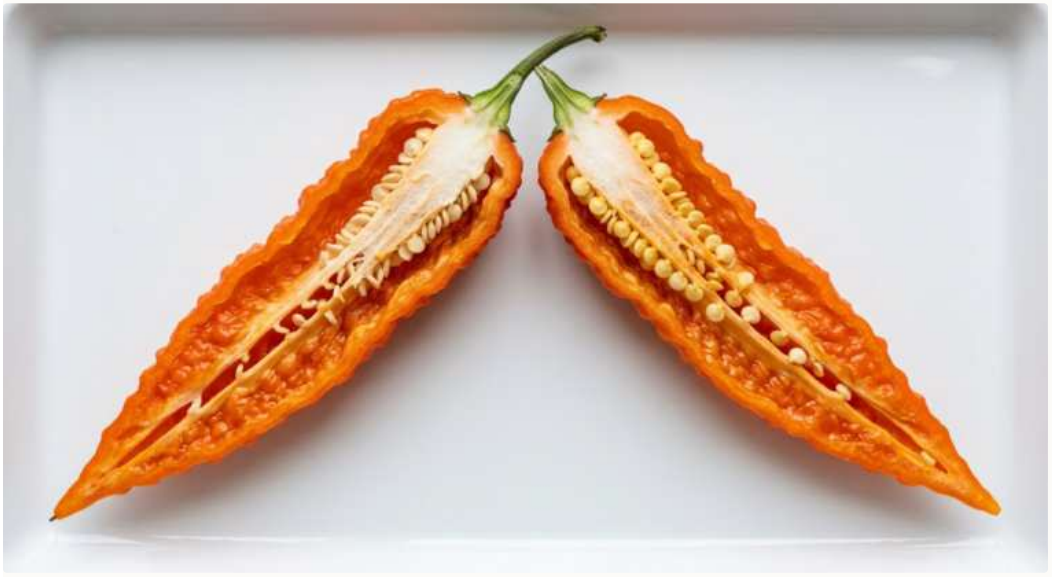


FIG. 15 — a cut from the engineered line; the condiments are where a diner reaches past the built chord for the single loud note.

A table set with a mild misir wat, a medium doro, and a pot of awaze and a dish of mitmita beside them is a table that has handed the heat dial to each eater — one diner stays at the plate's built-in warmth, another climbs to as much fire as they can take, and the cook has composed for both at once. That is only possible if the chili underneath is predictable; a condiment you cannot trust is a condiment no one reaches for twice. The reservoir of engineered heat, held flat at CV ≤7%, is what lets a mitmita be the same scorching friend every time, and what lets awaze's sweetness and heat stay locked in the swicy balance the paste was built on rather than drifting hot one batch and dull the next.

Chapter 16 · Buna — *the coffee ceremony; where coffee began.*

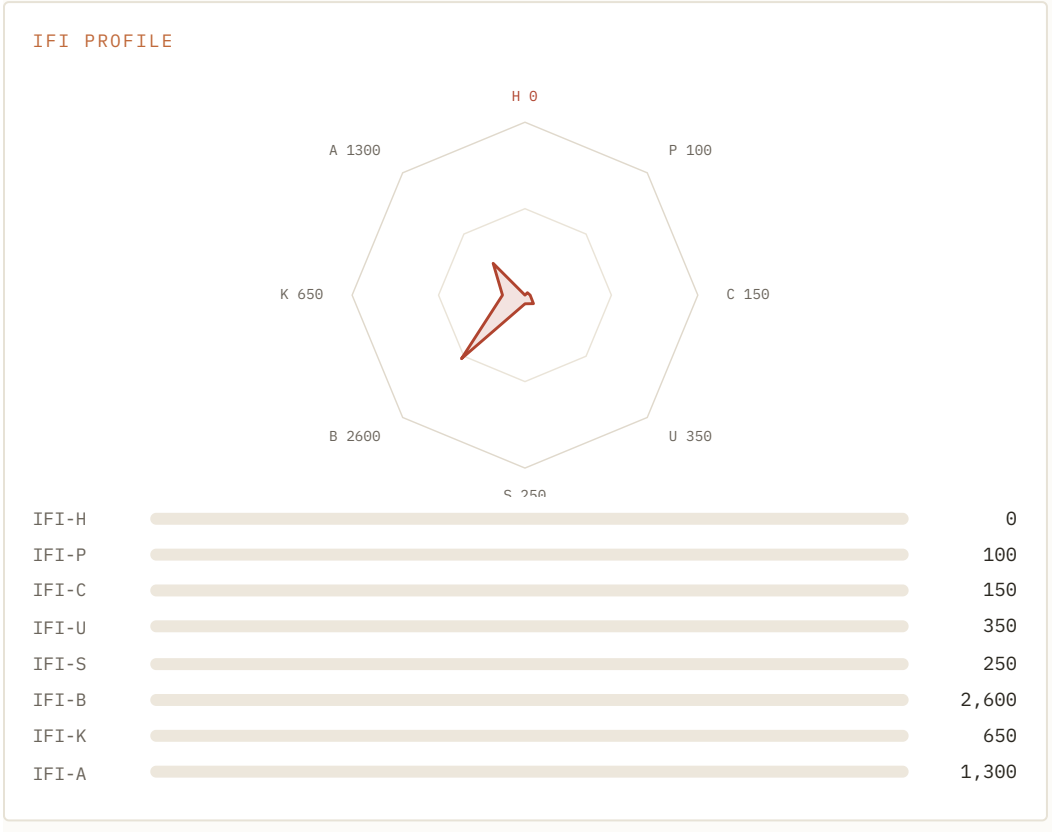
A meal ends where coffee began. Ethiopia is the botanical homeland of *Coffea arabica* — the southwestern forests of Kaffa gave the plant, and very likely the word — and the coffee ceremony, *buna*, is the cuisine's coda and one of its deepest acts of hospitality. Green beans are washed and roasted in a pan over coals, and the roasting pan is carried around the room so each guest can draw the smoke toward their face with a cupped hand. The beans are ground in a wooden mortar, brewed in a clay *jebena*, and poured in a thin arc from height into small handleless cups, the height aerating the coffee and settling the grounds. There are three rounds — *abol*, *tona*, and *baraka*, the third a blessing — and to leave before the third is to leave before the good wish. Incense burns; popcorn is passed; the coffee is sometimes cut with rue, salt, or butter.



Coffee cherries in our reference house — the origin crop, and the clearest meeting point between this cuisine and our bitterness work.

Coffee is the Index's bitterness axis made ceremonial, and its bitterness has a specific and changing chemistry. It is not mainly the caffeine — caffeine is genuinely bitter but contributes only a minor fraction of a cup's bitterness. The main actors are the **chlorogenic acids** and, more sharply, their thermal breakdown products. As the roast proceeds, chlorogenic acids degrade first to **chlorogenic acid lactones**, which carry the pleasant, coffee-ish bitterness of a light-to-medium roast, and then, as roasting continues, to **phenylindanes**, which are harsher and more lingering and account for the aggressive bitterness of a dark roast. So a roaster is, whether they name it or not, steering a bitterness reaction in real time, trading aromatic

development against the climb from lactone bitterness into phenylindane bitterness. All of these act at the TAS2R family of bitter receptors, and TAS2R38 is the specific lever the Index tracks as IFI-B — bitterness attenuation.



Read the block as the axis map of a cup: a towering IFI-B — meaning bitterness strongly tamed — with real astringency beneath it from the residual chlorogenic acids gripping the salivary proteins, and a quiet kokumi body. As with brassica greens, how bitter a given drinker finds the cup is partly written in their TAS2R genes, which is why the sugar bowl exists. Our **coffee** organism (40 constructs; primary axis B; among the hardest in the library to engineer) works precisely this lever, aiming to attenuate the harsh TAS2R-active fraction — the phenylindane end — while leaving the aromatic complexity that makes coffee worth the ceremony fully intact. The point is not to make coffee sweet, and certainly not to make it taste of less. It is to let a cup be as deep and as dark as the ceremony wants it while softening the specific bitterness that makes people reach past the coffee for the sugar — to honor the origin crop by letting it taste more completely of itself. In the one country that can call coffee its own, that feels like the right place to let our bitterness work and this cuisine shake hands.



Coffee in cross-section — the chlorogenic acids that become a dark roast's bitterness sit in the bean before the fire ever touches it.



PART V OF V

The Engineered Berbere

the method · the pathway · CV ≤7% · a berbere designed to a target · and the fasting table

Chapter 17 · Designing the Ladder — *a berbere to a target, batch after batch.*

Everything to this point has been description — the chord taken apart, the carriers explained, the codex scored. This chapter is construction: how we would design a berbere to a chosen profile and make it land the same every time. The problem has two halves. One spice — the chili — we grow and tune. The other fifteen we source and lot-match. The engineering lives in the first half; the discipline lives in the second; and the two meet in a single target IFI vector that the finished blend has to hit.

Tuning the chili means working the capsaicin pathway, and most of that pathway is shared botany. The phenylpropanoid branch runs in every vascular plant; only the terminal steps are pepper-specific:

STEP	ENZYME	SUBSTRATE → PRODUCT
1	PAL	phenylalanine → cinnamic acid
2	C4H	cinnamic acid → *p*-coumaric acid
3	4CL	*p*-coumaric acid → *p*-coumaroyl-CoA
4	HCT	→ caffeoyl shikimate
5	COMT	→ feruloyl / vanillin precursors
6	pAMT	vanillin → vanillylamine
7	BCAT	branched-chain amino acid → branched-chain α-keto acid
8	KAS	elongation → 8-methyl-branched fatty acyl-CoA
9	**Pun1/CS**	vanillylamine + 8-methylnonanoyl-CoA → **capsaicin**

The final condensation is the one that matters most: at the Pun1/AT3 acyltransferase, vanillylamine (built by pAMT) condenses with an 8-methyl branched-chain fatty acyl-CoA (built by BCAT feeding KAS) to make capsaicin. To find where to intervene we do not guess. First a genome-scale flux-balance model — a stoichiometric model of the plant's whole metabolism, solved for the fluxes that maximize capsaicinoid output subject to mass balance — tells us whether the bottleneck is the capsaicinoid branch itself or an upstream phenylpropanoid step. (It is the branch; the upstream supply is not the limiter.) Then a 650-million-parameter protein language model, ESM2, scores every possible single-residue substitution in Pun1 by its predicted effect on catalytic efficiency times fold stability, ranking tens of thousands of candidate edits in silico before a single seed is touched. two Pun1 substitutions, never before combined in any breeding program, rose to the top and were written in with CRISPR:

EDIT	EFFECT	ΔΔG (KCAL/MOL)
S39L	binding affinity ↑ (N-terminal)	−2.1
L345G	steric relief, active-site cleft	−1.8
C175S	disulfide-misfold prevention	−0.9

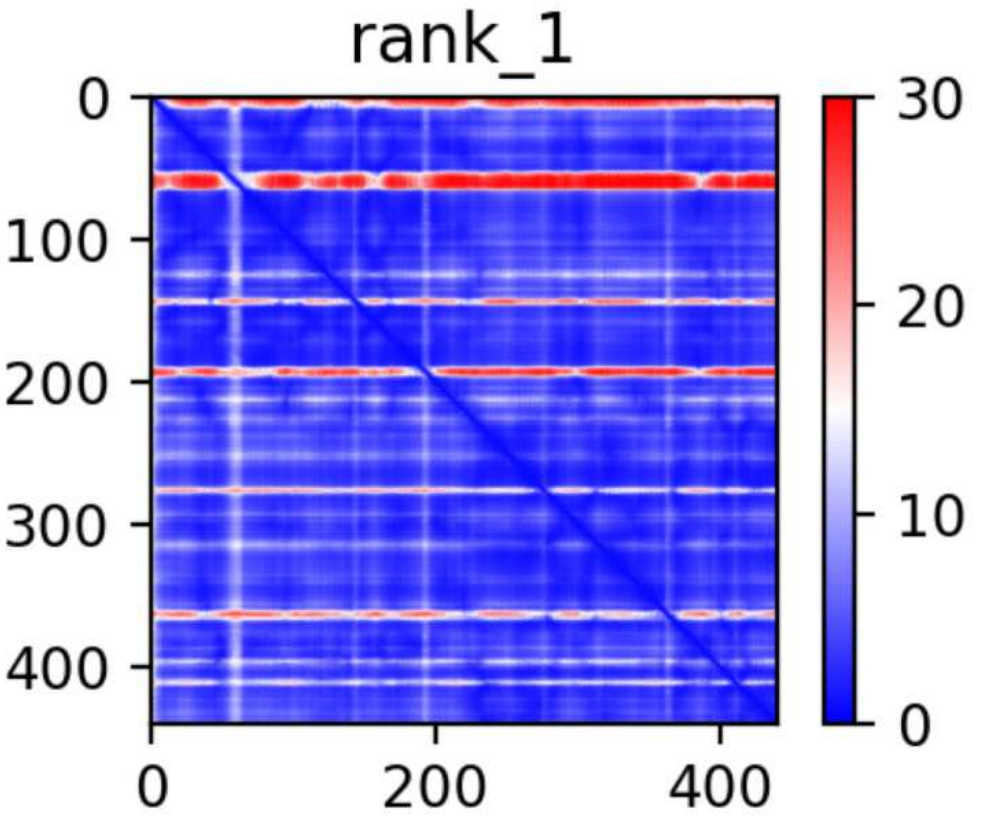
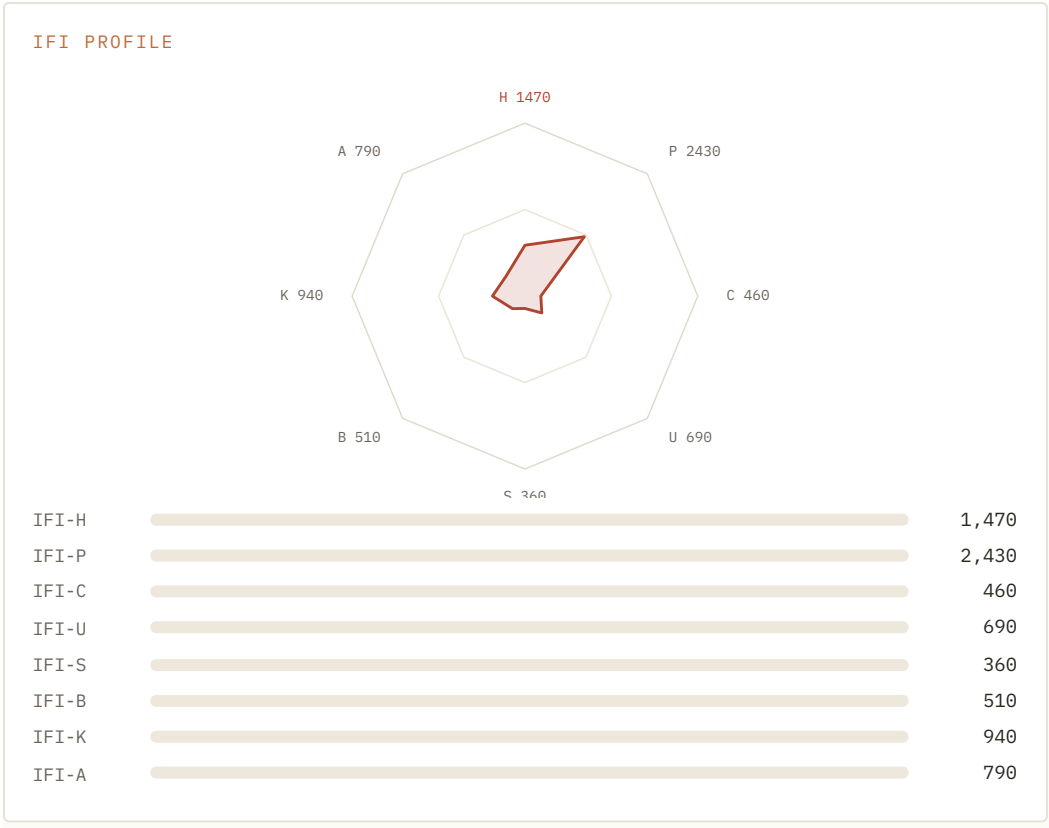


FIG. 17 — the predicted aligned error map for Pun1/AT3; low error through the catalytic core is what let us trust the single-residue scoring.

Those edits lift peak output to 2,937,948 SHU in the extreme lines — but for a berbere we almost never want peak. We want a *chosen* value held flat, and the same molecular control that reaches three million lets us set and hold a fruit-forward 35,000. The number that decides whether a blend is a specification or a wish is the coefficient of variation. Wild chili varies batch to batch at a CV near 42%; our engineered lines sit at ≤7%. The distributional meaning is concrete: at 42% CV, a "35,000 SHU" chili routinely delivers anywhere from roughly 15,000 to 55,000 from lot to lot, and a berbere built on it is a different blend every time; at ≤7%, that same chili stays within a few thousand units of target, batch after batch. And in a sixteen-component blend the variances compound — one rowdy component detunes the whole chord — so pinning down the single largest and heat-defining term is what makes the rest of the specification mean anything.

Designing to a target, then, looks like this. Pick the IFI vector you want. Solve for the spice charges and the chili cultivar that produce it under the competition-and-saturation model of Chapter 5. Blend, measure the result against the target, and close the gap by adjusting the charges and re-lot-matching the sourced spices. A worked example — a medium everyday berbere, target against achieved:

AXIS	TARGET	ACHIEVED	Δ
H	1,500	1,470	−30
P	2,400	2,430	+30
C	450	460	+10
U	700	690	−10
S	350	360	+10
B	500	510	+10
K	950	940	−10
A	800	790	−10



Every axis inside a few percent of target, and — because the chili is held at CV ≤7% — reproducible across batches, which is the only reason the "achieved" column is worth printing at all; an achieved vector you cannot hit again next month is an anecdote, not a spec.

This is the whole promise of the platform expressed through one spice blend, and it rests on a real company with a real ledger behind it: roughly 19,000 engineered constructs, 1,000 of them live and purchasable today, across 42 host organisms and 8 sensory axes, held to a batch CV of ≤7%, with 3 patents filed and 21 peer-reviewed papers posted open-access under CC BY 4.0. The organisms that build this particular cuisine are a small, specific slice of that library:

ORGANISM	CONSTRUCTS	AXES	ROLE HERE
Tomato	2,040	S/U/F/M	modern wats · *timatim* salad
Pepper	1,060	all	the berbere chili
Garlic	560	K/P	niter · every wat
Soybean	360	U/K	the shiro family
Ginger	120	P	berbere · niter
Sorghum	120	A	the teff/injera proxy
Potato	80	B	atkilt
Onion	40	K	the foundation
Cinnamon	40	P	berbere
Cabbage · Kale	40 · 40	B	tikil gomen · gomen
Coffee	40	B	buna

Chapter 18 · The Fasting Table — *ye'tsom, and food given with intention.*

There is a reason so many of the dishes in this book are, without ever announcing it, vegan. The Ethiopian Orthodox calendar asks the observant to fast — *ye'tsom* — for much of the year: every Wednesday and Friday, the long weeks of Lent (*Hudadi* or *Abiy Tsom*), the fasts of the Apostles and of the Assumption, and the Advent weeks before Christmas, during which no meat, no dairy, and no eggs are eaten, and often no food at all before midday. Across a full calendar that can reach toward two hundred days. And so one of the world's great plant-based culinary traditions grew not as a trend or a diet but as a devotion — misir wat, shiro, kik alicha, atkilt, gomen, the whole golden-and-red spread of the *beyaynetu*, the fasting combination platter where a little of everything is laid together on one injera so that nothing is missed.

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BEYAYNETU · the fasting platter · serves a table
──────────────────────────────────────────────────
injera                          1 large round + rolls
misir wat                       a dark red mound
shiro                           a smooth rust pool
kik alicha                      pale gold
atkilt · gomen · fosolia        the vegetable arc
azifa · timatim salata          the cool, sharp notes
awaze · mitmita                 at the rim
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1. Lay the injera over the whole platter as the cloth beneath everything.
2. Spoon each dish into its own place around the round, colors alternating — red beside gold beside green — so the plate reads as a composition before a single bite is taken.
3. Set the condiments at the rim and extra rolled injera alongside. Tear, fold, share; finish with buna.

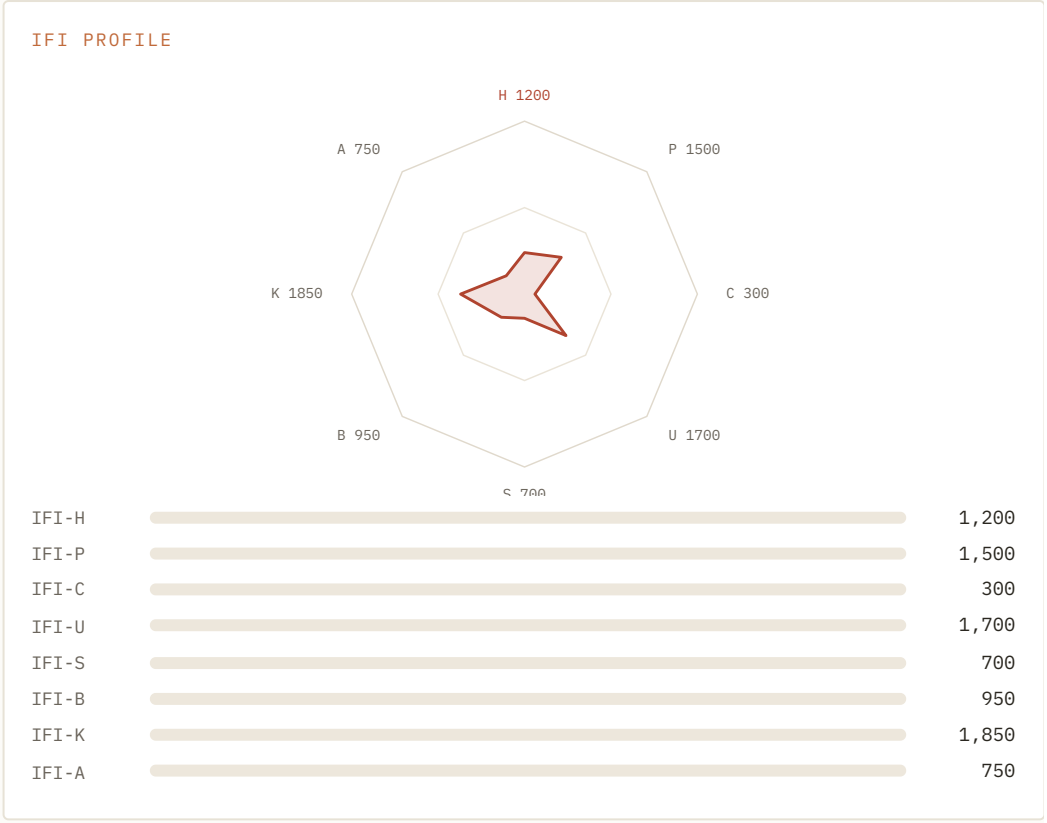


The research house at dusk — the work and the table are a family's; the computing was one pair of hands, the growing and the cooking were never one.

This is where the quiet value that runs under the whole Scoville Splice library stops being quiet. We believe food should be grown to hold the most nourishment it can, and that designing flavor and

designing nourishment are, done right, the same act. The fasting table is that belief already cooked and eaten: legumes carrying their protein and iron, teff milled whole for its minerals and its slow starch, greens and roots and alliums, a plate built entirely from plants that no one sitting at it experiences as a sacrifice. We make no claim here about what any of it does inside a body — that is not ours to promise, and this cuisine never needed the promise. We note only what is plainly true: that a tradition which eats this way for half the year has had many centuries to learn how to make the plant-forward meal the one you actually *want*, and that it learned, and that the beyaynetu is the proof, laid out in color on the bread. That is also, exactly, the brief of this library — to let the plant do more of the work, so the plate is both the most flavorful and the most nourishing version of itself, without anyone having to be told.

Read the whole fasting platter as one composition and the reason it satisfies becomes plain — every axis present, none shouting, the eight voices of the Index all somewhere on the injera at once:



That is a complete meal, scored. Pungency and kokumi lead, as they should in a cuisine built on berbere and the long onion; umami stands with them; heat sits in the middle, where a shared table wants it, dialable up by the condiments at each eater's elbow; bitterness is tamed, astringency gives structure, sweetness and a thread of cool run through. It is the chord we started with, grown to the size of a whole table — the same composition logic that governs a single

berbere, scaled up to govern the balance of an entire plate, which is finally what a great cuisine is: a composition held across many dishes at once.

We came to Ethiopian food hungry and curious, and we leave it taught. It knew, long before anyone had receptors to name or a platform to tune them, that flavor is layered and not loud, that fat and ferment are how you carry it, that patience at the start of a wat is repaid at the end, and that the surest way to feed someone well might be to build a plant-forward table so good they never think to ask where the meat is — and then, now and again, to tear off a piece, load it, and reach across. *Gursha.* We want you to be nourished. We would like to be the ones who do it. Everything in this book is only that wish, worked out to the molecule.

These are computational designs; Scoville Splice's cultivars and constructs have not been experimentally validated in a laboratory.