

THE SCOVILLE SPLICE LIBRARY · THE CRAFT

# Rubs, Spice Blends & Seasonings

## The dry side of fire. *Built, not sprinkled.*

The craft of the rub and the spice blend — built from aromatics we grow to a specification, every compound tuned to its receptor, every jar scored on the Index. A reference for the dry side of cooking, where there is no liquid to hide behind and every gram shows.

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

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# Opening essay · A blend is a blueprint

Open any good spice drawer and you are standing in front of a library. The dusty amber of ground ginger, the resinous green of crushed thyme, the dark sweetness of a stick of cinnamon snapped in half, the pale mustard powder that smells like almost nothing until the exact moment it does — each jar is a plant's whole argument, pressed into a powder and waiting. We grew up with a drawer like this, in a house where the cooking was done by many hands and the plants were the thing the whole family revered. And we grew up with a belief none of us ever quite said out loud: that a handful of dried seasoning worked into the surface of something about to meet heat is not a garnish. It is a structure. It is the blueprint for what the fire is going to build.

That is the quiet thesis of this book, and the reason it sits on the craft shelf rather than the kitchen one. A rub is architecture. Scatter salt and pepper across a surface and you have seasoned it; press a designed blend into that same surface and you have *specified* the crust it will become — which note arrives first, which one holds the middle, which one clears the palate so the next bite lands as cleanly as the first. The dry side of cooking has always been the more exacting half of the craft, precisely because there is no liquid to dissolve a mistake into. A sauce can be adjusted on the stove, tasted and corrected and tasted again. A rub is committed the moment your palm leaves the meat. Every gram shows.



The founders in the research greenhouse at dawn — where a family that reveres its plants first asked what it means to grow an aromatic to a number rather than forage it to a season.

Here is the fact that moves the whole dusty drawer onto the Index, and it is a small miracle of convergence. Nearly every aromatic in that drawer speaks through a *single receptor.* Mustard's allyl isothiocyanate, garlic's allicin, cinnamon's cinnamaldehyde, ginger's gingerol, the thymol of thyme and the carvacrol of oregano — a dozen unrelated plants, a dozen unrelated molecules, and one lock. They are all read by **TRPA1**, the sharp pungency channel at the front of the mouth, scored across this library as **IFI-P**, pungency. Where capsaicin's heat settles onto **TRPV1** and blooms and lingers, pungency flashes and clears. That flash — fast to arrive, fast to leave — is the entire reason a dry blend wakes a plate up, cuts through fat, lifts a heavy roast off the tongue. The honest measure underneath it is the same one every book in this library is built on:

$$\mathbf{IFI(candidate) = 1{,}000 \times EC_{50}(reference) \div EC_{50}(candidate)}$$

$EC_{50}$ is simply the concentration at which a compound drives its receptor to half of its full response — how *loudly* the molecule speaks, not how much of it is present. Invert that against a fixed reference, scale by a thousand, and loudness becomes a number you can design toward and read off a jar. For ten thousand years a blender could only combine the spices the world handed over, at whatever strength that season's soil and sun happened to grant them — a thyme that was piercing one year and flat the next, a chili of unknowable heat, a cinnamon that might be fragrant or might be bark. We grow the aromatics themselves to a specification now: forty-two host organisms, eight sensory axes, batches held to a coefficient of variation at or under seven percent. The sharp, the warm, the green, the savory, the sweet, and the heat each arrive at a number you can place on purpose.

A pinch is a wish. A blend, built to a scorecard, is a promise. The chapters that follow are how we keep it — the receptor the whole rack speaks through, the pathway inside each aromatic, the four levers you add to it, the physics of salt and powder and crust, the arithmetic of consistency, and then a working library of blends scored axis by axis so you can taste the intention and read it in the same breath. We are plant people, vegetarian by habit and by heart, and this is in large part a book about seasoning meat. We write it with no apology and no distance, because the reverence we bring to a thick-cut cauliflower and the reverence we bring to a brisket are the same reverence, learned from the plant first and carried to the fire after. Feeding someone well, exactly what they love, made the same every time — that is the whole of the craft. The powder in the jar is how it is done.



PART I OF V

# The Science of the Dry Rack

TRPA1 · the five layers · the composed scorecard · $EC_{50}$ → IFI

# Chapter 1 · The Pungent Channel — *the one receptor the whole rack speaks through.*

**IFI-P · TRPA1**

Everything in the spice drawer that makes you sit up — the sinus-clearing hit of fresh mustard, the sharp edge on crushed garlic, the warm penetrating bite of dried ginger, the clean medicinal lift of thyme — is, at bottom, the same event happening to the same protein. Learn that protein exactly and the dry rack stops being a folklore of a hundred separate spices and becomes a single instrument you can play. So we begin where every book in this library begins: at the receptor, because you cannot design toward a sensation you cannot name.

The receptor is **TRPA1** — Transient Receptor Potential Ankyrin 1, the channel the literature nicknames the *wasabi receptor.* It is a non-selective cation channel, permeable to calcium and sodium, built as a tetramer of four identical subunits arranged around a central pore in the membrane of the trigeminal nerve endings that serve the front of the mouth and the nose. Its signature, the feature that gives it its name, is an enormous intracellular **ankyrin repeat domain** — a stack of some sixteen or seventeen helix-turn-helix repeats that hang down into the cytoplasm like a coiled spring, a structure found on no other temperature-sensing channel at anything near this scale. That spring is the part that matters to a blender, because of *how* the aromatics open it.

Here is the thing that separates pungency from heat at the most fundamental chemical level, and it is worth slowing down for. Capsaicin opens TRPV1 by **binding** — it slots into a pocket on the channel, a key into a lock, a reversible non-covalent fit, held by shape and charge and nothing more. Let the capsaicin wash away and the channel closes; the relationship was never permanent. TRPA1's agonists do something categorically different. The sharp molecules of the spice rack are **electrophiles** — reactive, electron-hungry compounds — and they open TRPA1 by *chemically bonding to it.* Allyl isothiocyanate from mustard, allicin from garlic, cinnamaldehyde from cinnamon: each carries a reactive site that reaches into the N-terminal spring and forms a covalent adduct with a handful of specific **cysteine** residues there — in the human channel, the literature points to cysteines at positions 621, 641, and 665, with a nearby lysine at 710 also in play. The molecule does not sit in a pocket. It welds itself, briefly, to the machinery.



Garlic in cross-section — the clove that manufactures its pungency only when cut, as alliinase finds its substrate and allicin is born. The sharp molecule that follows reaches into TRPA1 and bonds to it, rather than merely resting in a pocket.

This single mechanistic fact explains almost everything a blender experiences and never has words for. Because the activation is a chemical reaction rather than a passive fit, pungency arrives *fast* — as fast as the electrophile can find its cysteine — and it clears as the adduct resolves and the modified channel resets, which is why the mustard that detonates in your sinuses is gone within a minute while a chili's heat is still climbing. It explains why pungency reads as *sharp* and heat reads as *deep.* It explains why a grind, a crush, a wetting — anything that liberates the reactive molecule from the place the plant stored it — is the trigger: an intact clove of garlic is silent; a cut one is loud, because cutting is what starts the chemistry. And it explains why the sensation is, in the most literal sense, the plant's chemistry continuing inside your mouth. A second behavior rides on top of this: the calcium that floods in through the opened channel binds a site on that same N-terminal domain and briefly *potentiates* the response before desensitizing it — the flash-then-fade, amplification followed by a shutting-off, written into the receptor itself.

On the Index, all of this resolves to one axis. **IFI-P** is anchored, like every axis, to the half-activation of a fixed reference pungency — invert the candidate's $EC_{50}$ against it, scale by a thousand, and you have a number. A compound that half-activates TRPA1 at a lower concentration is *louder* and scores higher. This is why the quantity of a spice tells you so much less than you would hope: two thymes of identical weight can differ twofold in pungency if one carries its signal as thymol and the other has let it drift to a duller companion molecule. The Index measures the loudness at the nerve, not the dust in the jar — and that gap, between amount and loudness, is the entire space the dry side of this company works in.

There is one more subtlety the serious blender should hold, because it keeps the model honest. Not every TRPA1 agonist is a pure electrophile. Menthol, thymol, and carvacrol activate the channel at least partly through non-covalent sites, and TRPA1's exact behavior — whether it also reads cold, how it couples to the neighboring channels — varies across species and has kept physiologists arguing for twenty years. We do not need to resolve those arguments to blend. What we need is the load-bearing fact: the aromatic top of nearly every rub ever built is a set of different molecules playing one receptor, which is why they balance against

each other so cleanly, and why a single axis — pungency, IFI-P — can describe the whole bright top of the dry rack. Capsaicin and its heat are a *separate* channel and a separate axis, and the discipline of this book begins with never confusing the two. Pungency is the flash at the front. Heat is the fire that follows. A great blend uses both, on purpose, and knows at every moment which one it is reaching for.

# Chapter 2 · The Anatomy of a Blend — *a rub is five layers, not one list.*

Ask most cooks what is in a rub and they will read you a list — paprika, garlic, salt, sugar, some pepper, maybe a chili. A list is not a blend. A blend is a *structure*, and every blend we build, from a four-ingredient table seasoning to an eight-axis signature, is assembled in the same five layers. Naming them is the first thing we teach anyone who wants to design rather than guess, because once you can see the layers, you can hear which one a blend is missing the instant it hits your tongue.

**The base** is salt and the carrier. Salt is not a flavoring here; it is the structural medium — the thing that pulls moisture to the surface, seasons the whole depth of a cut rather than only its skin, and gives the fine aromatics a bulk to distribute against so they fall evenly from a pinch. The carrier is whatever inert-ish bulk rounds the volume: a measure of the base coat, a mild paprika, a ground seed. Without a base, a blend is a handful of loud notes with nothing to stand on, and it seasons in patches.

**The body** is the savory floor — granulated garlic and onion, chief among them, the low round hum that makes a blend read as *built* rather than *dusted on.* This is where umami (IFI-U) and especially kokumi (IFI-K) live in a dry blend: not as a flavor you can point to, but as the quality a taster calls *depth* and cannot name. A blend with no body tastes thin and sprinkled no matter how aggressive its top.

**The aromatic top** is the pungent lift — the bright TRPA1 flash of Chapter 1. Mustard, ginger, cinnamon, the green herbs, watercress: the layer that arrives first and clears fast, the part that cuts fat and lifts the whole plate. This is the layer most cooks under-build, because dried and sitting in a jar it smells faint, and they forget it is a sleeping charge that wakes against the moisture and heat of the food.

**The heat** is capsaicin — a separate channel, a separate axis (IFI-H), dosed to a chosen rung of a ladder we will spend a whole chapter on. Heat is the one layer that must be *specified* rather than estimated, because a chili of unknown strength makes the whole blend a guess.

**The finish** is whatever you want the mouth to be left holding once everything else has cleared: a trace of cooling mint (IFI-C), a measured astringent grip (IFI-A), a sweetness that persists past the bite (IFI-S). The finish is the most advanced layer and the one that most separates a blend that was *designed* from a blend that was merely mixed. A blend with a brilliant top and no finish arrives and then simply stops, which the palate reads, correctly, as cheap.



A research tray of candidate lines — the dry side of the company, where each aromatic is grown, dried, and read for the one signal it is meant to carry before it ever reaches a jar.

The craft is proportion — and here is the move that makes this a design discipline rather than a cooking tip: *proportion, on the Index, is just the ratio of the axis scores you are aiming for.* When we sketch a new blend we do not start with a list of ingredients. We start with a target scorecard — a set of eight numbers, one per axis, that describes the silhouette we want the finished blend to have on the tongue. Pungency leads, say, at 900; kokumi holds the body at 600; umami sits under it at 450; heat is a climbable floor at 250; everything else is a trace. *Then* we open the jars, because now each jar has a job defined by a number. The mustard is there to deliver so many points of IFI-P. The garlic is there to deliver so many points of IFI-K and a little IFI-P of its own. The chili is there to put IFI-H at exactly 250 and not a point more. The blend is the solution to a small system of equations, and the powder is the work of solving it.

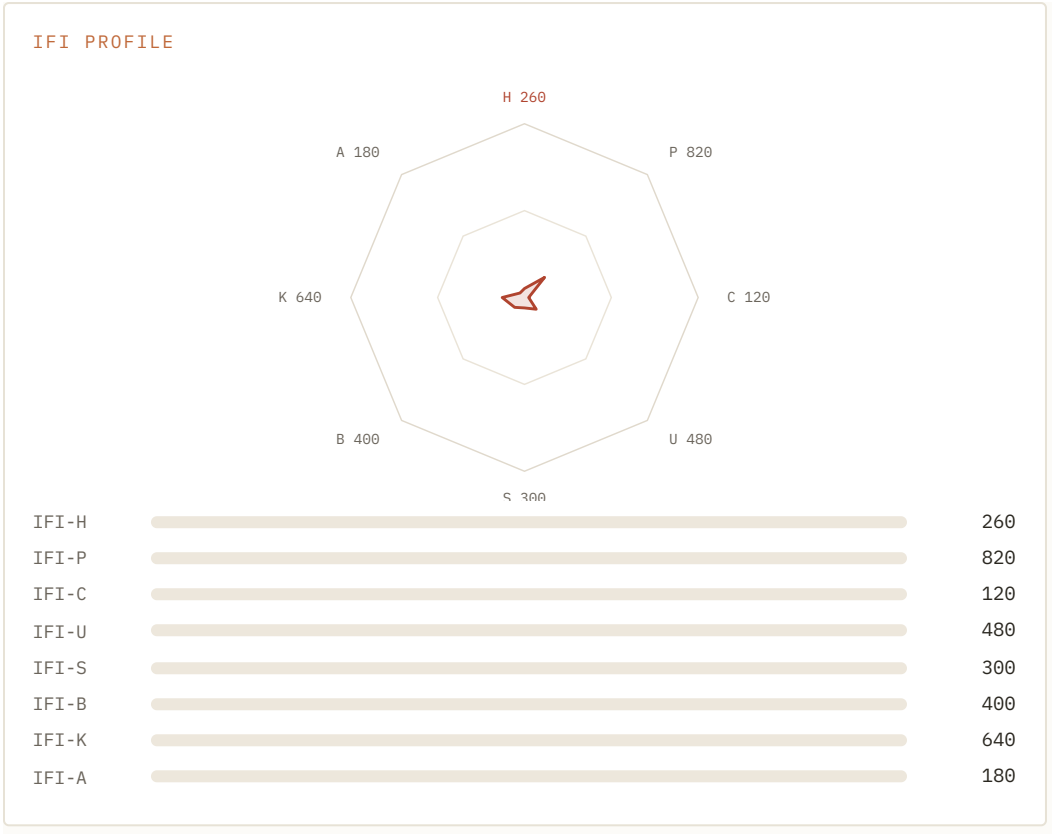
This is why the five layers matter more than any recipe. A recipe is one solution to one target. The layers are the grammar that lets you write a thousand of them — and, just as usefully, lets you diagnose a blend that is not working. Too flat? The body is thin; build the alliums. Too harsh, all top and no floor? Same fix. Arrives beautifully and vanishes? There is no finish; add a trace. Tastes muddy and indistinct? Too many loud notes competing for the top with no base to separate them. Every failure of a blend is a failure of one of the five layers, and naming the layer is naming the fix. The rest of this book is the five layers, taken one at a time and grown to a number.

# Chapter 3 · Reading a Rub — *a dry blend, scored and seen as a silhouette.*

A finished blend carries a scorecard the same way a cultivar does, and learning to read one is learning to taste on purpose. But a blend's scorecard is a different kind of object from a cultivar's, and the difference is worth understanding precisely, because getting it wrong is the most common mistake we see in people new to designing with the Index.

A cultivar's IFI score is *computed.* Our model predicts the $EC_{50}$ at the target receptor from the designed sequence — the number is a computational design specification for that line. A blend's scorecard is **composed.** It is not the score of any single molecule; it is where the whole assembly lands once every component is in proportion, each axis the net of what every ingredient contributes and, crucially, of how the ingredients interact. Pungency compounds can mask one another; kokumi peptides can make a modest umami read louder by extending it; a cooling trace can make a heat read lower than its capsaicin content alone would predict, because the mouth is distracted. The composed score is a *sensory* quantity — where a trained panel, and the Index's reference assays, place the finished blend — and it is the number that actually matters, because it is the one the eater experiences.

We read a scorecard as a **silhouette.** Lay the eight axes out and the pattern of their heights is the shape of the blend on the tongue — not a list of ingredients but a profile, the way a mountain range read left to right tells you where the peak is and how the land falls away from it. Here is the one we keep taped inside the cabinet door: our everyday all-purpose coat, the house default, read across all eight axes so a new blender can see exactly what *balanced* looks like.




Read that silhouette. Pungency leads at 820 — this is a dry blend, the bright top note *should* lead. Kokumi and umami hold the body just underneath, 640 and 480, so the blend never reads thin. Heat sits low at 260, a warm floor the whole table can eat. And everything else — the sweet, the bitter-subtraction, the cool, the astringent grip — is a trace between 120 and 400, present enough to round the edges and not one point more. That is the shape of a seasoning you reach for every day: a low, even ridge with one clean peak. Contrast it with a condiment, whose silhouette spikes hard on a single axis — a hot sauce is a tower at IFI-H, a finishing honey a tower at IFI-S. A seasoning is a *landscape*; a condiment is a *spire.* Knowing which you are building is the first decision, and the scorecard makes it visible before you open a jar.



A candidate extract read at the sequencer bench — loudness at the receptor, not amount in the jar, is the only thing the Index records, and the only thing a blend's composed scorecard reports.

Two numbers govern how to read any scorecard, and both come straight from the formula. The first is the **reference**: every axis is anchored to the half-activation of a fixed reference stimulus, so a 480 on umami and a 480 on pungency mean the same thing — each compound is reaching half-activation of its own receptor at the same multiple of its reference. The axes are directly comparable *as loudness*, which is the whole reason eight different receptors can share one page. The second is the **ceiling**: for scorecard

normalization we cap each axis at **5,000**, the practical top of the scale, the loudness beyond which a human simply cannot register more. Phoenix, the only cultivar we ever built to register on all eight axes at once, tops out at IFI-H 4,200 — near the ceiling, by design, and nothing a *seasoning* should ever approach, because a rub is a landscape and 4,200 is a spire. When you read a rub's scorecard and see every number living between, say, 100 and 1,500, you are looking at a blend that was built to be eaten by the mouthful, over a whole plate, by a whole table — which is exactly what a seasoning is for.

Here is the discipline the scorecard enforces, and why we draw it first. When you design a blend by taste alone, you chase the loudest thing — you add, and add, and the blend climbs until one note wins and the rest are rubble. When you design to a silhouette, you are building *toward a shape*, and the shape tells you when to stop. The all-purpose coat above is finished not because it tastes maximal but because its silhouette is complete: a clean pungent peak, a full body, a climbable heat floor, a dusting of everything else. One more gram of mustard would spike the peak and break the ridge. The scorecard is how a blender learns the hardest thing in the craft, which is restraint — the knowledge that a seasoning is finished not when there is nothing left to add but when the silhouette is right. Draw the silhouette. Then make the jar match it. Everything else in this book is practice at exactly that.




PART II OF V

# The Aromatics, Grown to a Number

mustard · the alliums · the warm spices · the green herbs · the sharp greens

# Chapter 4 · Mustard & the Glucosinolate Engine — *the sharp that only wakes when it's wet.*

**IFI-P · TRPA1 · Brassica nigra 2,790 constructs · Sinapis alba 200**

Of all the aromatics, mustard is the one that teaches humility, because dry mustard powder is very nearly silent. Smell a spoonful straight from the tin and you get almost nothing — a faint, dusty, oily warmth, the ghost of a flavor rather than the thing itself. The sharpness that defines mustard, the volatile hit that clears a sinus and defines a good deli, *does not exist yet.* It is not in the jar. It is manufactured, on demand, in the instant the powder meets water — and understanding that manufacture is the key to blending with mustard, and a perfect illustration of why we grow a plant for a *pathway* and not for a flavor.

The chemistry is one of the most elegant defensive systems in the plant kingdom, and it runs on two components the plant keeps carefully apart. The first is the **glucosinolate**: a stable, water-soluble storage molecule, a β-thioglucoside-N-hydroxysulfate with a variable side chain, sitting inertly in the plant's cells doing nothing. Black and brown mustard (*Brassica nigra*) store **sinigrin** — allyl glucosinolate. Yellow or white mustard (*Sinapis alba*) stores **sinalbin** — p-hydroxybenzyl glucosinolate. On their own, these are flavorless. The second component, kept in physically separate cells called myrosin cells, is an enzyme: **myrosinase**, a thioglucoside glucohydrolase (EC 3.2.1.147, the plant genes *TGG1* and *TGG2*). As long as cell and enzyme stay apart, nothing happens. The powder is silent because it is a loaded trap with the trigger held open.

Crush the tissue — grind the seed, wet the powder — and the two meet. Myrosinase finds the glucosinolate and cleaves off its glucose, leaving an unstable aglycone (a thiohydroximate-O-sulfonate) that cannot hold its shape for more than an instant. It undergoes a spontaneous **Lossen rearrangement**: the sulfate leaves, the skeleton reorganizes, and an **isothiocyanate** is born — the sharp, reactive, TRPA1-welding electrophile of Chapter 1. From sinigrin comes **allyl isothiocyanate (AITC)**: small, volatile, the molecule that leaps off the surface into your nose, the defining pungency of brown mustard, horseradish, and wasabi. From sinalbin comes **p-hydroxybenzyl isothiocyanate**: larger, *non-volatile*, which changes everything about how you experience it — because it cannot leap into the nose, it stays on the tongue, where it reads as a slower, rounder, lingering mouth-warmth rather than a nasal detonation. Two mustards, two glucosinolates, two isothiocyanates, two completely different sensations from the same reaction run on different substrates. This is the whole dial, and the plant hands it to us in two species.



A petri-dish reaction under observation — the kind of controlled wetting that lets us read exactly how much allyl isothiocyanate a line's myrosinase liberates, and how fast, before a single seed is milled to powder.

The biosynthesis upstream is worth naming, because it is where our engineering reaches in. Glucosinolate production begins with an amino acid — methionine, for the aliphatic glucosinolates like sinigrin — which is chain-elongated (the MAM enzymes, BCAT4) and then built into the core glucosinolate skeleton by a conserved cassette: a cytochrome P450 of the CYP79 family converts the amino acid to an aldoxime; CYP83 oxidizes it further; a C–S lyase (SUR1) and a glucosyltransferase (UGT74B1) and a sulfotransferase (SOT) finish the molecule. Each step is a lever. *Brassica nigra* carries 2,790 engineered constructs in our library — one of the most heavily worked non-pepper organisms we run — precisely because the glucosinolate pathway has so many points at which total yield, the ratio of sinigrin to its lower companions, and the activity of the resident myrosinase can each be tuned. We grow a black mustard whose seed, milled and wetted, liberates AITC high and clean, and a white mustard (200 constructs) kept deliberately low in the bitter companion compounds, for body and a gentler, non-volatile lift.

For the blender, one fact governs all use of mustard, and it is a gift: **mustard sleeps in the jar.** Because the sharp does not exist until the powder meets moisture, you can load mustard into a dry blend without fear of it blowing off the shelf the way a volatile herb does. It waits. It does not bloom until the blend meets the surface moisture of the food — and then, as the myrosinase wakes, you will actually *smell* the blend turn sharp on the meat, a living reaction you triggered. Three practical consequences follow. First, **heat kills the enzyme**: myrosinase denatures well below cooking temperatures, so a mustard cooked hard goes nutty and mild (the AITC already made will also cook off), which is why the sharpest mustard flavor comes from blooming it at the surface *before* the fire, not from loading more into a long cook. Second, **time and temperature set the character**: a cool, slow wetting favors the full isothiocyanate; very hot or very alkaline conditions push the reaction toward duller nitriles instead, so a mustard bloomed in cool surface moisture is sharper than one slapped onto a screaming surface. Third, **acid stabilizes** the fresh sharp — a reason prepared mustards hold their bite. Grow the pathway, mill the seed, and you hold the trigger; the cook decides when to pull it.

## Sharp Yellow — a Mustard Coat

*Makes a small jar · 10 minutes · for salmon, pork loin, a whole roasted cauliflower*

A pungent, waking blend built to bloom against a moist surface. It is a favorite on things that can take a sharp edge — fatty fish, a loin, a cauliflower cut thick and seared hard so the mustard's crest meets a real crust.

```
3  tbsp    yellow mustard powder (low-bitter white mustard, for mild non-volatile body)
1  tbsp    brown mustard powder (black mustard, for the sharp volatile crest)
2  tsp     granulated garlic
2  tsp     granulated onion
1  tbsp    flaky salt, crushed fine
1  tsp     cracked black pepper
½  tsp     ground ginger (dried, for a warm underline)
```

1. Combine dry and shake hard for a full thirty seconds — the two mustard powders are the finest particles in the jar and will segregate if you let them, which lands the sharp in patches instead of a sheet.
2. Coat the surface about thirty minutes before cooking and leave it, uncovered, somewhere cool. The food's own surface moisture wakes the myrosinase; you will smell the coat turn sharp as the AITC is born. This is the blend working, not spoiling.
3. Cook hot and do not disturb the crust. Under the fire the volatile crest softens into a rounded, nutty mustard warmth while the non-volatile white-mustard note holds on the tongue — the flash becomes a hum.

### IFI readout — the finished coat

| AXIS | SCORE | WHAT IT IS |
|---|---|---|
| IFI-P · Pungency | 1,680 | the brown-mustard crest, bloomed through TRPA1 |
| IFI-K · Kokumi | 520 | the garlic's γ-glutamyl roundness, through CaSR |
| IFI-U · Umami | 360 | a low savory floor from the alliums |
| IFI-H · Heat | 140 | a whisper under the sharp, from the pepper |

# Chapter 5 · The Alliums — *garlic and onion, the savory floor of everything.*

**IFI-K · CaSR · IFI-P · TRPA1 · Allium sativum 560 constructs · Allium cepa 40**

If mustard is the lesson in restraint, the alliums are the lesson in foundation. Almost nothing we blend begins without granulated garlic and onion, because they are how a dry mix acquires a *body* — the low, round, mouth-filling savor that keeps a blend from reading like dust on a surface. But the alliums are doing two jobs at once, on two different receptors, and the serious blender learns to think of them as two ingredients wearing one skin.

The first job is pungency, and it runs on the same kind of enzyme-and-substrate trap as mustard. Intact garlic is nearly odorless; its sharp is manufactured on damage. The clove stores **alliin** — (+)-S-allyl-L-cysteine sulfoxide, a stable, flavorless precursor — physically separated from its enzyme, **alliinase** (EC 4.4.1.4, a pyridoxal-phosphate–dependent carbon–sulfur lyase). Crush the clove and the two meet: alliinase cleaves alliin into allyl sulfenic acid, pyruvate, and ammonia, and two of those sulfenic acids condense almost instantly into **allicin** — diallyl thiosulfinate, the hot, sharp, TRPA1-active molecule of fresh cut garlic. Allicin is itself unstable and decomposes over minutes to hours into a family of downstream sulfur compounds — diallyl disulfide, diallyl trisulfide, ajoene, the vinyldithiins — which are the mellower, deeper, cooked-and-aged garlic notes. Onion runs the parallel system on a different substrate, isoalliin (S-1-propenyl-cysteine sulfoxide), whose cleavage products rearrange via a dedicated lachrymatory-factor synthase into the volatile that makes you cry, and whose sweeter, rounder character is the reason onion reads gentler than garlic even though the machinery is the same.

The second job is the one you cannot point to, and it is the more important of the two for a dry blend. Alongside its pungency, garlic carries **γ-glutamyl peptides** — γ-glutamyl-S-allyl-cysteine, γ-glutamyl-valyl-glycine, and their relatives, kin to glutathione — and these are **kokumi** compounds. Kokumi is not a taste. It is a *modulation*: these peptides bind the **calcium-sensing receptor (CaSR)**, a class C G-protein-coupled receptor on the taste cell, and what they do is make the other tastes present — the umami, the sweet, the salt — read as thicker, more continuous, more mouth-filling, and longer-lasting. It is the quality a taster calls *depth*, or *body*, or *roundness*, and cannot name, because there is no single flavor to point at; CaSR does not add a note, it enriches the whole chord. Scored on the Index as **IFI-K**, it is the axis you feel rather than taste, and the alliums are its densest everyday source.




Garlic, whole and dense — grown toward its γ-glutamyl peptides and its alliin alike, so a granulated clove carries both the pungent flash and the kokumi body a dry blend is otherwise missing.

Here is why we grow them rather than buy them, and it is the dry side's whole economy in one move. Kokumi is normally something you *earn* — you build it over hours, braising and reducing and caramelizing, coaxing γ-glutamyl peptides and Maillard products out of long slow cooking until a sauce has body. Grown for its peptides and dried to concentrate them, our garlic carries that body *in the powder*, so a dry blend can read as though it had been simmered for hours when it has in fact only been shaken in a jar. That is the trade the dry side offers: body you can grow in and shake out, rather than body you have to stand at a stove and build. Our *Allium sativum* runs 560 engineered constructs tuned across exactly this split — some toward the allicin pathway for a sharper granule, some toward the γ-glutamyl peptides for a rounder one — and our onion, a lighter 40, brings the same roundness in a sweeter register. A practical note from the chemistry: because alliinase, like myrosinase, is heat-labile, the pungent flash of granulated garlic is strongest when the blend meets moderate surface moisture before high heat; but the γ-glutamyl kokumi is heat-*stable* and survives the whole cook, which is why garlic's body outlasts its sharp. Blend the sharp for the top of the bite; trust the kokumi to hold the floor all the way through.

## The Base Coat — the Savory Floor

*Makes a large jar · 5 minutes · the foundation under nearly every blend in this book*

| | | |
|---|---|---|
| 4 | tbsp | granulated garlic (grown for kokumi, dried hard) |
| 3 | tbsp | granulated onion |
| 3 | tbsp | flaky salt |
| 1 | tbsp | cracked black pepper |

1. Combine and shake for a full thirty seconds — longer than feels necessary — so the salt and the fine allium granules distribute into one even powder rather than settling into strata.
2. Use it alone as an honest everyday seasoning, or treat it as the base layer and build an aromatic top, a heat, and a finish on top of it. Most recipes that follow call for it by name.
3. Keep it airtight and out of the light. The allium sulfur volatiles are the part that fades first; the kokumi peptides keep for far longer, so an old jar loses its sharp before it loses its body.

**IFI readout** — IFI-K 1,200 (kokumi, the grown-in body, through CaSR) · IFI-U 540 · IFI-P 460 (the garlic's own low pungency) · IFI-H 80. A base, not a statement — a low, broad floor the whole rest of the rack is built to stand on.

# Chapter 6 · The Warm Spices — *cinnamon and ginger, pungency that reads as warmth.*

**IFI-P · TRPA1 · Cinnamomum 40 constructs · Zingiber officinale 120**

There is a whole family of pungency that reads not as *sharp* but as *warm* — the deep glow of cinnamon, the rounded penetrating bite of dried ginger, the spices that lean toward the dessert end of the drawer and toward the deep end of a long braise. Their molecules land on the very same TRPA1 channel as mustard's sharpness, but lower and slower, and the mouth reads that slower activation as warmth rather than a flash. These are the aromatics that make a blend feel *built for cold weather* — the ones that belong on ribs and short rib, on roasted squash and sweet potato, on anything that wants depth without a bright cutting edge.

Cinnamon's warmth is **cinnamaldehyde** — more exactly, trans-cinnamaldehyde — and its origin is a quiet thread that ties this whole book back to the heat it is the gentle cousin of. Cinnamaldehyde is a **phenylpropanoid**, built on the same early pathway that feeds capsaicin itself: phenylalanine is deaminated by **phenylalanine ammonia-lyase (PAL)** to cinnamic acid; cinnamic acid is activated to cinnamoyl-CoA by **4-coumarate-CoA ligase (4CL)**; and **cinnamoyl-CoA reductase (CCR)** reduces it to the aldehyde. That the warm spice and the hot chili share the opening moves of their biosynthesis — the PAL → C4H → 4CL trunk that runs in every vascular plant — is not a coincidence a blender needs, but it is a reason the two sit so naturally in one jar: they are, at the root, branches of the same tree. Chemically, cinnamaldehyde is an α,β-unsaturated aldehyde, which makes it a genuine electrophile, a true Michael acceptor — it bonds to TRPA1's cysteines exactly as Chapter 1 described, which is why its warmth, however gentle, is unmistakably *pungency* and not mere aroma.

Ginger's warmth is **gingerol** — [6]-gingerol in the fresh root — and it comes by a different and, for this book, far more consequential route. Gingerol is a phenylpropanoid-polyketide: a feruloyl-CoA unit (off the same phenylpropanoid trunk) extended by malonyl-CoA through a **type III polyketide synthase (PKS)** and then reduced, building the long hydroxylated side chain that carries the bite. Here is the fact every dry-rub blender must hold, because it is the single most important difference between the fresh spice and the jarred one: **drying converts gingerol to shogaol.** [6]-Gingerol loses a molecule of water — a dehydration favored by heat and by the slow loss of moisture in drying — to become **[6]-shogaol**, which is a *different* and considerably *sharper* pungency, roughly twice as loud, and one that hits both TRPA1 and, unlike most of the rack, TRPV1 as well, lending it a faint true-heat edge. Fresh ginger and dried ginger are not the same spice at different strengths; they are two different molecules. The dried ginger in your rub is a shogaol spice — more

penetrating, more insistent, warmer-toward-hot — and that is exactly why it belongs on the fire and in the jar, where its fresh cousin's bright volatility would be wasted.



Ginger, whole and knuckled — fresh it speaks as gingerol; dried and milled for a rub it has become shogaol, sharper and more penetrating, a different molecule grown from the same root.

The craft risk with the warm spices is that they turn muddy and medicinal in excess. A heavy hand of cinnamon reads as potpourri, not food; too much dried ginger goes soapy and sharp in the wrong way. Both faults are faults of the *companion* compounds, not the hero — the coumarin that rides along in cassia cinnamon, the duller terpenes in a poorly grown ginger — which is precisely where a grown-to-spec aromatic earns its place. Our cinnamon (40 constructs, a hard organism to work and a small, careful program) is tuned toward a cleaner cinnamaldehyde with its coumarin held low, so its warmth holds at a lower dose without tipping into perfume. Our ginger (120 constructs) is grown and dried toward a controlled gingerol-to-shogaol conversion, so the dried powder lands its penetrating warmth without the soapy edge. The payoff is the same as everywhere in this library: grow the plant to say the one thing, and you need less of it to be heard, which means less dusty bulk in the jar and more of the actual signal.

A word on the partners these two keep, in the interest of honesty. A warm blend almost always wants allies that we do not yet engineer — the earthy color of **turmeric**, the citrus-floral lift of **coriander** and **cardamom**, the dark sweetness of **allspice** and **clove**, the backbone of cracked black peppercorn, whose piperine plays both TRPA1 and TRPV1. These we source rather than grow; they are classical partners, not part of the forty-two, and we blend them with the same respect we give our own aromatics. The engineered backbone sets the warm pungency to a number; the sourced partners give it the color and complexity a great warm blend needs. Naming which is which is part of the discipline — a blend is more honest, and easier to repeat, when you know exactly which of its notes you controlled at the seed and which you bought at the strength the season gave.



Turmeric in cross-section — a classical partner we source rather than engineer, bringing color and earth to a warm blend where our tuned cinnamon and ginger set the pungency.

## Warm Dark — a Rib & Root Rub

*Makes a jar · 10 minutes · for ribs, short rib, roasted winter squash, sweet potato*

| | | |
|---|---|---|
| 3 | tbsp | the Base Coat (Chapter 5) |
| 2 | tbsp | sweet paprika (mild Capsicum, for color and body) |
| 1 | tbsp | ground cinnamon (tuned for clean cinnamaldehyde, low coumarin) |
| 2 | tsp | ground ginger (dried — a shogaol spice, penetrating) |
| 2 | tsp | cocoa, bitterness-attenuated (optional, for a darker bark) |
| 1 | tsp | ground coriander (a sourced partner, for citrus lift) |
| 1–2 | tsp | chili, ground, dosed to your rung (Chapter 9) |

1. Combine and shake well; the cocoa and paprika cake more than the rest, so break any clumps against the side of the jar before you shake.
2. Coat generously and rest, uncovered and cool, for an hour or overnight — the longer rest lets the warm aromatics settle into the surface and the shogaol begin to bloom against the meat's moisture.
3. Cook low and long. Cinnamaldehyde's warmth deepens under slow heat rather than cooking off; the blend finishes rounder and darker than it goes on, and the bark reads of warmth and depth, not of baking.

### IFI readout — the finished rub

| AXIS | SCORE | WHAT IT IS |
|---|---|---|
| IFI-P · Pungency | 940 | warm pungency — shogaol and cinnamaldehyde on TRPA1 |
| IFI-B · Zero-Bitter | 1,100 | the cocoa, tuned down so the dark bark reads deep, not acrid |
| IFI-K · Kokumi | 600 | the grown-in allium body |
| IFI-U · Umami | 420 | a low savory floor |
| IFI-H · Heat | 320 | laddered low, a warm climbable glow |

# Chapter 7 · The Green High Notes — *thyme and oregano, the top of the aromatic stack.*

**IFI-P · TRPA1 / TRPV3 · Thymus 120 constructs · Origanum 40**

The green herbs are the brightest voice in the dry rack and the most fragile, and learning to blend with them is learning to handle a signal that is loud the day you make it and gone the month after. Thyme's **thymol** and oregano's **carvacrol** are high, clean, faintly medicinal pungencies — the lift that reads as *fresh* even from a dried leaf, the note that makes a roast chicken smell like a garden and a tray of potatoes smell like Sunday. They sit at the very top of the aromatic stack, above the warm spices and above the savory floor, and they are the first thing in any blend to go dull. A green blend is a blend you make small and use fast.

The two molecules are, beautifully, **positional isomers** — the same atoms, a monoterpene phenol, differing only in where the hydroxyl group sits on the ring — which is why thyme and oregano read as cousins, two dialects of one green brightness. Their biosynthesis is a short, well-mapped terpene route: geranyl diphosphate is cyclized by a terpene synthase to **γ-terpinene**; γ-terpinene is aromatized to **p-cymene**; and a pair of cytochrome P450s of the **CYP71D** subfamily (CYP71D178, CYP71D180, CYP71D181 and their kin, depending on the species) hydroxylate p-cymene to thymol or carvacrol, with a short-chain dehydrogenase finishing the step. Which isomer a plant makes, and how much, is set by which P450s it expresses and how strongly — which is exactly the kind of switch our engineering is built to throw. On the receptor side these phenols are the subtler of the rack's agonists: they activate TRPA1, but partly through non-covalent interaction rather than pure electrophilic bonding, and they also engage **TRPV3**, a warm channel in the skin and mouth, which is part of why their pungency reads as a clean lift rather than a bite. They are, as a bonus the plant made for its own defense and we inherit, strongly **antimicrobial** — membrane-permeabilizing against bacteria and fungi — which is a quiet reason herb-heavy rubs have always traveled well.



Basil in cross-section — a representative green aromatic; the same volatile-phenol chemistry that makes thyme and oregano the brightest and most fragile voice in the dry rack, the first note to arrive and the first to fade.

Because thymol and carvacrol are **volatile**, the dose-to-signal ratio is everything with the green herbs, and it is exactly where a tuned plant earns its keep. An ordinary dried thyme carries its thymol diluted among a crowd of duller terpenes and a great deal of spent leaf, so you must add a lot of dusty bulk to get a little lift — and the lift fades fast as the volatiles escape the open jar. A thyme grown toward its thymol (our *Thymus* runs 120 constructs, a hard organism worked for exactly this) delivers the same brightness from less leaf: more signal, less filler, and a blend that stays loud longer because there is more thymol to lose before it goes quiet. Oregano, a smaller program at 40 constructs, is tuned the same way toward its carvacrol. The practical rules follow straight from the volatility. Crush the herbs between your palms as you add them — the bruising ruptures the oil cells and wakes the lift. Make green blends in small batches and use them within weeks. And apply them *late*: unlike mustard and the warm spices, which want a long rest to bloom, the green herbs want to arrive fresh, so a green blend goes on just before the fire, not the night before, or its brightest note will have surrendered to the air before the first coal is lit.

## Greenline — a Thyme & Oregano Rub

*Makes a small jar · 10 minutes · for chicken, lamb, roasted mushrooms and potatoes*

| | | |
|---|---|---|
| 2 | tbsp | dried thyme (tuned for thymol), crushed |
| 1 | tbsp | dried oregano (tuned for carvacrol), crushed |
| 2 | tbsp | the Base Coat (Chapter 5) |
| 2 | tsp | cracked black pepper |
| 1 | tsp | dried lemon zest (a sourced partner, for a citrus edge) |

1. Crush the thyme and oregano between your palms as you add them — the bruising wakes the volatile oils that carry the whole lift. You should smell the jar brighten as you do it.
2. Combine with the base and the zest, shake, and use within a few weeks while the green note is still loud. Label it with the date; this is the one blend in the book that has a short season.
3. Apply just before cooking. The green herbs do not want a rest — they want to arrive fresh and meet the fire while they are still at their brightest.

**IFI readout** — IFI-P 1,120 (the bright herbal lift, thymol and carvacrol on TRPA1/TRPV3) · IFI-K 520 (the allium floor) · IFI-A 240 (a faint green grip, from the herbs' rosmarinic acid) · IFI-H 100. A blend that is almost all top note, by design — the one you reach for when you want a plate to smell like a garden.

# Chapter 8 · The Sharp Greens — *watercress and the peppery leaves, a finishing lift.*

**IFI-P · TRPA1 · Nasturtium officinale 120 constructs**

There is a corner of the mustard family that most spice racks ignore, and it is a quiet favorite of ours for the way it brings pungency as a *green* rather than a *spice*: the peppery leaves, with watercress at their head. Watercress runs the same glucosinolate-and-myrosinase engine as mustard — it is a Brassica relative — but on a different substrate, and the difference is the whole character. Where black mustard stores sinigrin, watercress stores **gluconasturtiin** (2-phenethyl glucosinolate), and when the leaf is damaged and its myrosinase wakes, gluconasturtiin becomes **phenethyl isothiocyanate (PEITC)** — a larger, less volatile isothiocyanate than mustard's AITC, so its pungency reads lower and greener, a peppery warmth that sits in the mouth rather than leaping into the nose. It is the sharp of a good peppery salad leaf, and dried and milled it becomes a seasoning note almost no one uses, which is reason enough to love it.

Our *Nasturtium officinale* carries 120 constructs, worked across the same glucosinolate levers as the mustards — total gluconasturtiin yield, the resident myrosinase activity, and the ratio of the clean isothiocyanate to the duller nitrile that forms when the Lossen rearrangement is pushed off course. Dried watercress loses the water-dependent half of its reaction but keeps enough precursor and enzyme that, pressed onto a moist surface, it blooms a soft peppery PEITC lift — a thing we use most as a *finishing dust* rather than a cooking rub, because its green sharpness, like the volatile herbs', is a top note that fire would spend. A pinch over a finished plate — a roasted vegetable, a seared fish, a soft egg — lands a fresh, peppery, mustard-family brightness that reads as *just-picked* even in February. It is the dry rack's answer to a squeeze of something green, and it is pure IFI-P with almost nothing else attached.



A plant cluster under glass — the green leaf grown for a single sharp molecule, the way we grow every aromatic in this book toward the one signal it is meant to carry.

## Peppercress — a Green Finishing Dust

*Makes a tiny jar · 5 minutes · a last-second lift over finished plates*

| | | |
|---|---|---|
| 3 | tbsp | dried watercress (tuned for gluconasturtiin), milled fine |
| 1 | tsp | flaky salt, crushed fine |
| 1 | tsp | dried lemon zest |
| ½ | tsp | granulated garlic |

1. Mill the dried watercress fine and combine with the rest; this is a dust, not a rub, so you want it to fall like a fine snow.
2. Keep it small and airtight, and do not cook with it — this blend is a finisher, applied to the plate after the heat is done.
3. Pinch it over anything that wants a fresh peppery lift: a roasted carrot, a seared piece of fish, a soft egg, a bowl of beans. The surface moisture of the hot food wakes the last of the PEITC and the dish reads green and alive.

**IFI readout** — IFI-P 860 (peppery PEITC on TRPA1, a low green sharp) · IFI-A 180 · IFI-K 140 · IFI-H 40. Almost pure lift — the finishing move of the aromatic Part.




PART III OF V

# The Four Levers You Add

heat · sweet · the bitter subtraction · the cool finish

# Chapter 9 · Laddering the Heat — *a specified burn, dosed to the grain.*

**IFI-H · TRPV1 · Capsicum — the flagship ladder · ~19,000 constructs across the platform**

Heat is the one layer most blenders get wrong, and the reason is always the same: the usual heat source is a guess. A cayenne of unknown strength, a chili flake that varies two- or threefold between one harvest and the next, a "hot paprika" with no number on it at all — none of them lets you *design* toward an IFI-H, because you cannot aim at a target with a weapon of unknown caliber. You end up chasing heat by the handful, tasting, correcting, and hoping the next batch of chili behaves like the last. The dry side's great advantage is a heat source specified at the seed.

Recall the mechanism, because it is a different channel from everything in Part II and must be blended as such. Capsaicin is not an electrophile and does not weld itself to anything. It **binds** — slots into a vanilloid pocket on **TRPV1**, the heat-and-acid channel, lowering the channel's thermal threshold so the nerve reports a fire that is not there. It arrives slowly, builds, and lingers, because binding and unbinding are gentle reversible events, not a chemical reaction that fires and resolves. That is why heat is a *floor* you build a plate on and pungency is a *flash* you lift it with; confusing the two is the commonest error in the craft. Capsaicin is made in the chili by an acyltransferase, **Pun1 (AT3)**, which condenses vanillylamine with an eight-methyl branched-chain fatty acid; the length and saturation of that acyl chain set the ratio of capsaicin to dihydrocapsaicin, and with it the *shape* of the burn — where it lands, how it blooms, how cleanly it leaves.

Our flagship ladder is ten superhot cultivars (*C. chinense*), each pinned to an exact Scoville value and an exact IFI-H, bred and engineered as a *specified* heat series so that a measured dose lands the same burn every time. This is the ladder in full:

| CULTIVAR | SKU | SHU | IFI-H | AXES |
|---|---|---|---|---|
| Ember | SS-0087 | 866K | 1,570 | 2/8 |
| Cinder | SS-0088 | 1.05M | 2,290 | 3/8 |
| Kindle | SS-0089 | 1.25M | 2,000 | 3/8 |
| Flare | SS-0090 | 1.48M | — | 4/8 |
| Blaze | SS-0091 | 1.72M | 2,630 | 4/8 |
| Wildfire | SS-0092 | 1.96M | 2,930 | 5/8 |
| Scorch | SS-0093 | 2.21M | 3,220 | 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** |



Phoenix — the only cultivar we ever built to register on all eight axes at once, grown in the controlled chamber. In a rub it is never used whole; it is a tincture, dosed to the grain.

The counterintuitive truth of blending with a superhot is that you do not blend it *strong* — you blend it *small,* and the strength is exactly what makes the smallness precise. A cultivar specified at 2.95 million SHU and IFI-H 4,200 is not a rub ingredient in the ordinary sense; it is a *tincture*, a heat you dose the way a baker doses an extract, a few ground grains to move a blend's IFI-H by a known amount. Because the source is pinned to a number, you can hit a target heat to the point instead of chasing it with handfuls of something milder and less certain — and you can hold a whole family of blends on one shelf at graded heat simply by changing the rung. For a warm, whole-table glow we reach for Ember, the gentlest rung at IFI-H 1,570, ground fine; for a blend meant to climb, a few grains higher up the ladder buy a controlled, repeatable burn without any change to the rest of the silhouette.

Why the heat is a *number* and not a hope comes down to the engineering under the top rung, and it is worth seeing once. The peak of the ladder, Phoenix, was not found by breeding and luck. An ESM2 650-million-parameter protein language model scored every possible single-residue substitution in Pun1 for its predicted effect on catalytic efficiency and fold stability; a genome-scale flux-balance model predicted that flux control sits upstream in the phenylpropanoid pathway at 4CL and HCT, not at the terminal Pun1 step — Pun1 labels the product, it does not govern the rate — and the ESM2 substitutions improved the enzyme's catalytic efficiency and consistency; and two Pun1 substitutions that no breeder ever stumbled on were written in with CRISPR:

| EDIT | EFFECT | ΔΔG (KCAL/MOL) |
|---|---|---|
| S39L | binding affinity ↑ at the N-terminus | −2.1 |
| L345G | steric relief in the active-site cleft | −1.8 |
| C175S | prevents a disulfide misfold *(structural annotation — not in shipped construct)* | −0.9 |

Those two Pun1 substitutions are why Phoenix holds its peak output at a batch-to-batch coefficient of variation at or under **seven percent**, against the forty-two percent that is ordinary for a foraged chili. And that CV is the whole reason a superhot can be a *blending* ingredient at all: a heat that varies by forty percent cannot be dosed

to the grain, but a heat that varies by seven percent can. Heat, to us, is a pleasure and never an assault — even at the top of the ladder we design for the *shape* of the burn and not merely its size, because a heat you can taste through is a heat that feeds you rather than one that only tests you. The next recipe is a single blend built at four rungs, so one jar's worth of work gives a whole table its own heat.

## The Four Rungs — one blend, laddered

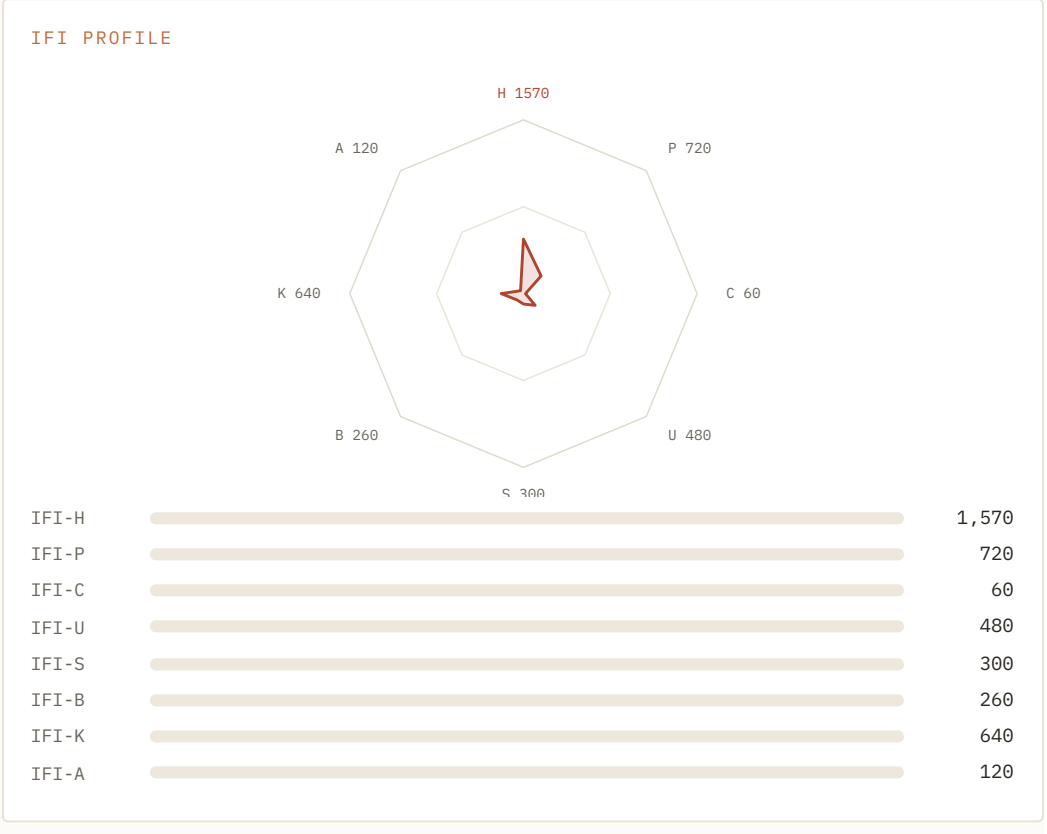
*Makes four small jars · 15 minutes · a single rub at four graded heats, for a table of mixed tolerances*

```
BASE (make once, divide into four):
6  tbsp    the Base Coat (Chapter 5)
3  tbsp    sweet paprika
2  tbsp    granulated garlic (extra, for body)
1  tbsp    ground coriander
1  tbsp    cracked black pepper

THEN, to each quarter of the base, add one:
 Mild    — ¼ tsp  Ember (SS-0087), ground fine
 Medium  — ¼ tsp  Blaze (SS-0091), ground fine
 Hot     — ⅛ tsp  Firestorm (SS-0094), ground fine
 Fierce  — a few grains  Phoenix (SS-0096), ground fine
```

1. Make the base and shake it thoroughly, then divide it into four jars by weight, not eye, so each starts identical.
2. Dose each jar with its rung. Note that the hotter the cultivar, the *less* of it you add — a few grains of Phoenix out-heats a quarter-teaspoon of Ember — which is the specified ladder doing exactly what it is for.
3. Label the jars by rung and cook identically. One fire, one rub, four heats: the uncle who wants the top of the ladder eats beside the child who wants none of it, and nobody is dared and nobody is left out.

**IFI readout — the four rungs share one silhouette, differing only in H**




The H value above is the Mild rung; Medium, Hot, and Fierce climb to roughly 2,600, 3,500, and toward 4,200 while every other axis holds. That is the point of laddering: change one number, keep the shape.

# Chapter 10 · Sweet Without the Scorch — *the brown-sugar problem, solved at the source.*

**IFI-S · TAS1R2·TAS1R3 · Stevia 910 constructs · Sugarcane 200 · Monk Fruit 80**

Every barbecue blender knows the brown-sugar problem, even the ones who have never named it. Sugar in a rub does beautiful things — it rounds the heat, deepens the bark, pulls a blend toward comfort, and feeds the browning that makes a crust — right up until the fire runs hot or the cook runs long, at which point the sugar caramelizes past its sweet point and keeps going, to carbon and acrid smoke. The lacquered crust you wanted goes black and bitter, and the sweetness that was supposed to be the whole charm is the very first thing to burn away. The griller's usual answer is a careful dance — sugar late, fire low, foil at the right hour — but the dance is a workaround for a flaw in the ingredient, and the dry side can fix the ingredient instead.

The flaw is that in ordinary sugar the *sweetness* and the *fuel* are the same molecule. Sucrose is both the thing you taste as sweet and the thing that caramelizes to carbon; you cannot have one without risking the other. So we separate them. Sweetness, on the tongue, is a duet: the **TAS1R2 and TAS1R3** receptors, two subunits clasped into one Venus-flytrap heterodimer, and only when a molecule closes that trap does the brain hear *sweet.* The remarkable thing — the thing the whole sugar-free world rests on — is how many unrelated molecules can close that trap. Steviol glycosides (stevioside, rebaudioside A and the cleaner rebaudioside M) close it. The mogrosides of monk fruit close it. And a class of intensely sweet *proteins* — **brazzein**, thaumatin, monellin — close it hard, at vanishingly low concentration, carrying no fermentable carbohydrate at all. A rub sweetened with these reads sweet from the first bite and has *nothing in it to scorch*, because none of these molecules is a sugar and none of them caramelizes. The fire can run as hot and as long as the cut needs; the sweetness simply persists.




Sugarcane in cross-section — the classic sweetness, and the problem: in sucrose the taste and the fuel are one molecule. We grow the sweetness instead as glycosides and proteins that close the same receptor and carry no sugar to burn.

A point of chemistry keeps this honest and is worth drawing, because it is the hinge of the whole chapter: **caramelization and the Maillard reaction are not the same browning.** Caramelization is the pyrolysis of sugar *alone* — sucrose breaking down under heat, roughly from 160°C upward, through a cascade that ends, if you let it, in bitter carbon. The Maillard reaction is a reaction *between* a reducing sugar and an amino group, and it is the one that makes a savory crust (Chapter 14). The brown-sugar problem is a caramelization problem: it is the sugar burning by itself. A designed sweetener sidesteps it entirely because it is not a sugar and cannot caramelize — but that means it also contributes *nothing* to Maillard browning, which is a feature, not a loss, because you want the *meat's own* amino acids and the blend's savory floor driving Maillard, not a scorching sugar. Pair the designed sweetness with a bitterness-attenuated note (Chapter 11) so the deep Maillard char reads as roast rather than burn, and you get the lacquered, sweet-dark bark without the acrid edge that sugar always risked. Our stevia runs 910 constructs — a large, well-worked program tuned toward the cleaner rebaudiosides and away from the licorice-bitter tail that cheap stevia carries; monk fruit (80) and the brazzein-class proteins fill in a rounder, more sugar-like curve. The practical bonus is one of volume: these sweeteners are hundreds of times sweeter than sucrose by weight, so a rub sweetened this way carries almost none of the caking, clumping bulk a muscovado rub drags along — the jar stays dry and pours clean.

### Sweet Smoke — a No-Scorch Barbecue Rub

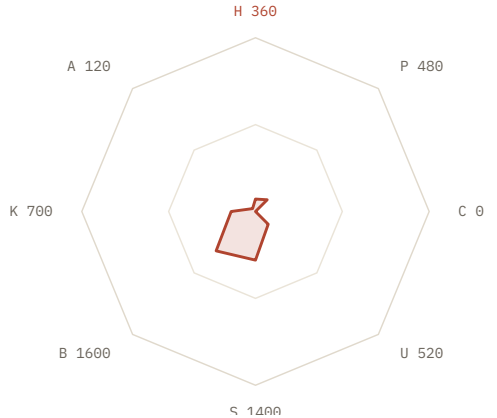
*Makes a jar · 10 minutes · for brisket, pork shoulder, roasted sweet potato*

```
4  tbsp    the Base Coat (Chapter 5)
3  tbsp    sweet paprika
2  tbsp    designed sweetener (steviol-glycoside / brazzein blend, no
fermentable sugar)
2  tsp     cocoa, bitterness-attenuated
2  tsp     smoked paprika (sourced, for the smoke note)
1  tsp     cracked black pepper
1–2 tsp    chili, dosed to your rung (Ember for a warm floor)
```

1. Combine and shake well. The designed sweetener is far lighter by volume than sugar, so it will not cake or clump the way a brown-sugar rub does; if anything the blend pours too freely, so shake before each use.
2. Coat heavily the night before — this blend is built for the long cook — and leave it uncovered in the cool so the salt sets the surface up to take smoke and color.
3. Run the fire as hot and as long as the cut needs. Nothing in the sweetness burns; the bark darkens to lacquer and stays sweet to the last hour, because the sweet molecules were never fuel.

**IFI readout — the finished rub**

IFI PROFILE




| | |
|---|---|
| IFI-H | 360 |
| IFI-P | 480 |
| IFI-C | 0 |
| IFI-U | 520 |
| IFI-S | 1,400 |
| IFI-B | 1,600 |
| IFI-K | 700 |
| IFI-A | 120 |

Read the silhouette: sweet and bitter-subtraction lead together (1,400 and 1,600), which is the sound of a sweet-dark bark that reads as roast; the savory floor holds underneath; the heat is laddered low for the whole table to climb on its own plate.

# Chapter 11 · The Bitter Subtraction — *the kindest axis, and the darkest bark.*

**IFI-B · TAS2R38 · attenuation 20–65% · Cocoa · Coffee · the Brassicas**

Of all eight axes, one is defined not by what it adds but by what it *takes away*, and it is the one that lets a rub do something no amount of skill at the grill can: let a bark go darker and richer without ever reading as burnt. This is **IFI-B**, the zero-bitter axis, and it works on the bitter receptors — chief among them **TAS2R38**, the famous one, the receptor whose two common forms (the PAV and AVI haplotypes) divide the world into people who find certain greens unbearable and people who shrug at them. Humans carry some twenty-five bitter receptors, a wary sensory alarm system evolved to flag the alkaloids and phenolics that so often mean *poison* — which is exactly why bitterness, unmanaged, reads as *danger* and makes the mouth recoil.

In a rub, bitterness comes from two directions, and the axis answers both. The first is the ingredients you *want* for their depth but not their bite: cocoa, with its theobromine and dark polyphenols; coffee, with its chlorogenic-acid lactones and quinic acid; the brassica notes; a heavy char of spice. These bring a dark, roasted, grown-up complexity to a bark — and a harsh bitter tail you must otherwise dose around. The second is the fire itself: the far end of browning is **pyrolysis**, the point past Maillard where the surface tips from deep-savory to carbon, and pyrolysis is bitter. Both problems have one solution. We grow the deep ingredients — our cocoa, our coffee notes — with their bitterness *attenuated at the source*, the receptor response to their bitter compounds knocked down by twenty to sixty-five percent, so the depth arrives without the recoil. A bitterness-attenuated cocoa reads as dark chocolate's *body* with its acrid edge removed; a bitterness-attenuated coffee note reads as roast and caramel without the ashtray.



Cocoa in cross-section — theobromine, polyphenols, and a deep dark bitterness we knock down at the source by twenty to sixty-five percent, so a bark can carry cocoa's body without its bite.

Here is why this is the most *useful* axis for the serious barbecue blender, and it is a genuinely non-obvious move. Because IFI-B subtracts the bitter signal, it effectively *moves the line* at which a cook reads a crust as burnt. Without it, you brown to the edge of Maillard and stop, because one shade darker reads as acrid and the whole bark is ruined. With a bitterness-attenuated note built into the rub, you can push the surface a shade or two further — darker, more lacquered, more deeply Maillard — because the bitterness that *would* have flagged "burnt" at that darkness has been turned down below the threshold of alarm. You are not making the crust less burnt; you are making the mouth less alarmed by the same darkness, so you can chase a blacker, richer bark with confidence. It is the kindest axis — a subtraction that makes room — and in a dark rub it is the quiet reason the bark reads *roast* all the way to a color that would have read *ash* on any other blend.

## Black Bark — a Deep-Roast Rub

*Makes a jar · 10 minutes · for beef short rib, brisket, roasted king oyster mushrooms*

```
4  tbsp    the Base Coat (Chapter 5)
2  tbsp    cocoa, bitterness-attenuated
1  tbsp    coffee, finely ground, bitterness-attenuated
2  tbsp    smoked paprika (sourced)
2  tsp     designed sweetener (to round the dark, no sugar to scorch)
1  tsp     cracked black pepper
1–2 tsp    chili, dosed to your rung
```

1. Combine and shake hard; the cocoa and coffee are the finest and darkest particles and will streak the blend if you do not distribute them fully.
2. Coat heavily and rest overnight. This is a blend built to go dark, and the long rest lets the salt and the fine powders set a surface that will take a deep char.
3. Cook to a bark darker than instinct allows — then one shade darker still. The attenuated bitter lets the Maillard run deep before it ever reads as burnt; trust the blend and let the crust go black.

### IFI readout — the finished rub

| AXIS | SCORE | WHAT IT IS |
|---|---|---|
| IFI-B · Zero-Bitter | 2,100 | the bark pushed dark, read as roast not ash, through TAS2R38 |
| IFI-U · Umami | 640 | the savory floor, deepened by the coffee |
| IFI-K · Kokumi | 720 | the grown-in allium body |
| IFI-P · Pungency | 420 | a low pepper-and-smoke top |
| IFI-H · Heat | 300 | laddered low |

# Chapter 12 · The Cool Finish — *a breath of mint at the very end.*

**IFI-C · TRPM8 · Peppermint 2,360 constructs · the five-gene menthol pathway**

Most blends are built to arrive and deepen. A few of the very best are built to *clear* — and the finish, the last layer, the sensation the mouth is left holding after everything else has resolved, is where a cooling note earns a place almost no one thinks to give it. **TRPM8** is the receptor that answers to menthol: the channel that reads *cool* with no drop in actual temperature, the counterpart to capsaicin's TRPV1, a thermometer the plant learned to lie to. A trace of it at the end of a hot, savory blend does something the tongue cannot quite believe — it opens the bite back up, resets the palate, so the next mouthful lands as fresh as the first. On a laddered-hot blend it is the difference between a heat that piles up, bite after bite, until the mouth is exhausted, and a heat that clears between bites and stays a pleasure to the end of the plate.

The molecule is **(–)-menthol**, and mint builds it through a well-mapped five-step pathway that is one of the prettier runs of enzymatic sculpture in the plant world. It begins with limonene, which a hydroxylase turns to trans-isopiperitenol; a dehydrogenase and an isomerase carry it through isopiperitenone and (+)-cis-isopulegone to **(+)-pulegone**; a reductase (pulegone reductase) makes **(–)-menthone**; and a final reductase (menthone reductase) delivers **(–)-menthol**. Five enzymes, each a committed step, and the stereochemistry matters enormously — it is the specific (–)-menthol that keys TRPM8 cleanly, where the wrong isomers read muddy or medicinal. Our peppermint is one of the largest non-pepper programs in the whole library, **2,360 constructs**, worked across every step of that pathway toward a clean, high (–)-menthol with its harsher companion terpenes held down — which is exactly what lets us dose cooling as a *whisper* rather than a mouthful of toothpaste.



Dew at dawn on a cultivar in the chamber — the cool the tongue reads without any real drop in temperature, the sensation a trace of grown menthol lends the very end of a hot blend.

The discipline here is a single word: **trace.** A cooling finish is measured in a pinch, never a spoon — enough to read as a clean exhale after the heat, never enough to taste of mint. Scored, it is a

low IFI-C, deliberately kept *under* the threshold at which the mouth would register *cold* as a flavor; it is present as structure and invisible as taste, the way a bass note under a chord is felt and not named. This is the most advanced move in the dry rack, and the one that most separates a blend that was designed from a blend that was merely mixed — because it requires the blender to add something the eater will never consciously notice and would miss the instant it was gone. We reach for it most on the hottest blends and on seafood, where a cool finish and a delicate heat are an old and perfect pairing. A related trick, for the adventurous: a cooling trace set *against* a real heat produces the numbing-tingle the Sichuan tradition prizes — IFI-C and IFI-H played at once, cool and fire on the same bite — which is a whole intersection of its own, and one the dry rack can sketch with a pinch.

## Cool Coast — a Seafood & Citrus Seasoning

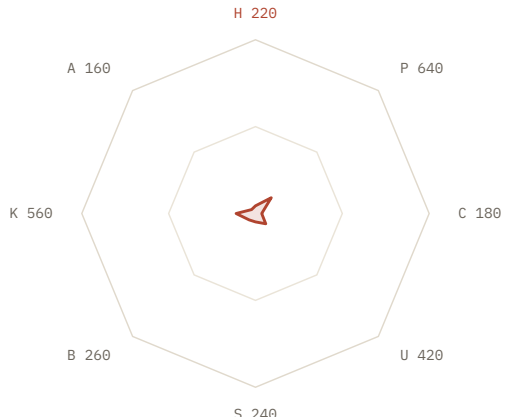
*Makes a small jar · 10 minutes · for white fish, shrimp, scallops, a summer vegetable plate*

```
3  tbsp    the Base Coat (Chapter 5)
1  tbsp    dried lemon zest (sourced)
2  tsp     ground coriander (sourced)
1  tsp     dried thyme (tuned for thymol), crushed
¼  tsp     chili, Ember, ground fine (a delicate floor)
pinch      dried mint (tuned for (−)-menthol), for the cool finish — a
true pinch
```

1. Build the base and the citrus and herb notes first and shake well; add the single pinch of mint *last* and shake once more, briefly, so it distributes without dominating.
2. Season delicately — seafood wants a sheer coat, not a crust — and cook gently and fast.
3. The cool should arrive only at the very end, a clean exhale after the bite, never a taste of mint. If you can name the mint, you used too much; take it back to a smaller pinch next time.

**IFI readout — the finished seasoning**

IFI PROFILE




| | | |
|---|---|---|
| IFI-H | | 220 |
| IFI-P | | 640 |
| IFI-C | | 180 |
| IFI-U | | 420 |
| IFI-S | | 240 |
| IFI-B | | 260 |
| IFI-K | | 560 |
| IFI-A | | 160 |

Note the IFI-C at 180 — a deliberate trace, under the threshold of *cold*, present as a clean finish and invisible as flavor. That restraint is the whole craft of the cool.




PART IV OF V

# From Powder to Crust

salt and the physics of adhesion · the Maillard reagent bed · the measure of a jar

# Chapter 13 · Salt, Carrier & the Physics of a Rub — *the base layer is a machine.*

We have spent the aromatic chapters on the loud notes and the levers — the mustard and the heat, the sweet and the cool. This chapter is about the quiet half of every blend, the base, and it is not a passive filler. The base is a *machine*: it moves water, it binds the blend to the food, it decides which of your aromatics even get a chance to speak, and it governs the single most important variable in the whole craft, which is whether a rub *sticks.* Understanding the physics of the base is what separates a blend that performs the way its scorecard promises from a blend that was perfectly designed and then slid off the meat into the fire.

Start with salt, because salt is not a flavor in a rub — it is the engine. Lay salt on a wet surface and **osmosis** begins: the salt draws moisture out of the food to the surface, where it dissolves into a concentrated brine. Given time, that brine is *reabsorbed*, carried back into the food along the gradient it created, taking dissolved seasoning with it — which is why a rub salted hours ahead seasons the whole depth of a cut and not merely its skin, the phenomenon grillers call a dry brine. Along the way the salt **denatures the surface proteins**, which does two useful things: it lets the surface hold moisture better through the cook, and it builds a tacky protein film that helps everything else in the rub adhere and that browns more readily. This is why salt goes on *early* and why time is an ingredient. A blend applied five minutes before the fire is a coating; the same blend applied the night before is a cure in miniature, seasoned to the center.



A research tray of milled and measured components — the physical craft of the dry side, where particle size and the order of layering decide whether a scorecard ever reaches the tongue.

Then there is **particle size**, which is a lever most cooks never consider and which changes everything about how a blend behaves. Fine particles have enormous surface area: they dissolve and season fast, distribute evenly, and bloom their reactions quickly — a finely milled blend is a blend that speaks the instant it is wet. Coarse

particles season more slowly but survive the fire to give *texture*, the crackle and grain of a true crust, and they resist clumping. A well-built rub is usually a deliberate blend of both — a fine fraction for even, fast seasoning and a coarse fraction for crust and bite — and the order you combine them in matters, because the fine powders will sift to the bottom of a jar if you let them, landing the seasoning in strata instead of a sheet. Shake every jar before every use; a blend is only as even as its last agitation.

The deepest physics, though, is **solubility**, and it is where the chemistry of Parts I through III comes home to roost. Your aromatics are not all soluble in the same thing, and that fact dictates how each one must be deployed. The isothiocyanates of mustard and watercress, and the allicin of garlic, are *water-dependent* — they are *born* in water (the myrosinase and alliinase reactions need it) and they are water-soluble, so they wake against the surface moisture of the food and want no help from fat. The capsaicinoids of your chili, by contrast, and many of the terpene aromatics — the thymol, the carvacrol, the cinnamaldehyde — are **lipophilic**, fat-soluble, which is why a chili's heat blooms and spreads in oil and why water does almost nothing to carry or to quench it. This split has direct, practical consequences for every blend. It is why a mustard coat wants a moist surface and a short bloom, while a chili rub can be *loosened into oil* to make a paste that carries its heat evenly and deeply. It is why water douses the sharp of mustard and fat does not, and why milk (whose fat and casein grab capsaicin) quiets a chili burn that water only spreads. And it is the basis for the whole next-to-last chapter of this book, on turning a dry rub into a bloomed paste: you are choosing a solvent to match your aromatics, water for the sharp, oil for the heat, and the base layer is where that choice is made. Design the silhouette on the Index; then build the base so the physics lets every axis on that scorecard actually reach the tongue.

# Chapter 14 · The Crust — *what a blend becomes on the fire.*

A rub is not finished in the jar. It is finished on the fire, where it stops being a powder and becomes a **crust** — and the crust is the reason to do any of this. Everything in the preceding chapters, every tuned aromatic and dosed lever and considered particle, is a preparation for one event: the moment the seasoned surface loses its water and the browning begins. To understand a rub fully you have to understand that the blend you press on is not the flavor you will taste. It is the *reagent bed* for a reaction, and the reaction is what you eat.

The reaction is the **Maillard**, and it deserves to be seen in full because so much of the craft is really the craft of steering it. It is not caramelization — that is sugar alone, and we dealt with its hazards in Chapter 10. Maillard is a reaction *between* two things: the carbonyl group of a reducing sugar and the free amino group of an amino acid or protein. It begins above roughly 140°C on a surface dry enough to get there (which is why a wet surface steams and will not brown — the water must leave first), and it unspools through a thicket of named stages. The sugar and amine condense and rearrange — the **Amadori rearrangement** for the common case — into reactive intermediates; those break down into **dicarbonyls**, which attack amino acids in the **Strecker degradation**, cleaving them into aldehydes and aminoketones; and the fragments recombine, cyclize, and polymerize into two families of product: the volatile aroma compounds — the nutty **pyrazines**, the roasted furans, the meaty sulfur-bearing thiophenes and thiols — and the brown, high-molecular-weight **melanoidins** that give a crust its color and its deepest savor. Hundreds of new molecules, none of them present in the raw blend or the raw food, all of them generated in the first millimeter of the surface by the fire. The smell of a grill *is* the Maillard reaction made airborne.



Golden-hour light on peppers hung to ripen — the warmth of controlled browning, the reaction every rub is a reagent bed for, caught before the fire ever touches it.

Here is where the rub's design decides the crust's character, and where two of our axes do their quiet work. First, **the savory floor feeds the reaction.** Maillard needs amino groups, and a blend carrying grown-in umami and kokumi — free glutamate and the γ-

glutamyl peptides of the alliums — gives the reaction more to fold in, so the crust reads *rounder and fuller* rather than merely dark. A blend with a strong body does not just taste savory before the fire; it browns to a deeper savor, because its savory compounds are themselves Maillard reactants. Second, **the bitter subtraction extends the runway.** The far end of Maillard is pyrolysis — carbon, ash, the acrid bite that TAS2R38 evolved to warn us off — and ordinarily that threshold is where a cook must stop browning. With a bitterness-attenuated note built into the blend (Chapter 11), the darkness at which the crust reads as *burnt* moves further out, so you can push the bark deeper and richer before the mouth sounds the alarm. The two axes work as a pair: the body gives the reaction more to build with, and the subtraction lets it build further.

There is one caution the chemistry demands, and it is the reason a rub can be *over*-applied. The Strecker degradation *consumes* free amino acids — it spends them as reactants — so a surface browned past a certain darkness can actually burn through the very glutamate it would otherwise have shown as savor, tipping the crust from deep-savory to merely bitter even before true pyrolysis. The best bark is a balance: dark enough that the Maillard has run rich and full, not so dark that it has spent its own savory substrate. This is why *when* and *how much* matter as much as *what* — why the volatile green herbs go on late (the fire would spend them), why the mustard blooms before the heat (its sharp would cook off), why the sweet is designed not to scorch and the bitter designed to let the dark run. The dry side's whole promise comes true here, on the crust: what you specified in the jar, through eight axes and five layers, is what the fire builds on the plate. Press on a blend whose scorecard you drew on purpose, and the crust is not a hope. It is a result.

# Chapter 15 · The Measure of a Jar — *consistency, and the number a spice brand lives or dies by.*

**CV ≤ 7% · the arithmetic of reproducibility**

We have reached the least romantic chapter in the book and, for anyone who means to sell a blend rather than merely make one, the most important. Everything to this point has been about *designing* a silhouette — getting the eight axes into the shape you want. This chapter is about *repeating* it: making the jar you blend next spring season a brisket exactly the way this one did, and the one after that, and the ten thousand after those. For a home cook, a lucky blend is a joy. For a spice brand, a blend you cannot repeat is not a product; it is an accident you got away with once.

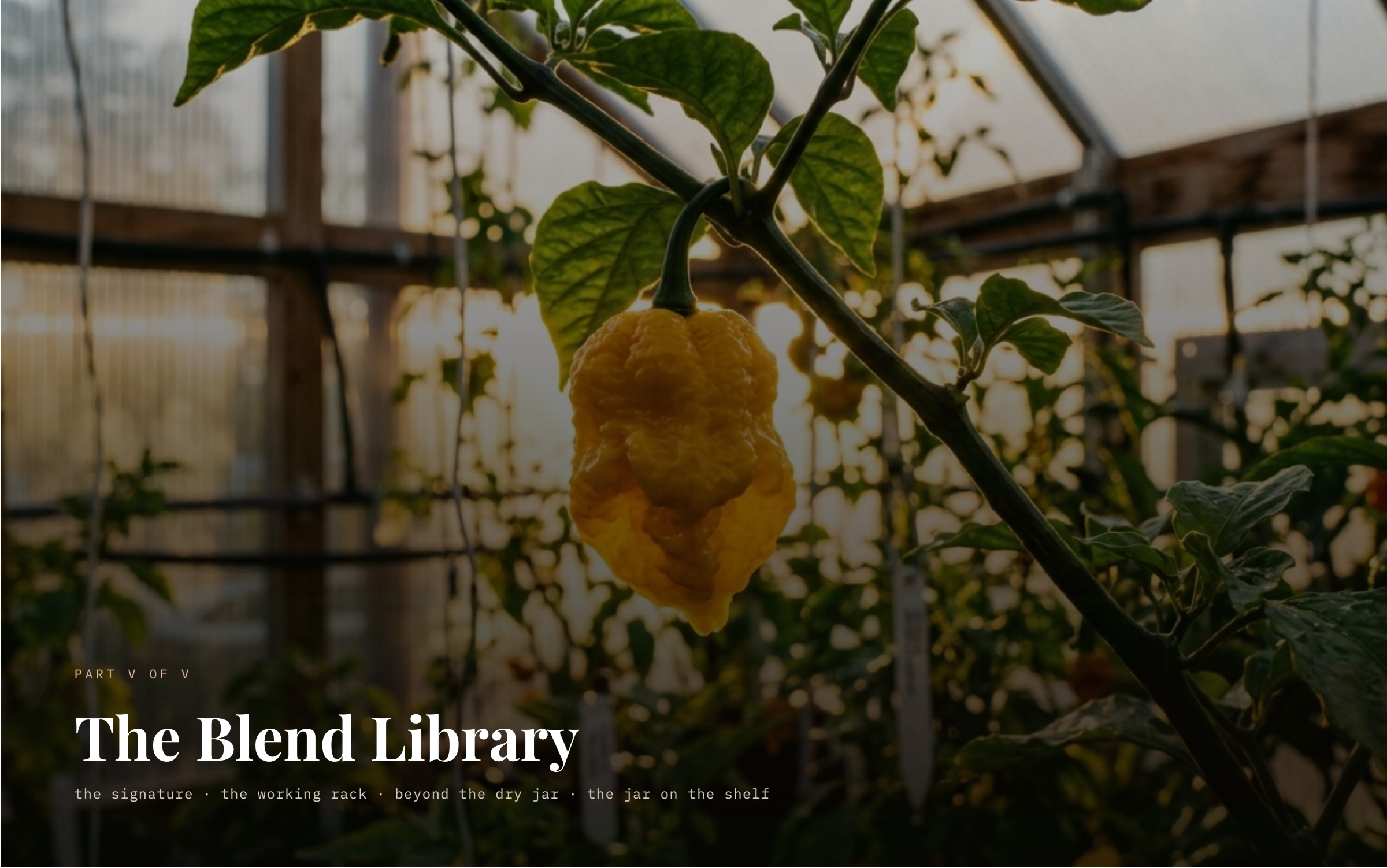
The measure of repeatability has a name and a number, and they run through this whole library: the **coefficient of variation**, CV, which is simply the standard deviation of a measurement divided by its mean, expressed as a percent — σ/μ. It asks: across many batches, how much does a value wander around its average? A low CV means a tight, predictable, trustworthy ingredient; a high CV means a wild one. And here is the fact that makes the dry side possible at all, the fact that justifies every construct and every controlled chamber in the preceding chapters: **a foraged spice is a high-CV ingredient, and a grown-to-spec one is a low-CV ingredient.** A chili picked from a field varies in heat by forty percent and more between harvests — sun, soil, water, and stress all pushing its capsaicin up and down — which is why "add cayenne to taste" is the only honest instruction anyone could ever give with it. Our chili, grown in controlled environment from a fixed genetic line selected and edited for exactly this, holds its heat at a CV **at or under seven percent.** The same discipline runs across the forty-two organisms: the thyme's thymol, the garlic's peptides, the mustard's sinigrin, the mint's menthol — each grown to a specification and read against the Index, each holding to single-digit variation where the foraged version would swing by halves.




A candidate line read at the microscope stage under fixed light and fixed hands — the discipline of measuring the same thing the same way, batch after batch, that turns a blend into a product.

Walk the arithmetic of why this matters so much for a *blend*, because it is more than the sum of its parts. A blend is a composition of many ingredients, and its final scorecard depends on all of them at once. If each ingredient wanders independently, the errors can stack — a blend of eight foraged components, each varying by forty percent, can land somewhere genuinely unpredictable, one jar sharp and hot and the next flat and mild, with no change to the recipe. The eater, who does not see the recipe, concludes the brand is careless. Hold each component to a CV at or under seven percent and the composition stays inside a tight envelope: the pungent peak lands where the scorecard says, the heat floor holds its rung, the body reads the same depth. The silhouette is stable because its inputs are. This is the hidden half of designing to a scorecard — the scorecard is only a promise if the ingredients are specified tightly enough to keep it, and the whole grown-to-spec platform exists, in the end, so that the number you draw is the number you can deliver, this batch and every batch.

There is a quieter consequence, and it is one we care about as much as the commercial one. Consistency is a form of *respect* — for the cook who trusts your jar, and for the person they are feeding. A blend that reads the same every time lets a griller build a reputation on a bark, lets a parent make the dish a child loves exactly the same way a hundred times, lets a small brand stand behind a name. The numbers are a form of care, the same way the reverence in the opening essay was: you measure the aromatic to a CV not because the number is beautiful (though it is) but because measuring it is how you keep a promise to someone who will never see the measurement. That is the whole argument of the dry side, reduced to a single statistic. Grow the plant to a specification; hold it to a CV; and the jar becomes something a person can rely on. From here, the rest of the book is the payoff — a working library of blends, each one a silhouette you can now both design and repeat.



PART V OF V

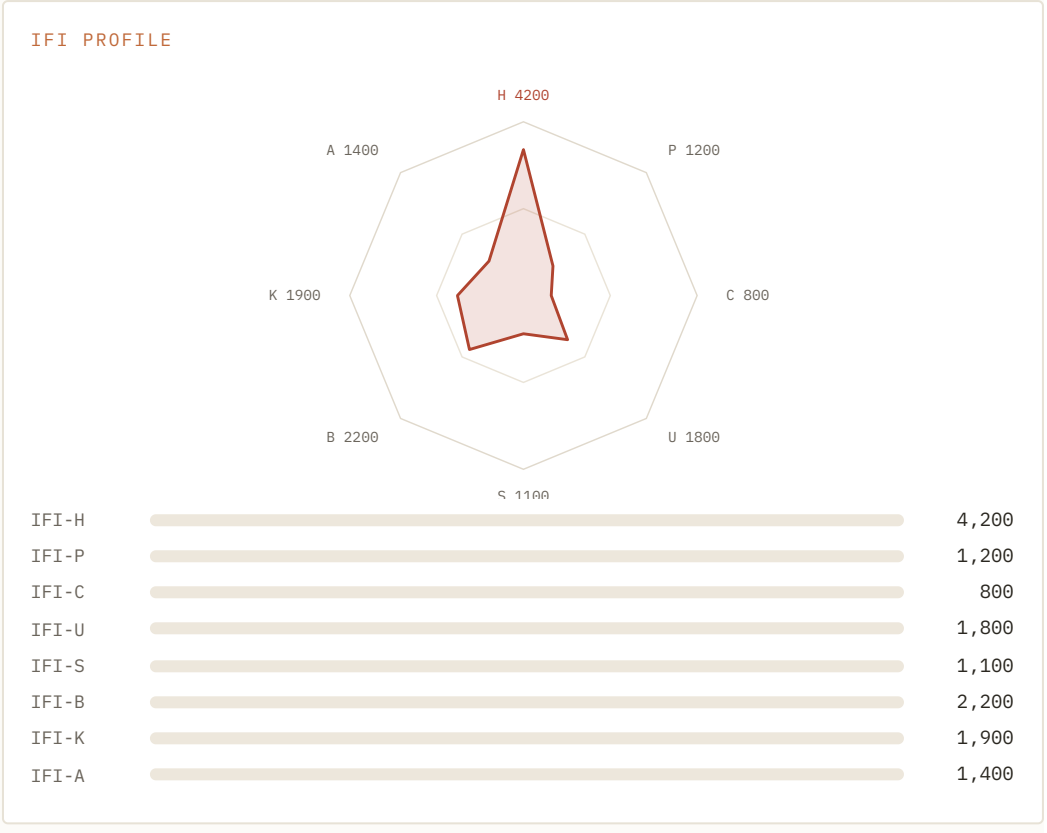
# The Blend Library

the signature · the working rack · beyond the dry jar · the jar on the shelf

# Chapter 16 · Designing a Signature — *a blend, formulated end to end.*

Here is the craft entire, in one blend. A **signature** — the jar a spice brand will put its name on, the one a griller becomes known for, the blend that is someone's whole reputation in a shaker — is designed the same way we design a cultivar: the target scorecard first, then the formula that hits it, then the discipline that makes it repeat. We will build one from nothing, naming every decision, so that the method is visible and you can run it yourself for a silhouette of your own.

Begin, as always, with the silhouette and not the ingredients. We want a signature that reads *complete* — a blend that touches every one of the eight axes at least a little, because a seasoning that reaches the whole Index reads *finished* in the way Phoenix, the only cultivar we ever built to register on all eight axes at once, reads finished. We are not matching Phoenix's numbers; a rub is a landscape and a superhot is a spire, and to make the point plainly, here is what *complete and maximal* looks like — the cultivar's real, measured, eight-axis profile:




That is a plant engineered to shout on every axis at once, every number a measured fact. Our signature borrows its *philosophy* — nothing stands alone, everything has company — and inverts its *scale*: where Phoenix is maximal, a signature is moderate; where Phoenix is a spire at IFI-H 4,200, a signature's heat is a climbable floor. We draw the target: pungency leading as the bright top (a dry blend should), the allium body full underneath it, umami under that, a

measured sweetness and a bitter-subtraction so a dark bark reads as roast, the heat laddered low, a faint astringent grip for structure, and the whole thing closed with a true trace of cool. Eight axes, every one present, none of them shouting. *Then* we open the jars, each with a job defined by a number.

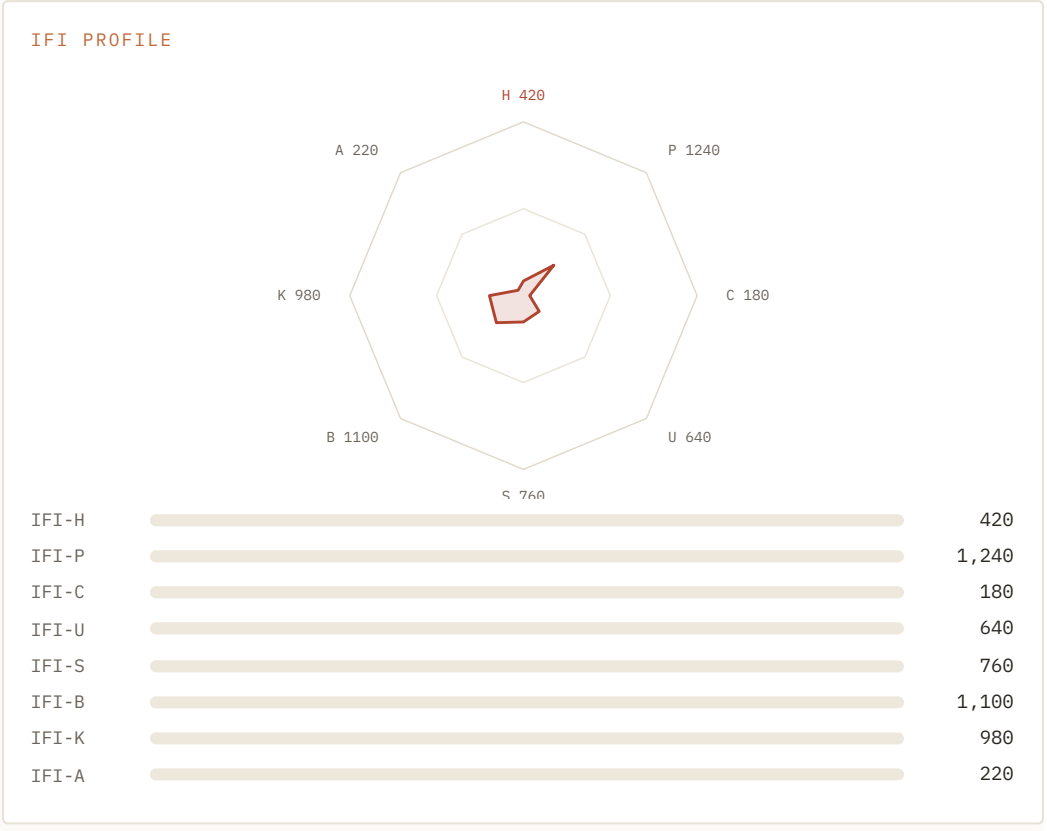
## The Eight — a House Signature

*Makes a jar · 15 minutes · the one with your name on it*

| | | |
|---|---|---|
| 3 | tbsp | granulated garlic (grown for kokumi) |
| 2 | tbsp | granulated onion |
| 2 | tbsp | sweet paprika |
| 1 | tbsp | brown mustard powder (the sharp top, sleeping until wet) |
| 2 | tsp | ground cinnamon (clean cinnamaldehyde) |
| 1 | tsp | ground ginger (dried — shogaol) |
| 2 | tsp | designed sweetener (no fermentable sugar) |
| 2 | tsp | cocoa, bitterness-attenuated |
| 1 | tbsp | flaky salt |
| 2 | tsp | cracked black pepper |
| 1 | tsp | chili, dosed to your rung |
| pinch | | dried mint (tuned for (−)-menthol), for the cool finish |

1. Build it in layers, not all at once, so you can taste the silhouette assemble: the base first (salt, garlic, onion), then the aromatic top (mustard, cinnamon, ginger), then the paprika and sweetener and cocoa, then the heat, and the single pinch of mint last of all.
2. Shake for a full minute. A balanced scorecard is, physically, a matter of even distribution — an unshaken jar seasons unevenly and the whole silhouette collapses into strata.
3. Taste a few grains on a wet fingertip before you commit to a batch. The mustard will have begun to bloom; the blend should read *sharp, then warm, then sweet*, with the heat arriving last and the mint clearing the whole thing for the next taste. If any one note wins, the silhouette is off — find the jar that overshot and take it back a gram.

### IFI readout — the finished signature



Read it beside Phoenix's profile above and the relationship is plain: the same impulse to touch every axis, at a fraction of the scale, shaped into a landscape instead of a spire. Pungency peaks, the body is full, every axis is present, nothing shouts. That is a signature.

The last discipline is the invisible one, and it is the subject of the chapter before this: **consistency.** Because every aromatic here is grown to a specification rather than foraged to a season, the batches hold to a coefficient of variation at or under seven percent — which is a technical way of saying the jar you blend next spring will season a brisket exactly the way this one did. For a spice brand that is not a nicety; it is the entire business. A signature you cannot repeat is a lucky accident. A signature scored and specified is a product with your name on it that will still be your name a thousand jars from now.

# Chapter 17 · The Working Rack — *a library of complete blends, each one scored.*

This is the chapter to cook from. What follows is a working rack — a set of complete, balanced blends across the range a real kitchen asks for, each one built on the five layers, each one scored on the Index so you can see its silhouette before you make it and taste the intention after. Every one is built on the Base Coat of Chapter 5 unless noted; every one names its heat as a rung of the ladder, so you can set it to your table. Make the ones you reach for again and again in quantity; make the fragile, herb-led ones small and often. Together they are a year of seasoning, grown to a number and shaken from a jar.

## The One Jar — an All-Purpose Seasoning

*Makes a large jar · 5 minutes · the one you keep within arm's reach of the stove*

The hardest blend to design, because it has to be good at everything and loud at nothing — the low, even ridge of Chapter 3 made real.

| | | |
|---|---|---|
| 4 | tbsp | granulated garlic |
| 3 | tbsp | granulated onion |
| 3 | tbsp | flaky salt |
| 1 | tbsp | sweet paprika |
| 1 | tbsp | cracked black pepper |
| 1 | tsp | dried thyme (thymol), crushed |
| 1 | tsp | brown mustard powder |

1. Combine and shake hard; keep the grind even so it falls evenly from a pinch.
2. Use it on everything, early and often — eggs, beans, a tray of roasting vegetables, the chicken you did not plan far enough ahead to rub properly. This is the blend that teaches your hand what *enough* feels like.
3. Make it in bulk but keep only a working jar open; store the reserve airtight so the open jar's fading volatiles are always refreshed from a loud supply.

**IFI readout** — IFI-P 780 · IFI-K 660 · IFI-U 460 · IFI-H 160. A low even ridge, nothing spiking, good on anything that meets heat.

## Steakhouse — a Coarse Grill Rub

*Makes a jar · 10 minutes · for beef — steak, chop, a thick roasted portobello*

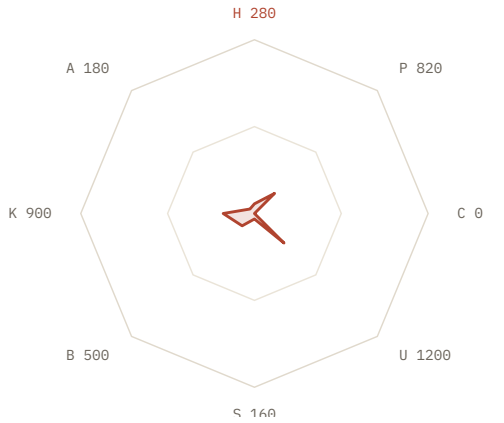
Umami-forward and deliberately coarse, built to pair with the inosinate a seared, aged cut brings to the plate; the blend supplies the grown glutamate, the meat supplies the nucleotide, and the two multiply on the tongue.

| | | |
|---|---|---|
| 3 | tbsp | the Base Coat (Chapter 5), using the coarse grind |
| 2 | tbsp | coarse cracked black pepper |
| 1 | tbsp | granulated garlic (extra) |
| 2 | tsp | restored-tomato powder (for grown glutamate, umami depth) |
| 1 | tsp | coffee, bitterness-attenuated, coarsely ground |
| 1 | tsp | chili, dosed to your rung |

1. Keep everything coarse — this is a rub for texture and crust, not a fine cure. Combine and shake.
2. Salt-forward and early: coat at least an hour ahead, overnight for a thick cut, so the salt seasons to the center and sets the surface to brown.
3. Sear hard and dark. The tomato's glutamate meets the meat's inosinate in the crust and the savory multiplies; the coarse pepper gives the bark its grain.

**IFI readout**

IFI PROFILE




| | |
|---|---|
| IFI-H | 280 |
| IFI-P | 820 |
| IFI-C | 0 |
| IFI-U | 1,200 |
| IFI-S | 160 |
| IFI-B | 500 |
| IFI-K | 900 |
| IFI-A | 180 |

## Birdsong — a Poultry & Herb Rub

*Makes a jar · 10 minutes · for chicken, turkey, roasted cauliflower steaks*

Green-led and bright, built to make a bird smell like a garden; make it small, because the herbs are the point and they fade.

| | | |
|---|---|---|
| 3 | tbsp | the Base Coat (Chapter 5) |
| 1 | tbsp | dried thyme (thymol), crushed |
| 2 | tsp | dried oregano (carvacrol), crushed |
| 2 | tsp | dried lemon zest (sourced) |
| 1 | tsp | sweet paprika |
| 1 | tsp | ground coriander (sourced) |
| ¼ | tsp | chili, Ember, ground fine |

1. Crush the herbs between your palms as you add them to wake the volatile lift.
2. Apply close to cooking — within the hour — so the green note arrives fresh; unlike the dark rubs, this one does not want an overnight rest.
3. Roast or grill; baste with fat, not water, so the lipophilic herb oils carry rather than wash away.

**IFI readout** — IFI-P 1,040 · IFI-K 560 · IFI-U 420 · IFI-A 220 · IFI-H 90. A top-note blend, all brightness and garden.

### Cool Coast — a Seafood Seasoning

*(see Chapter 12 for the full recipe and readout)* — delicate heat, citrus, and a true trace of cooling mint; the one blend in the rack built around IFI-C.

### Rooted — a Roasted-Vegetable & Grain Blend

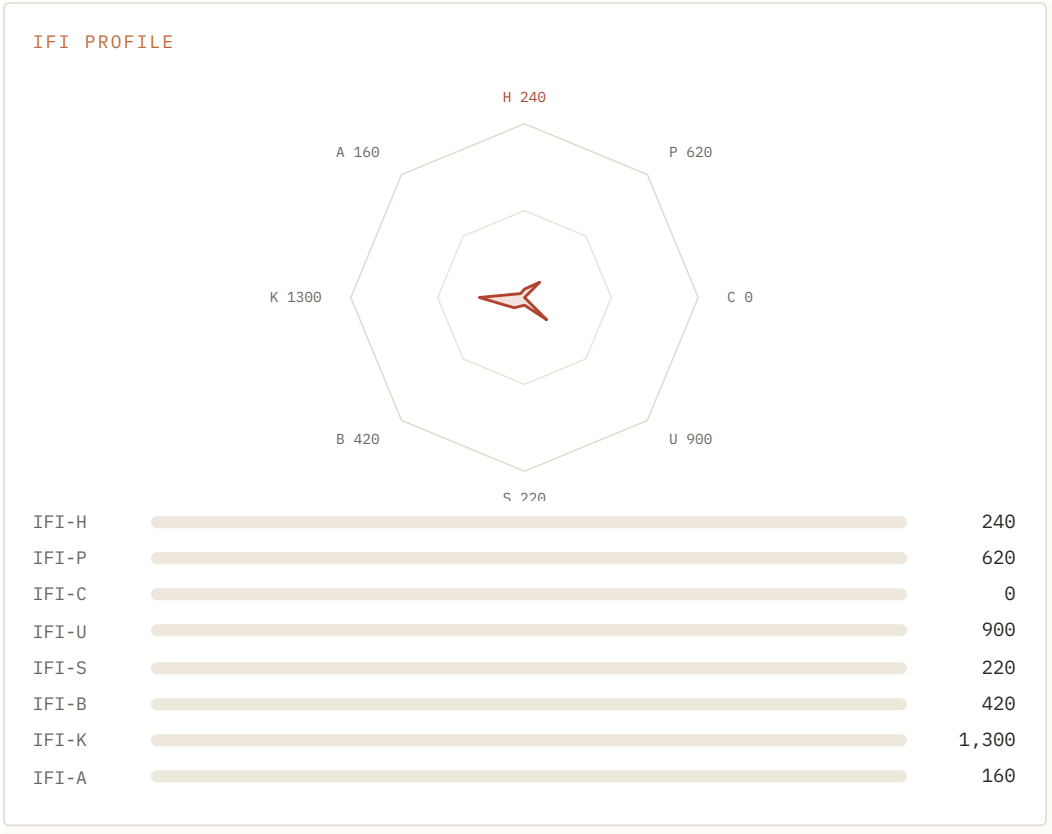
*Makes a jar · 10 minutes · for roasting roots, squash, mushrooms, and for grain bowls*

Our own table's everyday blend, vegetarian-first by habit — kokumi-forward so that plants alone read deep and round, no meat required to carry the savory.

| | | |
|---|---|---|
| 4 | tbsp | granulated garlic (grown for kokumi) |
| 2 | tbsp | granulated onion |
| 2 | tbsp | the Base Coat (Chapter 5) |
| 2 | tsp | restored-tomato powder (grown glutamate) |
| 1 | tsp | dried thyme (thymol), crushed |
| 1 | tsp | smoked paprika (sourced) |
| 1 | tsp | chili, dosed to your rung |

1. Combine and shake. This blend leans hard on the alliums because it has no meat to supply a savory floor; the kokumi peptides are doing the work a long braise would otherwise do.
2. Toss roots or mushrooms in oil, then the blend — the oil carries the lipophilic notes into the surface and helps the blend adhere and brown.
3. Roast hot. Vegetables brown through the same Maillard the meat does; a kokumi-rich blend gives that browning more to fold in, so the vegetables read as deep as a roast.

**IFI readout**




The IFI-K at 1,300 is the heart of this one — the grown-in body that lets a plate of vegetables read as satisfying as a plate of meat, which is the whole quiet argument of our table.

## Swicy — a Hot-Honey Barbecue Rub

*Makes a jar · 10 minutes · for pork, chicken wings, roasted squash, cornbread*

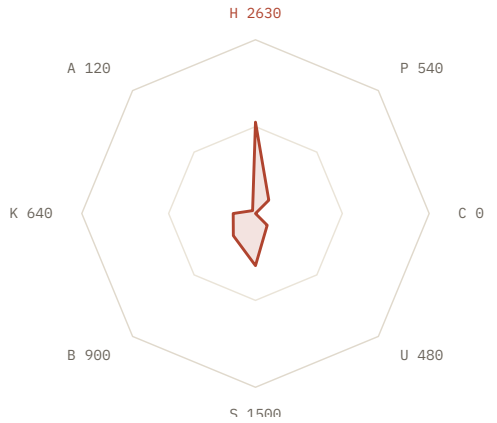
The heat-times-sweet intersection the whole category is chasing, built dry so the sweetness never scorches (Chapter 10) — a sweet-hot bark that stays sweet to the last hour.

| | | |
|---|---|---|
| 4 | tbsp | the Base Coat (Chapter 5) |
| 3 | tbsp | sweet paprika |
| 2 | tbsp | designed sweetener (no fermentable sugar) |
| 2 | tsp | smoked paprika (sourced) |
| 1 | tsp | ground ginger (dried — shogaol, for a warm bite under the sweet) |
| 1–2 | tsp | chili, dosed up a rung (Blaze for real climb) |

1. Combine and shake. The sweetener is light, so the blend pours freely; shake before each use.
2. Coat and rest; this blend likes a few hours for the heat and sweet to settle together.
3. Cook as hot and long as you like — the swicy stays bright because nothing in it is a sugar to burn.

**IFI readout**

IFI PROFILE




| | |
|---|---|
| IFI-H | 2,630 |
| IFI-P | 540 |
| IFI-C | 0 |
| IFI-U | 480 |
| IFI-S | 1,500 |
| IFI-B | 900 |
| IFI-K | 640 |
| IFI-A | 120 |

Heat and sweet lead together, a tower on two axes — this is the one blend in the rack that is closer to a spire than a landscape, because *swicy* is a statement and the statement is the point.

## Smoke Line — a Chili & Lime Taco Seasoning

*Makes a jar · 10 minutes · for beans, mushrooms, squash, any taco or bowl*

A Capsicum-forward seasoning across the mild end of the ladder, bright with citrus — the everyday heat blend, built to be eaten by the bowlful.

```
3  tbsp   the Base Coat (Chapter 5)
2  tbsp   mild ground chili (Capsicum, the gentle end)
2  tsp    ground coriander (sourced)
2  tsp    ground cumin (sourced)
2  tsp    dried lime zest (sourced)
1  tsp    smoked paprika (sourced)
1  tsp    chili, dosed to your rung for the top heat
```

1. Combine and shake. This one carries a lot of sourced partners — cumin, coriander, lime — around an engineered chili and allium core; name which is which so you can repeat it.
2. Bloom it: this is a blend that loves to be loosened in a little hot oil before it meets the food, because its heat and its cumin are lipophilic and oil carries them.
3. Cook, then finish with a second pinch raw over the top for brightness.

**IFI readout** — IFI-H 640 · IFI-P 720 · IFI-U 520 · IFI-K 560 · IFI-A 180. A bright, everyday heat, built for volume eating.

## Ember Curry — a Warm Masala-Leaning Blend

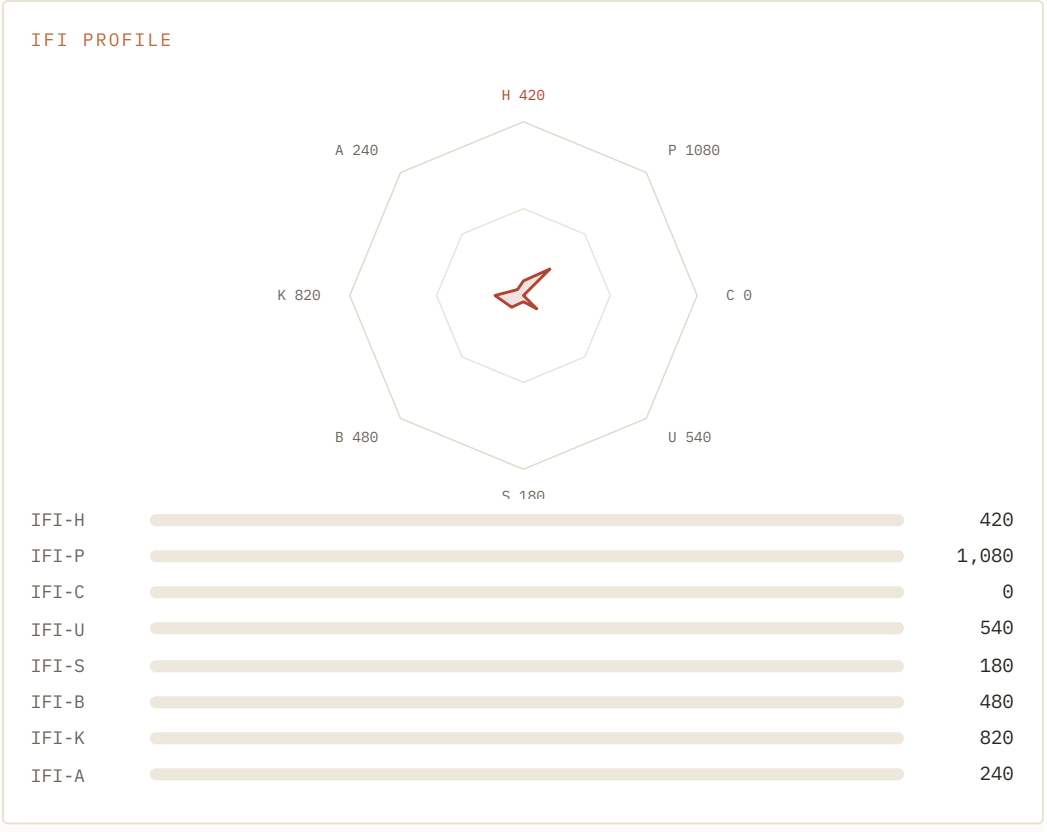
*Makes a jar · 12 minutes · for roasted vegetables, legumes, paneer, chicken*

A warm-spice blend in the key of the subcontinent's dry masalas, where a vegetarian-first cuisine has always made plants taste profound; our tuned cinnamon and ginger set the warm pungency, sourced partners give the color and complexity.

| | | |
|---|---|---|
| 3 | tbsp | the Base Coat (Chapter 5) |
| 1 | tbsp | ground coriander (sourced) |
| 2 | tsp | ground cumin (sourced) |
| 2 | tsp | ground ginger (dried — shogaol) |
| 1 | tsp | ground cinnamon (clean cinnamaldehyde) |
| 1 | tsp | ground turmeric (sourced, for color and earth) |
| ½ | tsp | ground cardamom (sourced) |
| 1–2 | tsp | chili, dosed to your rung |

1. Combine and shake well; turmeric stains, so wipe the rim.
2. Bloom in hot oil or ghee before it meets the food — a warm blend's lipophilic aromatics and its turmeric color both open in fat, and the whole blend deepens.
3. Use generously on anything roasted or simmered; this is a blend built for depth, not brightness, and it rewards a long cook.

**IFI readout**




## Island Heat — a Jerk-Style Dry Blend

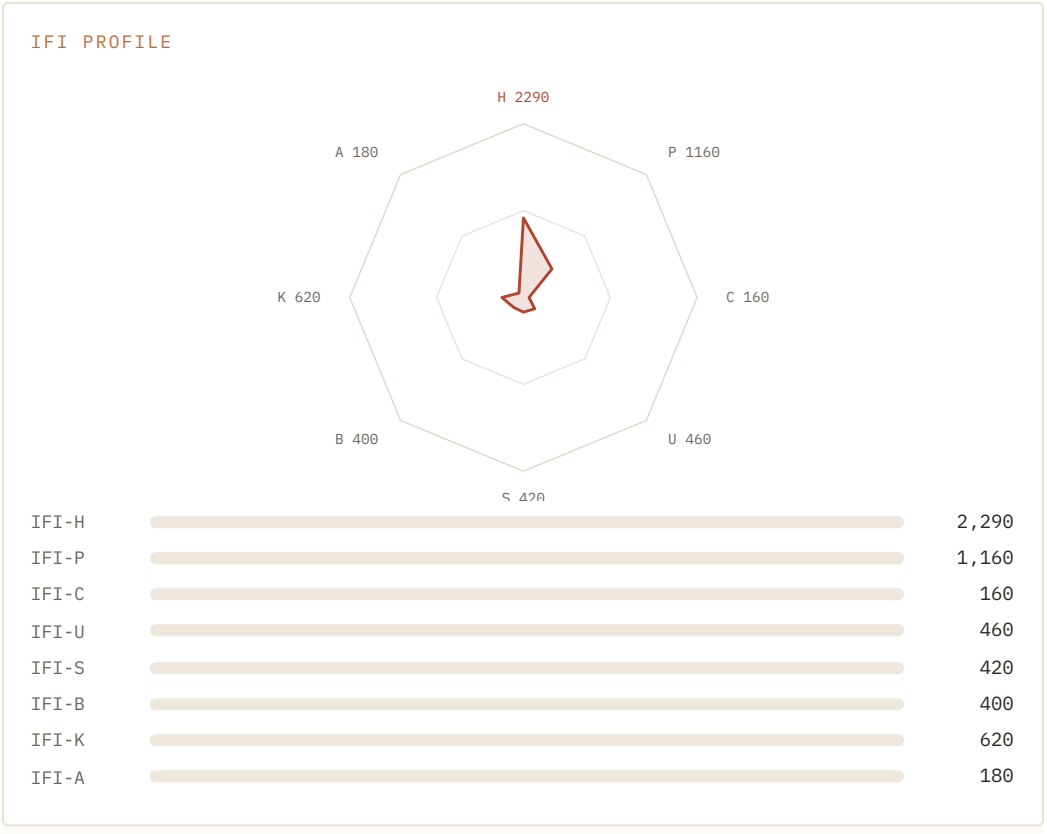
*Makes a jar · 10 minutes · for roasted sweet potato, mushrooms, chicken, pork*

The warm-hot-green intersection of a jerk, built dry — allspice and thyme against a real climb of heat, the blend that most needs its cool finish.

| | | |
|---|---|---|
| 3 | tbsp | the Base Coat (Chapter 5) |
| 1 | tbsp | dried thyme (thymol), crushed |
| 2 | tsp | ground allspice (sourced) |
| 1 | tsp | ground ginger (dried — shogaol) |
| 1 | tsp | designed sweetener (no sugar to scorch) |
| 2–3 | tsp | chili, dosed up the ladder (this blend wants heat) |
| pinch | | dried mint ((−)-menthol), for the cool finish |

1. Combine, herbs crushed, mint last and in a true pinch.
2. Coat and rest a few hours; jerk wants its spices to settle into the surface.
3. Cook dark. The cool finish is not optional here — it is what keeps a genuinely hot, warm-spiced blend from exhausting the mouth.

**IFI readout**




## Garden Red — an Italian-Leaning Dry Dust

*Makes a small jar · 8 minutes · for pizza, roasted tomatoes, white beans, focaccia*

The restraint of great simplicity, dry: tomato umami and oregano, almost nothing else, the blend that proves a silhouette need not be crowded to be complete.

| | | |
|---|---|---|
| 2 | tbsp | restored-tomato powder (grown glutamate, umami depth) |
| 2 | tbsp | dried oregano (carvacrol), crushed |
| 2 | tbsp | granulated garlic |
| 1 | tbsp | flaky salt, crushed fine |
| 1 | tsp | dried basil (sourced) |
| ½ | tsp | chili flakes (Capsicum, mild) |

1. Crush the oregano and combine; this is a dust for scattering, not a crust for pressing.
2. Scatter over anything tomato-forward before baking, or over a finished plate for a raw herbal lift.
3. Keep it small and fresh — the oregano is the voice and it fades.

**IFI readout** — IFI-U 1,100 (the restored tomato) · IFI-P 940 (the oregano) · IFI-K 520 · IFI-A 220 · IFI-H 120. Two notes and a floor, and complete for all its simplicity.

# Chapter 18 · Beyond the Dry Jar — *blooming, compound salts, and finishing dusts.*

A rub is the beginning of the dry craft, not the end of it. Once you can design a silhouette in powder, three further forms open up — and each is just the dry blend met with the physics of Chapter 13, the solubility split put to deliberate use. This short chapter is the bridge from the jar to the plate's edge: how to turn a scored blend into a paste, a salt, or a last-second dust, and when each is the right move.

**The bloom — a rub becomes a paste.** The lipophilic half of your aromatics — the capsaicinoids, the cinnamaldehyde, the thymol and carvacrol — live in fat, which means a dry blend loosened into warm oil does something the powder cannot: it *extracts* those notes into a medium that carries them evenly and deeply into a surface, and it pre-blooms the heat so it spreads rather than striking in hot points. Warm, do not fry: hold the oil below a simmer, stir in the blend, and let it steep off the heat for a few minutes until the oil is colored and fragrant. The result is a paste you can spread where a powder would only dust, ideal for a surface too wet or too smooth for a dry rub to grip, and essential for any blend whose heat you want *even* rather than *speckled.* One caution from the chemistry: do not bloom a mustard-led or watercress-led blend in oil — their sharp is water-born and water-soluble, and fat will neither extract it nor carry it. Bloom the heat and the terpenes; wake the isothiocyanates on the moist surface of the food instead.



A gloved handoff of a finished candidate between benches — the dry craft moving from powder toward preparation, the same care carried one step closer to the plate.

**The compound salt — a finishing seasoning.** Where a rub is pressed on before the fire, a compound salt is scattered after it — a coarse flaky salt carrying a measured dose of one or two loud notes, built for the moment the plate is already hot and nearly done. The craft here is the inverse of the rub's: not a full silhouette but a single clean statement, because a finishing salt is a *last word*, not a

foundation. A chili-lime salt on sweet corn. A smoked-paprika salt on roasted potatoes. A green watercress-and-lemon salt on a soft egg. Keep the salt coarse so it gives a crackle the food has not had a chance to dissolve, and keep the dose high and the palette narrow, because this is seasoning as punctuation.

**The finishing dust — a top note that fire would have spent.** The most fragile aromatics — the volatile green herbs, the peppery watercress, a raw pinch of mild chili — are wasted in a cooking rub because the fire spends them before they reach the tongue. Held back and dusted over the finished plate, they arrive at full brightness, the fresh top note a long cook can never keep. Peppercress (Chapter 8) is the archetype; a crushed-thyme-and-lemon dust is its warm cousin; a bloom of raw mild chili and citrus zest is its bright one. The rule is simple and follows straight from the volatility: if a note's whole value is its brightness, do not cook it — finish with it. A plate seasoned in two acts, a built rub under the fire and a fresh dust over it, reads with a depth and a lift at once that no single application can reach. That two-act seasoning — foundation then finish, the cooked and the raw — is the quiet summit of the dry craft, and it costs nothing but the discipline to hold the bright notes back.

# Chapter 19 · The Jar on the Shelf — *naming, allergens, and the discipline of the claim.*

A blend that leaves your kitchen for someone else's — sold, gifted, shipped — becomes a different kind of object, and the dry side has a responsibility the wet side shares: the jar must tell the truth, plainly, to a stranger who will trust it. This chapter is the one most craft books skip, and it is the one a spice brand cannot afford to. None of what follows is legal advice — rules differ by country and change, and a real product needs a real regulatory review — but the principles are stable, and they are a matter of respect for the person on the other side of the shelf.

**Name it for what it is.** A spice blend's ingredient statement lists its components in descending order by weight, which means the honest name of most rubs begins with salt and the alliums, however much the chili gets the glory. Where a term has a legal standard of identity — "chili powder," in some markets, has a defined composition — using it binds you to that standard. Our own discipline, carried from the shared Index, is to name which notes are *engineered to a specification* and which are *sourced* as classical partners: the tuned garlic, mustard, cinnamon, ginger, thyme, and Capsicum we grow to a number, against the cumin, coriander, turmeric, allspice, and black peppercorn we buy at the strength the season gives. A buyer deserves to know which is which, because it tells them what will be consistent jar to jar and what will drift.

**Declare the allergens — and mustard is one.** This is the single most important compliance fact in this entire book, and it surprises people: **mustard is a declared allergen** in a number of major markets, including the European Union and Canada, where it must be flagged on the label and cannot hide inside a blend. Celery, sesame, and others carry the same obligation in various jurisdictions. A rub is precisely the kind of product where a declarable allergen slips in unnoticed — a teaspoon of mustard powder in a barbecue blend is easy to forget on a label and dangerous to the person who reacts to it. The rule is absolute: if it is in the jar, it is on the label, in the words the law requires, every time. The consistency discipline of Chapter 15 serves this too — a blend whose composition is specified is a blend whose allergen statement you can actually stand behind.

**Most spices are GRAS; a novel ingredient is a question.** The culinary spices themselves are long-established as safe — in the United States, the common seasonings sit on the generally-recognized-as-safe lists built over decades of use. An ingredient produced by a new method, though, is not automatically covered by the history of the traditional one, and the honest posture is that a genuinely novel engineered ingredient raises a regulatory question that must be answered through the proper channel in each market

before it is sold, not assumed away. We state this plainly because the opposite — waving a new thing through on the reputation of the old — is exactly the kind of shortcut that the care in this book is meant to refuse.

**And the discipline of the claim.** Through this whole library runs a quiet value — that food should be grown to carry the most nourishment it can, and that the body should be able to draw the most from it. On a label, that value must stay a value and never become a *claim.* We do not write that a blend cures, detoxifies, heals, or prevents anything, because those are claims a seasoning has no business making and a regulator is right to forbid. What a label may honestly carry are *attributes* — no added sugar, where the designed sweetness makes it true; the named botanicals; the absence of what is genuinely absent. The line is bright and we hold it hard: describe what the jar *is*, never what it will *do* to the person who eats from it. The nourishment is real, and it is an intention written into how the plant is grown — but on the shelf it is expressed as honesty about the ingredient, not as a promise about the body. That restraint is not a limitation on the craft. It is the final form of the same respect that made us measure anything at all.

# Chapter 20 · A closing note — *what a blend is for.*

We have spent a whole book on powder. On the sharp that sleeps until it is wet and the savory floor you can grow and shake from a jar; on the heat you can specify to the single grain and the sweetness that will not scorch; on the warm pungency that drying turns from one molecule into another, the green lift that fades by the month, the cool breath held back for the very end. We have drawn silhouettes and named receptors, run the glucosinolate engine and the menthol pathway, done the arithmetic of a coefficient of variation and the chemistry of a crust. It can start to sound like engineering, and it is. But stand at the counter mixing a jar and you remember what the engineering is in service of: a palm pressing a dry blend into a surface, the smell of the whole spice drawer rising as the mustard begins to wake, a crust forming on the fire that tastes exactly the way you meant it to.

That is the thing the numbers are for. Not to replace the pleasure of the drawer — we revere that drawer, we grew up in front of one — but to make the pleasure *repeatable*, to turn a lucky pinch into a promise you can keep for the people you feed, again and again, the same every time. A blend scored on the Index is not a colder thing than a blend mixed by feel. It is a warmer one, because it can be given faithfully: the bark a child loves, made identically a hundred times; the rub a griller is known for, standing behind a name a thousand jars deep; the vegetable plate at our own table that reads as deep and satisfying as any roast, carried there by a kokumi we grew into a clove. The measuring was always in service of the giving.



The family's greenhouse at dusk — the plants the whole book is really about, grown with reverence toward the fullest flavor and the fullest nourishment they can carry.

There is a last thing we think about, and never put on a label, because it is a value and not a claim. An aromatic grown toward its fullest flavor — the thyme toward its thymol, the garlic toward its peptides, the chili toward a heat you can taste all the way through — is almost always a plant grown toward its fullest self, carrying more of what a plant is for. We season for pleasure first; the blend is how a plain thing becomes a thing someone finishes gladly, on a brisket

for the people who love meat and on a thick-cut cauliflower for the people at our own table, the same care given to both and an apology owed to neither. But the powder in that jar is a stand of plants at work — grown on purpose, measured with respect, pressed on with intention, feeding the people you cook for. That was always the reason to measure any of it.

Build the blend. Keep the jar. Feed your people well.

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