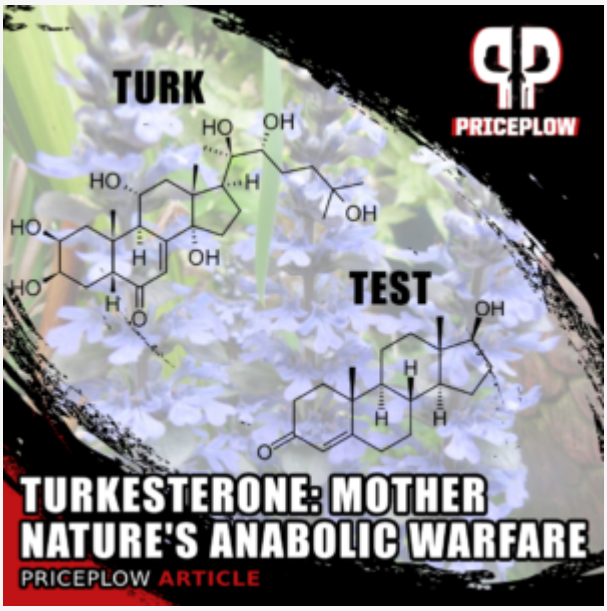
Turkesterone and Phytoecdysteroids: Mother Nature’s Anabolic Warfare

written by Mike Roberto | March 17, 2022

You’ve probably noticed that a plant-based anabolic compound called *turkesterone* is taking the supplement industry by storm lately. We recently covered the massively successful launch of *Anabolic Warfare’s Project Muscle*, which has a few different supplements containing the ingredient.

As is usually the case with trends in supplementation, the sudden popularity of turkesterone has sparked *fierce* controversy, with passionate proponents and equally passionate detractors doing rhetorical battle over the question of how to interpret a pretty small body of turkesterone-related research.



Everyone’s been talking about TURKESTERONE lately, and after Anabolic Warfare released Project Muscle, we decided to do a deep dive on it, along with other phytoecdysteroids like ecdysterone. We dug up some studies that nobody else has referenced, many of them going back to the Soviet era. Many think turkesterone overhyped, but the truth is that the data available is MORE impressive than we realized, sometimes outperforming certain steroids.

Combined with ecdysterone, there definitely seems to be serious anabolic potential, and both are found in the ajuga turkestanica plant, so we’d love to see supplement lab tests showing both of those. The biggest question is whether it binds to the androgen receptor or causes a negative feedback loop. For that, we’ll need before and after blood tests.

PricePlow likes to do a “special topic” article every once in a while on trends like this in the supplement space, so today we’re going to take a look at **turkesterone** – what it is, what it isn’t, and the current state of the scientific literature on this subject.

An introduction to Phyto*androgens*

Most of us are familiar with the concept of a "phytoestrogen," but much less has been said about *phytoandrogens*. In foods like pine pollen and spinach, there are phytonutrients analogous to *testosterone* – which, like testosterone, are thought by *some* to have similar effects such as promoting libido and lean mass gain, and assisting in the management of stress.

One of these phytoandrogens is making waves right now, riding on huge claims being made about its anabolic properties. Known as **turkesterone**, this molecule falls into a class of molecules called *ecdysteroids*, from the Greek *ékdusis* meaning "shedding" and the English *steroid*, a word which surely needs no introduction. The concept of a "shedding steroid" comes from the function of ecdysteroids in *insects*, which is to induce molting and the growth of a new outer shell.[1]

However, as we'll see, ecdysteroids are not *really* androgens. Although they have anabolic effects *like* androgens, they do *not* act on androgen receptors or androgen pathways.[2,3]

In fact, ecdysteroids don't just govern molting – they regulate *all* the development and reproduction of plants (where they are called *phyto*ecdysteroids) and insects.

The million-dollar question we'll be examining today is: does the ecdysterone *turkesterone* have the anabolic, pro-metabolic effects it's claimed to have?

Phytoecdysteroids: a primer

> The first thing to notice about phytoecdysteroids is that they are synthesized by plants from *cholesterol*[4] (yes, plants use cholesterol) – a fact that will cause any student of testosterone to perk up their ears. As most of us probably know, *our* testosterone is also synthesized from cholesterol,[5] so right away we should be thinking that we're in "hormone territory".
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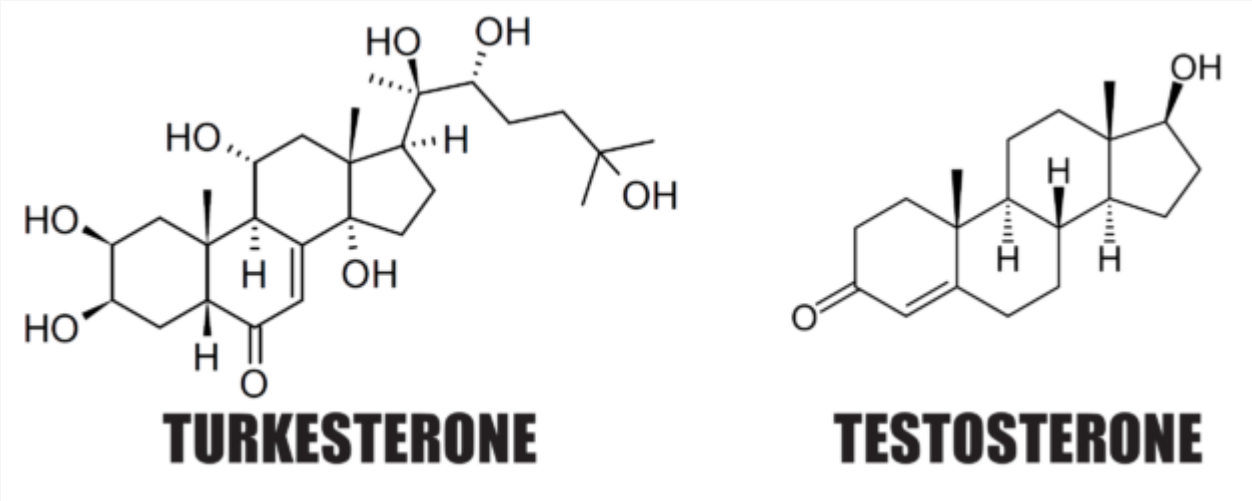
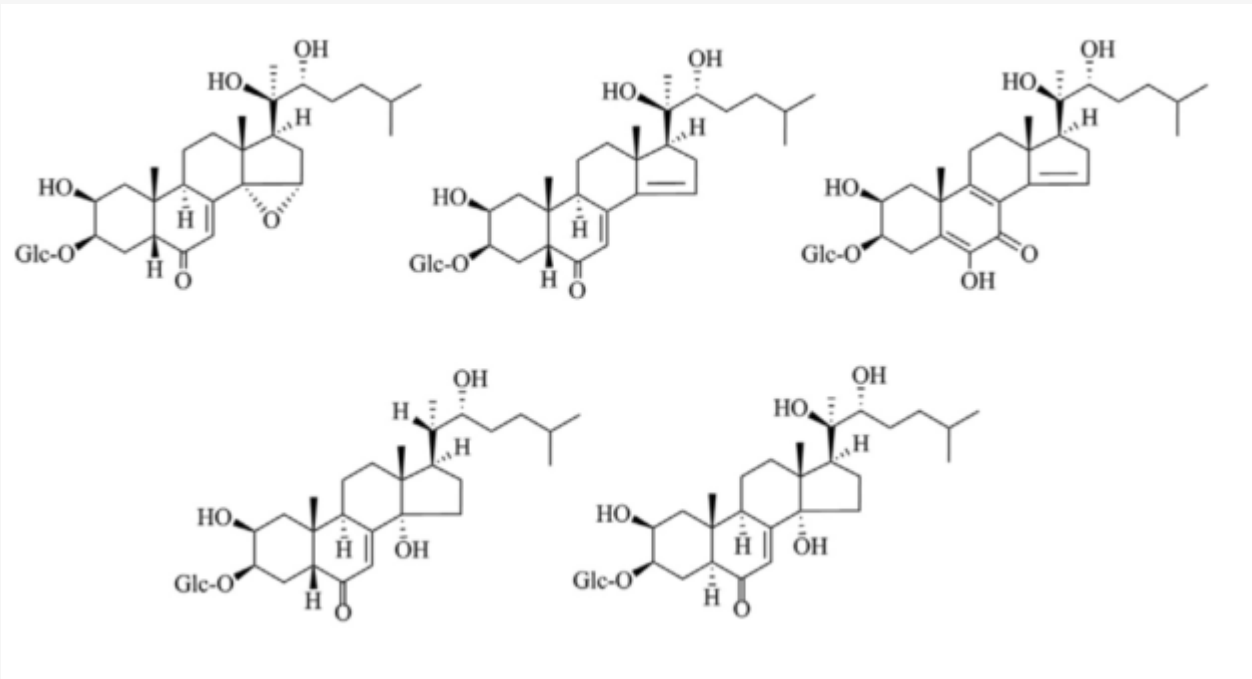
> Things get even more interesting when we compare the structure of *turkesterone* to that of testosterone:



The molecular structures of Turkesterone and Testosterone

There are *many* kinds of phytoecdysteroids – literally dozens, if not hundreds. In the *Blechnaceae* family of ferns alone, there are at least *five* different ecdysteroids, each with a distinct (but very similar) chemical formula, yet one basic commonality: a structure based on four carbon rings with hydroxyl and ketone groups at or near certain key positions.



Phytoecdysteroids from the Blechnaceae family of ferns[4]

Note on a key difference between androgens and phytoecdysteroids

The putative health benefits of *phytoestrogens* come from the fact that they are able to *interfere* with the actions of other estrogens, by occupying the estrogen receptor and thus "displacing" *stronger* forms of estrogen.[2,6]

Naively, we would probably expect the same to be true of phytoecdysteroids: because of their anabolic effects, we might be tempted to consider them to be *androgens*, and to act on *androgenic* receptors.

However, this is *not necessarily* the case. There's a pretty large body of research showing that the most well-studied phytoecdysteroid, ecdysterone (also known as 20HE) **exert its anabolic effects by occupying certain *estrogen* receptors**.[2,7]

Here's a direct quote from Parr, 2015[2] –

> *"Conversely to anabolic-androgenic steroids (AAS) that increase muscle mass mainly through their binding to the androgen receptor (AR), no nuclear receptor that is homologous to the ecdysone nuclear receptor found in insects has yet been described in mammals so far.[8] Only recently, binding of ecdysterone to the human ERβ (ED50 = 13 nM) could be shown in cell culture experiments and induction of hypertrophy in C2C12 cells was shown to be mediated by the ERβ activation"[2]*

Note that *"ERβ"* refers to *estrogen-receptor beta*.

Although the various forms of estrogen get a bad rap in an age where xenoestrogenic compounds abound, and *estrogen dominance* is an emerging public health concern,[9] *estradiol* and other mammalian estrogens do have certain masculinizing effects, and benefits for human health in general – this can be seen in research showing that the stimulation of *estrogen-receptor beta*, even with estrogens, can increase skeletal muscle synthesis.[10]

Ajuga Turkestanica is a powerful plant with *numerous* phytoecdysteroids inside. Image courtesy Wikimedia Commons

We should also think about what it means when phytoecdysteroids, which do not have any significant estrogenic activity, occupy estrogen receptors instead of estrogen itself. Theoretically, this should reduce the overall estrogenic burden of the body. And in fact, rats that take certain phytoecdysteroids do show lower levels of serum estrogen.[11] Presumably, this is because stimulating the estrogen receptors causes negative feedback, downregulating the production of endogenous estrogens. But to our knowledge, no research study has examined this question yet, so take our speculation with a grain of salt.

Perhaps the biggest advantage phytoecdysteroids have over traditional AAS compounds is that because many do not interact with androgen receptors (ARs),[2,3] supplementing with phytoecdysteroids will *not necessarily* cause the unwanted side effects that are typically associated with AAS use, such as downregulation of endogenous testosterone production through negative feedback, or increased estrogen levels from aromatase acting on the surplus androgens.

In both animal models and human studies, it has been shown repeatedly that phytoecdysteroids do not alter serum testosterone levels, or any other aspect of the *endocrine* system.[12]

Phytoecdysteroid Research

Since turkesterone is a *type* of phytoecdysteroid, we can give ourselves a

little background by briefly looking at research into other phytoecdysteroids.

This is especially useful because although there hasn't been *much* research on turkesterone specifically, there has been a lot of research on other phytoecdysteroids, ecdysterone (20HE) being probably the most extensively-studied.

Ever since Soviet bodybuilders were suspected of using 20HE as a doping agent in the 1980s,[2] scientists have been interested in discovering whether this compound and its relatives are as effective as the rumors suggest.

Please note that ecdysterone goes by several names – it is also referred to as 20-Hydroxyecdysone (20HE or 20E) or simply "ecdy" for short. A great review on 20-Hydroxyecdysone concluded that *"20E shows many beneficial pharmaceutical effects in mammals and is non-toxic"* and is worth reading.[13]

Phytoecdysteroids as Anabolic Compounds

Much of the research has been done with *in vivo* models, and the results have been generally positive.

In one study from 2019, researchers gave rats a preparation of *ecdysterone* (also known as 20HE or ecdy) a specific phytoecdysteroid found in *spinach* as well as other plants,[14] and concluded that ecdy had significant anabolic effects, increasing muscle fiber size in the rats as well as IGF-1,[7] a known and potent anabolic growth factor.[11] This reproduced effects that had already been seen in the late 1990s by Russian researchers.[15]

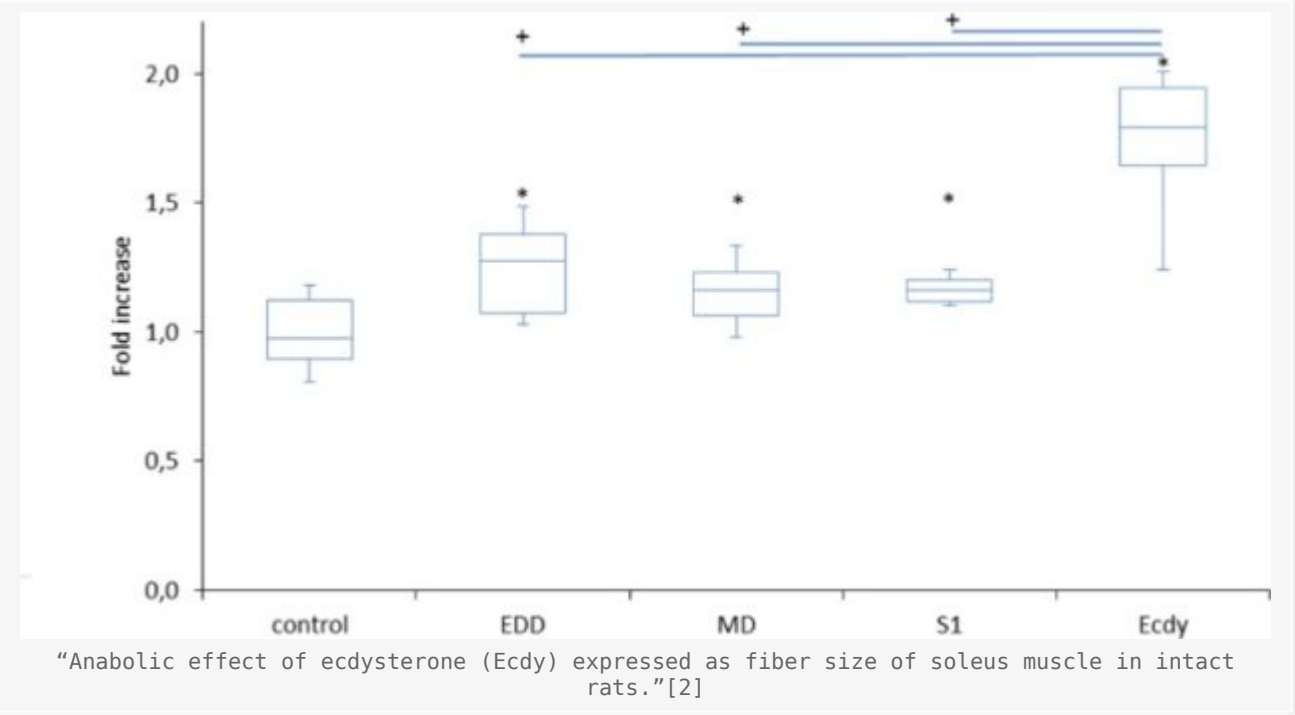
The result was, amazingly, that ecdysterone outperformed the traditional AAS drugs.

Interestingly, this study also showed that ecdy *decreases* serum estradiol (estrogen) levels – meaning that ecdy doesn't *just* displace estrogen at the receptor, it also has some kind of *directly anti-estrogen* effect. The researchers in this study were also able to corroborate the idea that phytoecdysteroid action takes place in *estrogen* receptors – they were able to antagonize the action of ecdy with an *anti-estrogen* drug, but *not* an anti-androgen drug.[11]

In another animal model, this one from 2015, researchers gave Wistar rats a *variety* of anabolic drugs alongside ecdysterone (ecdy), including some heavy-hitter androgenic anabolic steroids. In this study, all the drugs (including ecdy) were given to the rats in the same dose (5 mg/kg of body weight per day), along with an inert control. Given that these compounds are all close analogs of each other (except for the SARM), using the same dose for each makes sense: you are trying to figure out which is the *most* anabolic pound-

for-pound, after all.[2]

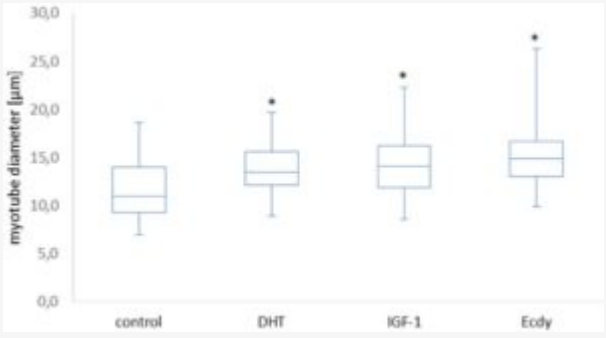
The result was, *amazingly*, that ***ecdysterone outperformed the traditional AAS drugs***. Rats who were given ecdy showed *nearly a two-fold increase* in the thickness of their soleus muscle – way above and beyond what estradienedione (EDD), metandienone (MD) and SARM S 1 (S1) were capable of achieving.[2]



"Anabolic effect of ecdysterone (Ecdy) expressed as fiber size of soleus muscle in intact rats."[2]

This is a remarkable finding, because all three of the active drugs being compared to ecdy are such powerful anabolic compounds that they're all banned by the World Anti-Doping Agency (WADA) for use in athletic competitions.

In fact, you might recognize estradienedione and metandienone by their more common names: *tren* and *dbol*.



The effects of DHT, IGF-1, and ecdysterone (Ecdy) on the diameter of C2C12 myotubes.[2]

That's right. In rats, ecdysterone was *more anabolic than dbol and tren*. And ecdy didn't outperform them by a little bit – it outperformed them by a *lot*.

The researchers who performed this study conclude their paper by writing that

"with respect to doping prevention the high anabolic potency of ecdysterone justifies its classification as an anabolic agent and therefore needs to be listed in the category "S1 Anabolic Agents" of the list of prohibited substances of the World Anti-Doping Agency."[2]

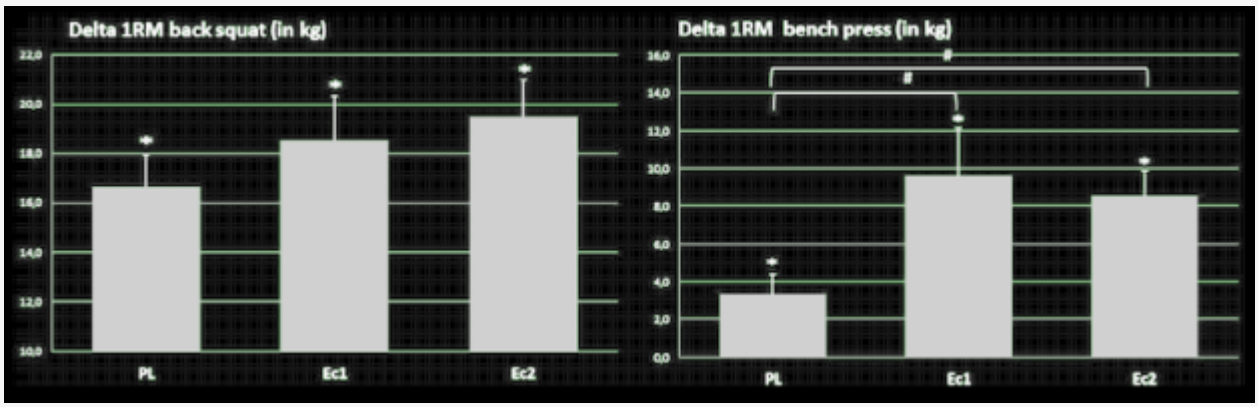
You know it's good when scientists are recommending that WADA ban it.

2019: Additional Human Research on collegiate athletes

Animal models are great, but what about *humans?* Can these results be replicated in people who are training under real-world conditions?

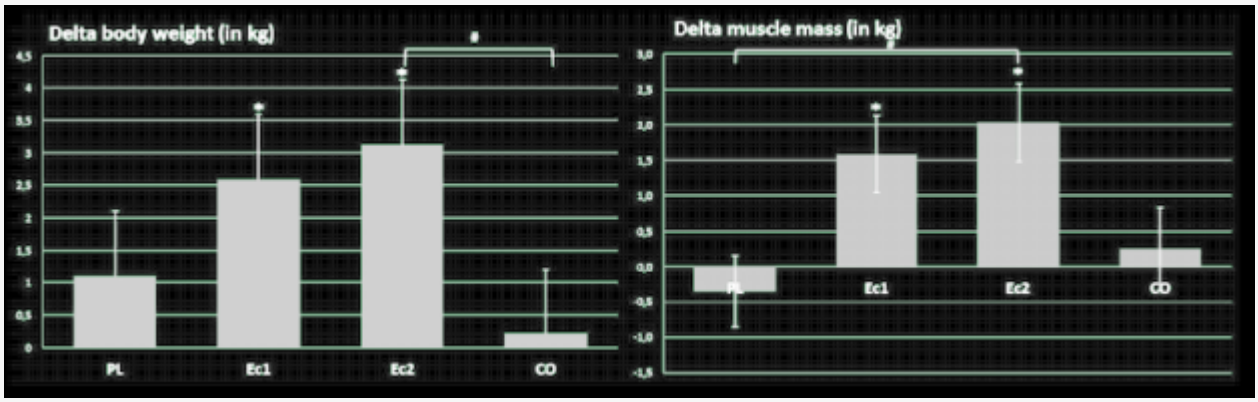
A team of German researchers set out to answer this question in 2019. They divided collegiate male weightlifters into four groups: a placebo-controlled group, a *first* ecdysterone group, a *second* ecdysterone group, and a control group. The placebo group and the two ecdysterone groups all undertook the same regimen of barbell strength training focused on compound movements, the difference between the ecdysterone groups being the size of the dose: ecdysterone group #2 took four times the amount as group #1.

The control group took ecdysterone *without* training.



Ecdysterone increased strength gains in collegiate male weightlifters[12]

While all three training groups increased their 1 rep maximums on back squats and bench presses, the ecdysterone groups saw significantly greater gains than the placebo group.



Ecdysterone increased muscle mass gains in collegiate male weightlifters[12]

The effects of ecdysterone on *mass* were similar: groups taking ecdysterone gained significantly more muscle mass than either the placebo group or the control group.

We wish there were more to write about this study, but there isn't. It's cut and dry: ecdysterone has significant anabolic effects in human males undergoing resistance training. The researchers behind this study conclude, similarly to the team whose study we discussed above, that *"This project demonstrates the performance-enhancing e□ect of ecdysterone in humans. Thus, our results strongly suggest including ecdysterone in class S1 "Anabolic Agents"*.[12]

Caution to drug-tested athletes: likely to get banned by WADA

Athletes should take note of this: it is possible that at some point in the near future, WADA will take action against phytoecdysteroids. Don't assume that something you can take today will remain permissible in the future: stay up to date on current trends and regulations.

You know it's good when scientists are recommending that WADA ban it.

Phytoecdysteroids as Adaptogens

But there's more to muscle growth than directly stimulating muscle protein synthesis through ER-beta activity. There are many other factors in the gains you'll get from your training, including but not limited to your stress hormone levels and your energy levels. Phytoecdysteroids can potentially help improve those factors.

Effects on the Central Nervous System

The next wave of warfare is here from Austin, TX based *Anabolic Warfare* – **Project Muscle**! Inside we introduce the *eleven* incredibly unique supplements, three of which lean on epic anabolic plant-based ingredient, *turkesterone*.

Ecdysterone (20E) was identified decades ago as a compound that can increase the activity of *glutamic decarboxylase*, the enzyme that convert *glutamate* to *gamma-Aminobutyric acid*, also known as GABA.[16] Since GABA plays a central role in restful sleep,[17] which is the foundation of of athletic recovery, anyone who's training hard wants to ensure that their GABA pathways are functioning at peak efficiency.

In rats, 20E also has been shown to increase the activity of *acetylcholinesterase*,[18] the enzyme that breaks down acetylcholine.

What GABA and acetylcholinesterase have in common is their *parasympathetic activity* – they "put the brakes" on the sympathetic nervous system, shifting the body and the brain from "vigilance" mode to "recovery" mode. Thus the parasympathetic activity of ecdysterone can help explain why the phytoecdysteroids are considered to have "adaptogenic" or "anti-stress" effects.

Effects on the Liver

In animal models where liver damage is pharmaceutically induced, ecdysterone and other phytoecdysteroids have been observed to accelerate healing,[19,20] or to prevent liver damage when used as a pre-treatment before the administration of a liver-damaging substance.[21]

Given the association between impaired liver function and low testosterone,[22,23] anyone who's trying to maximize their anabolic response should be interested in protecting their liver. And if you have liver injuries from using you-know-what, phytoecdysteroids might be able to help.

Effects on Immunity

Low serum concentrations of phytoecdysteroids can activate human lymphocytes[24] and T-cells,[25] which should directly increase the function of the immune system.

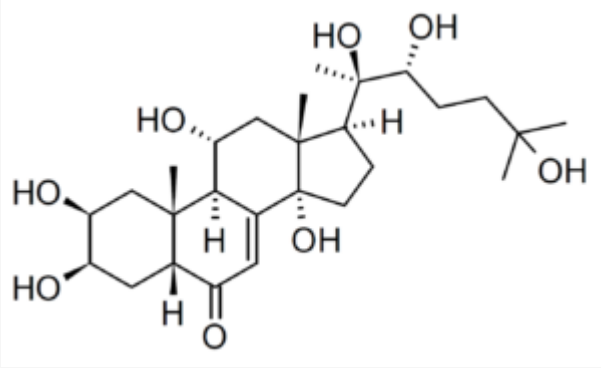
As discussed above, phytoecdysteroids have direct anti-estrogenic activity, which as been demonstrated by decreases in serum estrogen among rats who take them.[11]

Lowering estrogen levels is well and good, but we should also ask whether this can have any clinical significance. There's reason to believe the answer to this question is probably *yes:* phytoecdysteroids have been shown to inhibit the growth of estrogen-dependent breast cancer cells *in vitro*.[26]

Turkesterone: the evidence

The first question we have to ask is: *what is turkesterone?*

Strictly speaking, turkesterone is a *specific* phytoecdysteroid found in the plant *Ajuga turkestanica*. Importantly, it is *not* the *only* phytoecdysteroid derived from that plant. *Ecdysterone* among others is also found in *A. turkestanica*, which is part of the reason we discussed ecdysterone extensively above: **many supplements *marketed* as "turkesterone" are not *pure turkesterone*, but rather an *extract* of *the plant A. turkestanica*. This extract contains *both* ecdysterone (also known as 20-Hydroxyecdysone)[27] and turkesterone.[27]**



Turkesterone

In fact, there are at least *eight* (8) different phytoecdysteroid compounds contained in *A. turkestanica*.[27] As we discussed earlier, there are literally hundreds of different phytoecdysteroid compounds that have been identified by science, all with closely analogous structure and function.[4] The other six phytoecdysteroids in *A. turkestanica* probably have anabolic effects resembling those of turkesterone and ecdysterone – probably – but unfortunately, discussing all eight is beyond the scope of this article.

But since we know from our foregoing discussion that ecdysterone is a powerful anabolic and adaptogenic substance, it should be pretty obvious that using an

ecdysterone-containing extract of the plant, rather than pure turkesterone, is not necessarily a bad thing.

Turkesterone is *very* similar in formula and structure to ecdysterone – researchers who study it describe it as an *analog* of ecdysterone.[27,28] We saw in our above discussion of ecdysterone research that ecdysterone outperformed the anabolic effects of dbol in a rat model. So now you're probably all asking the same question: *can turkesterone deliver those kinds of results?*

In a 1998 study from the Uzbekistan Academy of Sciences, researchers put two different preparations of turkesterone (isolated from different parts of the *A. turkestanica* plant) head-to-head with *methandrostenolone*, another form of the AAS *dbol*.[29]

The results were downright astonishing. *Both* preparations of turkesterone performed as well as *dbol* at increasing the body mass and organ size of the rats that took them.[29]

TABLE 2. Influence of the Substances Investigated on the Weights of Organs and on their Protein Contents in Intact Sexually Immature Rats ($M \pm m$, $n = 6$-8)

Organ	Nature of the experiment	Weight of the organ, mg	Protein content of the organ	
			%	mg
Liver	Control	4586± 268	17.2±0.38	788±46.0
	Turkesterone, sample I	5862±218*	17.8±0.40	1043±62.4*
	Turkesterone, sample II	5744±224*	17.6±0.36	1010±58.8*
	Nerobol	5698±216*	17.6±0.38	1002±42.8*
Heart	Control	388±16.0	16.2±0.40	62.8±3.8
	Turkesterone, sample I	482±12.0*	17.4±0.62	84.6±5.6*
	Turkesterone, sample II	486±12.8*	17.0±0.64	81.9±4.2*
	Nerobol	490±14.6*	17.6±0.56	86.2±5.8*
Kidneys	Control	396±13.4	15.9±0.70	62.9±3.8
	Turkesterone, sample I	520±24.8*	17.2±0.88	89.4±4.8*
	Turkesterone, sample II	530±26.0*	17.2±0.82	91.2±5.2*
	Nerobol	544±25.8*	17.4±0.86	94.6±6.0*
Tibialis anterior muscle	Control	168±8.8	17.8±0.14	29.9±1.2
	Turkesterone, sample I	220±10.2*	18.2±0.78	40.0±2.6
	Turkesterone, sample II	216±9.2*	18.0±0.80	38.8±2.8*
	Nerobol	228±10.4*	18.6±0.82	42.4±3.2*

The anabolic effects of turkesterone were greater than those of dbol in rats![29]

The anabolic effects of turkesterone were greater than those of dbol in rats.[29]

These numbers speak for themselves – again, dbol is a mainstay AAS among bodybuilders, famed for its incredible anabolic effects, so the discovery that a safe, plant-derived compound without any of the traditional AAS side effects could *match* it is potentially revolutionary.

Negative Turkesterone Studies

Of course, whenever we get such an amazing result from a study, we have to ask ourselves: is it too good to be true? Can it be replicated?

Unfortunately, because turkesterone research is in its infancy, there's not a very large sample set of research studies that we can use to make generalizations about whether turkesterone works.

With that in mind, we would like to discuss one study, with a similar design, that had a result contrary to the one we just finished discussing above.

In this study, researchers gave a group of elderly rats (20 months old, the equivalent of about 60 human years) a solution of 5.85% turkesterone, and tracked changes in their muscle tissue over time.[30] Another experimental group received ecdy/20HE, which we've discussed extensively above. Their goal was to establish whether the phytoecdysteroids' putative anabolic effects would be strong enough to offset age-related muscle loss (sarcopenia).

Unfortunately, these researchers found that compared to an age-matched control group, the rats that got the turkesterone solution showed no significant difference in their progression of sarcopenia.[30]

Before we get too disappointed, there are a couple of things to keep in mind:

first, the study where turkesterone outperformed dbol was done in *sexually immature rats*.[29] It could very well be the case that turkesterone and ecdy have pronounced anabolic effects in relatively *young* organisms, but not old ones.

Another thing to note about this study is that it was done in *sedentary* mice – the mouse study where 20HE thickened the soleus fibers was designed to *actively* stimulate the muscle being studied. In other words, it could be the case that the phytoecdysteroids *do* have anabolic effects in aging muscle, but require *muscle stimulation* (resistance training) for those effects to be triggered.

Still, we can't say for sure – turkesterone studies are few and far between, and although ecdysterone is better-studied, there still needs to be a lot more research done. Until then, this is all just speculation.

The Safety Profile and Dosing of Phytoecdysteroids

Put simply, in none of the animal or human studies we've discussed did researchers observe any adverse effects caused by phytoecdysteroid supplementation.

- In the German study of collegiate weightlifters – a study where ecdysterone was given in a clinically significant dose, leading to significant gains in lean mass and strength – researchers concluded that *"side effects that are explicitly attributable to ecdysterone supplementation could not be demonstrated."*[12]
- A 2020 research review on dietary phytoecdysteroids also states that *"…ecdysteroids are regarded as nontoxic to mammals. Also, no effects were seen after the administration of these two ecdysteroids to bullfrogs or rabbits."*[31]
- A 2003 research review points out that *"ecdysteroids have a very low toxicity (LD50 > 6g/kg), they are not hypertensive and, in spite of their anabolic action, they would have neither androgenic nor oestrogenic (or antioestrogenic) effects."*[32]

> *"20E shows many beneficial pharmaceutical effects in mammals and is non-toxic"[13]*

However, absence of evidence is not evidence of absence. Be smart, don't go overboard – stick to the manufacturer's recommended dose, and look for supplements with third-party lab tests published.

It goes without saying on this one: get your nutrient-dense, high-protein red meat in!!

Also don't take unnecessary risks with high doses – if the German weightlifting study is any indication, the gains from increasing the dose of phytoecdysteroids was *not* linearly dose-dependent. Recall that in that study, ecdysterone group #2 took *4x* the dose of ecdy group #1, but didn't show significantly greater gains in strength or size compared to group #1.[12] There seems to be a law of diminishing returns.

A special word of caution about turkesterone

Although we've seen from our foregoing discussion that *some* phytoecdysteroids (i.e. ecdysterone/20HE/ecdy) have anabolic effects *without* binding to the androgen receptor, this is *not* the case with turkesterone.

There is some dispute that we are still chasing down. One industry researcher has claimed that a study *has* actually shown that turkesterone (the molecule, as opposed to the whole-plant extract of *A. turkestanica*) *does* have affinity for the androgen receptor, which is contrary to everything you'll read online. We're still looking for that citation.

This could imply that turkesterone *might* actually cause some negative feedback in the testosterone-synthesis pathway, ultimately downregulating the body's endogenous production of testosterone, in much the same way that anabolic steroids can if not used and cycled properly. As a counterpoint, note that there are many naturally-occurring compounds that bind to the AR (as well as ER and CR) that don't cause feedback loops – they simply just activate the enzyme.

Again, there's simply not enough evidence to say that which is the case – *but there's also not enough evidence to rule it out*. Nor is there enough evidence to say where the line between a harmless and a PCT-requiring dose might be.

Be safe: see a doctor and get blood work

Ultimately, consulting with a doctor while getting lab tests before and after supplementation is the smartest plan. The lab tests we'd be most interested in seeing are the following:

Best way to find out? Blood tests! Who’s up for some?

- Free *and* Total Testosterone
- SHBG (Sex Hormone Binding Globulin)
- LH (Luteinizing Hormone) and FSH (Follicle Stimulating Hormone)
- Estradiol
- Hematocrit and Red Blood Cell Count (RBC) (these are generally provided in a CBC with Differential Blood Test)
- Lipid Panel

The majority of these can be had through a male hormone panel, lipid panel, and CBC, but estradiol may have to come separately.

So use your judgment, and if you’re worried about this, you can consider opting for a pure preparation of *ecdysterone* instead of turkesterone.

Where can I get well-tested turkesterone?

As mentioned in the introduction, **Anabolic Warfare Project Muscle** is what really brought us to turkesterone. It includes a few supplements containing the ingredient that you can read about in our article titled *Anabolic Warfare Project Muscle Kicks Off with HULKing Success*.

Moving forward, this area will include supplements from trusted and reliable manufacturers that provide third-party lab tests. We’re interested in seeing lab tests that include not only turkesterone, but *ecdysterone* content as well. Extracts that include *both* may be most powerful.

Conclusion: There’s definitely something here

The idea that *some* phytoecdysteroids could deliver the primary benefits of

anabolic steroids, potentially with virtually none of the drawbacks, sounds too good to be true – but that is what the (very preliminary) research literature on the subject currently indicates.

Granted, the public research on this topic is still in its infancy, at least when it comes to pure turkesterone. There are some extremely promising animal studies on pure turkesterone, but the evidentiary support for its use is not as robust as that of ecdysterone.

Plus, there are some lingering safety questions about pure turkesterone and its effects on the androgen system. Turkesterone, unlike ecdysterone, *might* have negative effects on androgen synthesis – we need to see more research *and* some before and after blood work that includes the list shown above.

The bottom line is that we don't recommend turkesterone for everybody – if you want to try pure turkesterone (the *molecule* turkesterone, as opposed to the whole-plant extract that *contains* turkesterone and is often *referred to* as turkesterone), talk to your doctor, do your research, be extremely careful, and prepare to pay for some blood draws.

Otherwise, if you're looking for the more well-researched phytoecdysteroids, start with ecdysterone, which has a much greater research profile than turk.

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