



Introduction to Salivary Hormones

As hormones play an important role in maintaining health, the assessment of hormone levels can help identify the cause of many health related conditions. In both men and women adequate levels of a number of hormones are necessary for optimal health and wellbeing.

The family of sex hormones, which includes the oestrogens – oestrone (E1), oestradiol (E2), oestriol (E3), progesterone, testosterone, DHEA-S and cortisol, support a wide range of essential physiological functions. Variation in these hormones plays a large role in the changes seen in life cycle events such as pregnancy, menopause and ageing.

Baseline measurement of hormone levels in saliva provides an accurate assessment of menstrual irregularities for younger women, climacteric changes for the peri and postmenopausal women and andropause changes in men.

The connection between sex hormones and thyroid function, adrenal activity and liver detoxification may also be evaluated with appropriate testing and clinical history. Research shows that salivary hormone testing provides an accurate assessment of hormone status in both men and women of all ages.

Many factors contribute to altered hormone levels. These include environmental factors, such as chemical exposure and pesticides, lifestyle factors including smoking, alcohol, lack of exercise, poor diet and specific conditions such as infertility, endometriosis and enlarged prostate.

Saliva testing is non-invasive and designed so that the patient may collect the specimen(s) in the privacy of his or her own home. Patients are sent a test kit with easy to follow instructions for saliva collection.

Hormones Tested

- Oestrone (E1)
- Oestradiol (E2)
- Oestriol (E3)
- Progesterone (P4)
- Testosterone (TT)
- DHEA-S
- Cortisol
- Melatonin

Oestrogens

Oestrogens are a group of multiple hormones including E1, E2 and E3. In women, oestrogens are secreted directly by the ovaries or made in adipose cells by conversion from DHEA-S and testosterone. In men, oestrogen hormones are made to a lesser extent in the testes.

The pattern of circulating oestrogens in the human body is:

Oestrone (E1)	10-20%
Oestradiol (E2)	10-20%
Oestriol (E3)	60-80%

Oestrone (E1)

- **Readily converts to oestradiol**
- **Levels increase following menopause, giving the body some oestrogen benefits**

Oestrone (E1) is produced primarily from androstenedione in the testes in men, the ovaries in women and the adrenal glands in both sexes. There is conversion back and forth between E1 and E2. After menopause E1 levels increase, possibly due to increased conversion of androstenedione to E1, particularly in overweight people where there is more adipose tissue. E1 has less oestrogenic activity than E2.



Oestradiol (E2)

- **Readily converts to E1**
- **Promotes the growth of endometrial and breast tissue**
- **Responsible for development of secondary sex characteristics**
- **Increases fat stores**
- **Required for maturation of long bones**
- **Improves memory**
- **Relieves menopausal symptoms**
- **Protection against heart disease**

Oestradiol (E2) is the most potent of the three oestrogens. E2 is produced mainly by the ovaries, with secondary production by the adrenal glands. During the follicular phase of the menstrual cycle E2 levels remain nearly constant before the luteinising hormone (LH) surge, where levels of E2 peak as ovulation occurs. Following ovulation, E2 levels fall, followed by a second rise which corresponds with the formation of the corpus luteum.

At menopause, E2 levels decrease. This is often accompanied by vascular instability (hot flushes and night sweats).

Oestriol (E3)

- **Produced almost exclusively during pregnancy**
- **Topically may relieve postmenopausal vaginal atrophy and urinary incontinence**
- **E3 is less potent than E1 and E2**

Progesterone (P4)

- **Maintains uterus during pregnancy**
- **Prepares breasts for lactation**
- **Decreases oestrogen receptor synthesis**
- **Improves oestrogen receptor sensitivity**
- **Promotes cell differentiation**
- **Enhances mood and has a calming effect**
- **Reduces symptoms of premenstrual syndrome (PMS)**

Progesterone (P4) is produced from pregnenolone. P4 induces the cyclic changes in the endometrium that allows for implantation of a fertilised egg. It is also responsible for the maintenance of the uterus during pregnancy, suppression of uterine contractions and preparation of the breasts for lactation.

During the follicular phase of the menstrual cycle P4 remains at a low level. Throughout the luteal phase, where the corpus luteum produces P4, levels increase significantly, particularly around day 21 of the cycle.

Measurement of P4 is useful in numerous conditions such as PMS, infertility, depression and/ or to monitor supplemental progesterone.

Testosterone (TT)

- **Builds muscle and promotes muscle tone**
- **Increases libido**
- **Helps strengthen bones**
- **Reduces depression**
- **Protects against heart disease**

Testosterone (TT) is produced mainly by the testes in men, the ovaries in women and the adrenal glands in both sexes. Testosterone is synthesised from androstenedione, a metabolite of DHEA and progesterone.

Throughout most of the reproductive years, approximately 10-20 times more testosterone is produced in men than in women. At puberty males have much higher levels of testosterone, which is responsible for the development of male external genitalia and secondary hair patterns, stimulation of spermatogenesis and stimulation of anabolic activity leading to increased muscle mass and behavioural changes. In pubescent females, testosterone effects are more subtle but equally important for proper musculo-skeletal development, general anabolic activity and libido. In both sexes testosterone increases protein synthesis. Testosterone decreases with age in both men and women.

DHEA-S

- **Helps protect against heart disease**
- **Enhances immune system**
- **May increase energy levels, libido and memory**
- **Protects against the effects of stress**

DHEA (dehydroepiandrosterone) is produced primarily in the adrenal glands from the steroid precursor pregnenolone.

DHEA is the main precursor for oestradiol and testosterone. The body quickly converts DHEA to DHEA-Sulphate (DHEA-S).



DHEA-S is a weaker androgen than testosterone. Various diseases such as osteoporosis, cardiovascular disease, AIDS, autoimmune disease (e.g. Lupus), Alzheimer's disease, breast cancer, thyroid disease and diabetes have been associated with low circulating DHEA-S levels. DHEA-S levels also decline with age in both sexes.

Cortisol

- **Assists in stress response and coping with trauma, infection and environmental extremes**
- **Increases energy and metabolism**
- **Helps regulate blood pressure**
- **Enhances the integrity of blood vessels**
- **Reduces allergic and inflammatory response**

Cortisol is the most potent glucocorticoid produced by the human adrenal glands. It is produced from cholesterol and its production is stimulated by pituitary adrenocorticotropic hormone (ACTH) which is regulated by corticotrophin releasing factor (CRF). Cortisol affects numerous physiological systems including immune function, glucose counter-regulation, vascular tone and bone metabolism. Cortisol is also involved in the response to stressors and is essential for carbohydrate, fat and protein metabolism.

Cortisol production has a diurnal rhythm, where levels peak in the early morning and drop to the lowest concentration at night. It is therefore important to measure multiple saliva specimens collected throughout the day.

Melatonin

- **Regulates sleep**
- **Potent antioxidant properties**

Melatonin is made by the pineal gland from tryptophan and is involved in daily circadian body rhythms. Melatonin production occurs almost exclusively at night.

Melatonin is a potent antioxidant, immune stimulant and potential inhibitor of cancer. Human studies show melatonin helps regulate sleep/wake cycles and may help as a natural sleep aid and assist in treating symptoms of jet lag.

Melatonin decreases with age and its role in the ageing process is being further researched.

Saliva vs. Serum

Saliva testing has been used to measure hormones since the late 1960s and has many advantages over serum testing. The most significant feature of saliva testing is that it reflects the non-protein bound 'free' fraction of hormones at a given point of time.

As steroid hormones are predominantly bound to carrier proteins such as cortisol binding protein, sex hormone binding globulin and albumin in the blood, the unbound fraction is considered more readily available to the cells of the body (see Diagram 1). It is these 'free' hormones that best reflect a patient's hormonally-related symptoms, rather than total or bound hormone levels as measured in serum.

Furthermore, saliva testing effectively monitors the level of supplemental hormones as well as their absorption and utilisation. Studies show that 'salivary progesterone measurements confirm applied progesterone is being absorbed, despite the lack of change in serum progesterone'. Therefore, saliva testing can influence supplementation dosages and determine whether bio-identical hormone therapy is being absorbed.

Advantages of Saliva Testing:

- Saliva reflects the free, bio-available hormone levels (unlike blood which measures total levels)
- Baseline hormone levels can be assessed and bio-identical hormone replacement therapy can be easily monitored and adjusted
- Testing is suitable for both men and women
- Simple, painless, non-invasive, economical and can be collected at home
- Specimens are sent directly to the laboratory without special handling
- Multiple saliva collections can be taken over a day or a number of weeks
- Hormones are stable in saliva at room temperature
- Transport to laboratory by overnight courier from anywhere in Australasia



Limitations of Saliva Testing:

- Lack of familiarity
- Restricted to steroid hormones
- Saliva can become contaminated with topical hormones and make-up on lips/hands
- Mucous in saliva from the following may affect results:
 - Cold or flu
 - Sinus congestion Allergy
 - Infection
- Blood in saliva from the following may affect results:
 - Bleeding gums Oral infection
 - Open ulceration in mouth

