'The Science of light pollution'

Some human and animal model effects of light at night (LAN), mediated by melatonin

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1) Astronomy
   - – Prof.-Hobby: Disturbing: observations
   - – General: Loss: Scenery, night sky

2) Ecology
   - – Doom of insect, birds...

3) Human health...
   - – Light at night (LAN) ➔ melatonin (MT) ↓
     (antioxidant, immune stimulant and oncostatic hormone ↓) ➔
     breast, prostate, colon & liver cancer ↑

5) Law

6) Technic

7) Criminalistic, injuries...

- PubMed
  - US Nat Lib Med, Nat Inst Health *(NLM NIH)*
  - www.pubmed.gov
  - More than 20 million citations
    (MEDLINE, life science journals etc.)
  - Abstracts, links, full texts
  - ”Melatonin”
    - ~16,000 items
    - ~2,000 full FREE text

- **Melatonin**
  - Aaron Lerner, 1958
  - Pineal gland (corpus pineale)
  - N-Acetyl-5-methoxytryptamine
  - Tryptophan -> 5-Hydroxytryptophan -> *Serotonin* -> N-Acetylserotonin -> ~
  - Folic acid is necessary
  - Blood, saliva; liver: 20’ half-lifetime
  - *6-Sulphatoxymelatonin (6-SOM, urine)*

- **Regulation**
  - Synthesis: maximum: at night, in darkness!
  - Brainard et al. (2001), Thapan et al. (2001)
  - Light of 464 nm wavelength
    inhibits mostly the synthesis
  - Berson et al. (2002)
  - Not rods & cones: Retinal Ganglion Cells (RGC)
    - Photopigment melanopsin
  - Suprachiasmatic Nucleus (SCN)
  - Pineal gland
  - Activation: melatonin synthesis will be blocked

- Effects (1.)
  - Helps initiating sleep
  - Body temperature/pulse rate: diminish
- Effects (2.)
  - Scavenger

Martin et al. (2000)

- Mitochondria: oxidative stress
- Inhibition: melatonin >>> Vitamin C/E!

Qi et al. (2000)

- DNA+Cr(III)+H2O2
- 8-Hydroxydezoxyguanosin
- Inhibition: melatonin >>> Vitamin C/E!

- Effects (3.)
  - Immune system
    - Maestroni et al. (1987)
      - In vitro
      - Melatonin: IgM, IgG increasing
      - Opioid system

- **Effects (4.)**
  - **Oncostatic hormone (1.):**

    BREAST CANCER: **Human MCF-7 cell line**

    Rato et al. (1999)
    - **Melatonin inhibited:**

      growth induced by estradiol
    - **Inhibition: attach:**

      estrogen receptor–DNA

- Effects (4.)
  - Oncostatic hormone (1.):

    BREAST CANCER: DMBA

    Tamarkin et al. (1981)
    - Rats, exstirpated pineal gland
    - Dimetylbenzanthracene
    - Carcinogen (breast)
    - Melatonin: partly inhibited

- Effects (4.)
  - Oncostatic hormone (2.): *PROSTATE*

    Gilad et al. (1997)
    - Benign prostate cells,

      functioning MT-receptors
    - If balance of

      estradiol & dihydrotestosterone:

      MT inhibits
    - If not balance: proliferation

- Effects (4.)
  - Oncostatic hormone (3.): *COLON CANCER: DMHA*

    Anisimov et al. (1997)
    - Female rats
    - Dimetylhydrazine
    - Small intestine/colon carcinoma
    - Grades:

      MT inhibited

- Effects (4.)
  - Oncostatic hormone (4.): *LIVER CANCER*

    Blask et al. (1999)
    - Rat hepatoma
    - MT blocked:
      - Uptake of linolenic acid
      - Transformation to mytogenic signal molecule
    - Size of tumor: smaller

- Effects (5.)
  - Aging
    - Pierpaoli & Regelson (1994)
      - Life span was increased
      - In aged mice
        - By MT or
        - By pineal gland implantate from young mice
    - Roth et al. (2001)
      - Dietetic caloric restriction
      - Rhesus monkeys: life span: increased
      - Came together: smaller degree of the [normal] diminishing by age of the plasma MT level

- Controlled human essays
  - Graham et al. (2001)
    - Young, healthy women
    - MT & estrogen level
    - 5200 lux fluorescent lamps
  - Harada (2004)
    - Fluorescent lamps
    - 200–300 lux by night
    - Diminished saliva MT level
- *Stevens et al. (2007)*
  - *Parameters of the photic input?*

- Epidemiology (1.)
  - Kloog et al. (2008)
    - Ecological study
    - LAN: satellite
    - Breast cancer

- Epidemiology (2.)
  - Blind persons
    - Feychting et al. (1981)
      - Entirely blinds
      - Lower cancer incidence

- Epidemiology (3.)
  - Night shift work

    & increased breast cancer incidence

    Hansen (2001)

    Davis et al. (2001a)
    - Case-control study

    Schernhammer et al. (2001)
    - Cohort study

      ('Nurses' Health Study')

- **Epidemiology (3.)**
  - **'Shiftwork that involves circadian disruption'**
    - **Int Agency Res Cancer (IARC, 2007): possibly carcinogenic to humans *(Group 2A)***
- **MEDICAL SCIENCE**
  - **Aged: decreased MT levels**
  - **Substitution?**

(– Question

- *Some neurotic & other disturbances: not only through MT pathway?)*

– **Other medical subjects**

Estrogen- & cortisol levels
Alzheimer disease
Bone development
Biological clock
Asthma
Mitosis
Diabetes
Sleep
Depression

- **Epidemiology in Hungary, too**
  - **Exact physical parameter measurements**
    - **Satellite info: LAN:**

      ecologic investigations

    - **Individual light measurements…**
  - **Exact biological parameter measurements**

    (biological monitoring)
    - **6-Sulphatoxymelatonin (6-SOM, urine)**
    - **MT (blood, saliva)**

      individual investigations:

      surveys, case-control & cohort studies

– **Regulation (in Hungary, too)**

– Night lightings – Shift work

– Different groups...

(Astronomers Jurists

Ecologists Light technicians

Physicians Policemen…)

– Special requirements

– Common action plan; implementing!

– Lobbying in the legislation

Municipal, country & regional level

- Wish
  - Law in Hungary: for 2012 Spring!
  - Requires unity
    - Within groups
    - Between groups

- Conflict of interest
  - No link
    - Drug, shutter-, eye mask & special lamp…
    - …manufacturers & vendors

SUMMARY 1.

- Melatonin (1.)
  - Serotonin derivative
  - Effects
    - Sleep initiator; biological clock
    - Strong scavenger
    - Strong immune stimulant
    - Strong oncostatic hormone

      (breast, prostate, colon, liver)
    - Aged: level decreasing; substitution?

SUMMARY 2.

- Melatonin (2.)
  - Regulation
    - *Blue light inhibits secretion*
    - Sleep initiator,
    - Scavenger,
    - Immune stimulant &
    - Oncostatic *(…)*

      effects decrease

SUMMARY 3.

- Controlled human essays
- Ecological -, surveys, case-control - & cohort studies
  - Blind persons
  - Shiftwork
    - IARC (2007): possibly carcinogenic (2A)
- Ecology, astronomy

SUMMARY 4.

- Regulation
  - Night lightings, shift work
  - Groups
    - Common action plan to implement
    - Unity: within & between groups
- Wish
  - Law (in Hungary?): 2012 Spring?!

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