

Personal information

Name	ARNO HAZEKAMP, PhD
Nationality	Dutch (The Netherlands)
Date of birth	15 March 1976
Place of birth	Bilthoven, the Netherlands
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CV - narrative

Dr. Arno Hazekamp was born on 15 March 1976 in the Netherlands. He studied at Leiden University, the Netherlands, where he obtained his Bachelor's degree in the field of molecular biology from the School of Biology. He continued his studies at the same university, School of Pharmaceutical Sciences, where he worked for several years in the Department of Pharmacognosy (medicinal plant research), under prof. Rob Verpoorte. In 2000, Arno finished his MSc research on the ethnopharmacology of a Thai medicinal plant, and graduated with honours. Subsequently, he was employed as a technician and lab manager at Leiden University, assisting students and staff with their medicinal plant research.

In November 2001, Arno started as a PhD student under the supervision of prof. Rob Verpoorte. His research project was focused on the medicinal properties of the cannabis plant, and on the practical obstacles that stand between this plant and its development into a modern medicine. Because the cultivation and supply to patients of cannabis in the Netherlands was fully legal, Arno was able to work closely with the official grower of medicinal cannabis in the Netherlands, Bedrocan BV, and was involved in numerous projects regarding the chemical analysis, quality control, and product development regarding medicinal cannabis. Arno was actively involved in setting up the medicinal cannabis program of the Dutch Health Ministry, and was a strong advocate of a more science-based approach on the medicinal use of cannabis in the Netherlands and abroad. During his PhD, Arno spent several periods at the Institut Universitaire de Médecine Légale (IUML) in Lausanne, Switzerland, focussing on the forensic aspects of cannabis use.

In the last phase of his PhD study, in 2005, Arno started a phytochemical (plant chemistry) contract laboratory, as a spin-off from Leiden University, after successfully applying for a 600.000 euro grant for the purchase of research equipment. In order to handle larger projects, Arno joined forces with a consortium of biotech companies that work together under the name PRISNA (Product Isolation from Nature), providing phytochemical services and consultancy for the development of plant-based products, with a special focus on medicine and food. Arno remains a shareholder in PRISNA, and frequently works together with the consortium's specialists.

Based on the experiences during his PhD study, in the period 2005-2010 Arno further specialized as a medical cannabis expert, working closely with government agencies, universities and pharmaceutical companies. Some relevant experiences during this period include; involvement in the early phase of Echo Pharmaceuticals (a Dutch pharmaceutical company developing a sublingual administration form of THC and other cannabinoids); validation studies for German company Storz&Bickel (basis for the

successful development of the Volcano Medic, a vaporizer device specifically designed for inhalation of medicinal cannabis); and setting up the Dutch non-profit organization NCSM to provide science-based information about medicinal cannabis to the general public.

Arno continues to have a strong interest in the medicinal use of cannabis, with a specific focus on controlled growing, quality control, and safe access for medical patients. In 2009, Arno became a board member of the International Association for Cannabis as Medicine (IACM). Throughout his career, Arno has maintained contact with patients, care-takers, and patient-organisations. These connections and experiences serve as an inspiration for evolving research projects. He is an active traveller and lecturer, and is considered a professionally trained medicinal cannabis advocate. In 2011, Arno became the Head of Research and Education (R&E) of Bedrocan BV, where he spearheaded many scientific studies with medicinal cannabis, including development of new cannabis varieties and better administration forms, improvement of quality control methodology, and the design of clinical studies with herbal cannabis. Since 2011, he organizes the Masterclass Medicinal Cannabis, a week-long training event in the Netherlands that covers all aspects of medicinal cannabis use. Since early 2017, Arno is an independent consultant for regulators, cultivators and product developers in the cannabis industry. His company is called Hazekamp Herbal Consulting.

Education & Employment

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|--------------------------|---|
| Mar 2017-present | Director and founder of Hazekamp Herbal Consulting
Involved with legal medicinal cannabis projects around the world as scientific advisor. Currently active with clients in 10 different countries. |
| Nov 2010-Mar 2017 | Head of Research and Development
Working for the Dutch company Bedrocan BV; cultivates medicinal cannabis for the Dutch government; the first fully licensed grower of medicinal cannabis on the international market. www.bedrocan.com |
| 2007-May 2010 | Scientific director
Co-founder and Scientific director of PRISNA BV (Product Isolation from Nature), a Dutch consortium of biotech companies specialized in the commercialization of natural products. Joint venture in cooperation with Leiden University, the Netherlands. (Company discontinued in 2015) |
| 2005-Nov 2010 | Entrepreneur
Self-employed under the name “LabAssistant”, providing consultancy and lab support in research on medicinal plants, with a specialty in medicinal cannabis. |
| 2001-2007 | PhD research
Leiden-Amsterdam Center for Drug Research (LACDR), the Netherlands
PhD research on medicinal cannabis at the Medicinal Plant Research Lab of prof. Rob Verpoorte. Diploma received in September 2007. www.lacdr.nl |
| 2000-2001 | Lab manager & technician
Leiden University, department of Pharmacognosy
Employed by the Medicinal Plant Research Lab of prof. Rob Verpoorte
Assisted in various medicinal plant related research projects. |

1998-2000 **Master's degree (MSc) in Pharmacy and Phytochemistry**
Leiden University, The Netherlands
Faculty of Life Sciences, School of Pharmaceutical Sciences
Diploma received in August 2000 (with honours).

1994-1998 **Undergraduate study (BSc) in Molecular Biology**
Leiden University, The Netherlands
Faculty of Life Sciences, School of Biology

Research experience

2007-2017 **Bedrocan International BV**
Head of Research and Education

2001-2007 **Leiden University, The Netherlands, Faculty of Life Sciences**
6 years; PhD research project on the chemistry, cultivation and
administration of medicinal cannabis

2003/2004 **Forensic laboratory, Lausanne, Switzerland**
5 months internship; Research project on the effect of compounds from
Cannabis on an *in vitro* model of multiple sclerosis

2000-2001 **Leiden University, The Netherlands, Department of Pharmacognosy**
2 years employed as lab manager and technician. Full time involved in
various research projects of PhD-students and staff.

1999 **Chiang Mai University, Thailand, Department of Pharmacognosy**
3 months internship; Pharmacological evaluation of a Thai medicinal plant
with a traditional use as asthma relieving medicine.

1998-1999 **Leiden University, The Netherlands, Department of Pharmacognosy**
1 year internship; Research project: development of a general separation
method for plant extracts for improved detection of bioactive compounds in
medicinal plants.

1997 **Kent State University, Kent, Ohio, USA**
2 months exchange program; Research project: expression of the enzyme
3 β -HSD in MCF-7 cells (humane breast cancer cell-line).

1996-1997 **TNO prevention & health (Dutch Organisation for Applied Scientific
Research), Leiden, The Netherlands**
1 year internship; Research project: protein-expression and -purification of
matrix metalloproteinases using recombinant E. coli bacteria.

Other relevant experiences

- 2011-2017** **Masterclass Medicinal Cannabis**
Organized 6x an annual, one-week, course on the science behind medicinal cannabis for up to 20 international specialists on medicinal cannabis issues. www.cannabis-masterclass.com
- 2009-2013** **International Association for Cannabinoid Medicine (IACM)**
Vice-chairman (2011-2013) and board member (2007-2011) of the scientific advisory board. www.cannabis-med.org
- 2008-2014** **Medicinal Cannabis Foundation**
Co-founder and secretary of the Dutch foundation NCSM (Dutch association for legal cannabis and its constituents as medicine). The foundation aims to be the major provider of information on the medicinal use of cannabis in the Netherlands. www.ncsm.nl
- 2005-2016** **Expert witness as a medical cannabis expert**
Involved in (supreme) court cases of patients charged with offences related to personal medicinal cannabis use.
- 2003-2007** **Office of Medicinal Cannabis (OMC), Ministry of Health**
Member of the consultancy group for the development of quality control standards (monograph) for medicinal cannabis. www.cannabisbureau.nl
- 2001** **Dutch Society for Herbal Medicine Research (NVGO)**
Awarded the annual *van Os*-prize for promising young scientists in the field of medicinal plant research.

Publications

Full research papers

- Hazekamp A, Epifanova S (2017)** Grote variatie in samenstelling cannabisolie noopt tot regels. Pharmaceutisch Weekblad 152(44): 16-18
- Hazekamp A, Tejkalova K, Papadimitriou S (2016)** Cannabis: from cultivar to chemovar II — a metabolomics approach to Cannabis classification. Cannabis and Cannabinoid Research 1(1): 202-213
- Hazekamp A (2016)** Evaluating the effects of gamma-irradiation for decontamination of medicinal cannabis. Front. Pharmacol. 7: 108.
- Hazekamp A, Heerdink ER (2013)** The prevalence and incidence of medicinal cannabis on prescription in The Netherlands. Eur J Clin Pharmacol 69(8): 1575-1580
- Hazekamp A, Ware MA, Muller-Vahl KR, Abrams D, Grotenhermen F (2013)** The Medicinal Use of Cannabis and Cannabinoids—An International Cross-Sectional Survey on Administration Forms. Journal of Psychoactive Drugs 45(3): 199-210

Hazekamp A, Fishedick JT (2012) Cannabis – from cultivar to chemovar. Drug Testing and Analysis 4 (special issue): 660-667

Hazekamp A, Bastola K, Rashidi H, Bender J, Verpoorte R (2007) Cannabis tea revisited: A systematic evaluation of the cannabinoid composition of cannabis tea. J. Ethnopharmacol. 113(1): 85-90

Hazekamp A (2006) An evaluation of medicinal grade cannabis in The Netherlands. Cannabinoids 1(1): 1-9

Hazekamp A, Ruhaak R, Zuurman L, van Gerven J, Verpoorte R (2006) Evaluation of a vaporizing device (Volcano®) for the pulmonary delivery of tetrahydrocannabinol. J. Pharm. Sci. 95(6): 1308-1317

Hazekamp A, Verpoorte R (2006) Structure elucidation of the tetrahydrocannabinol complex with randomly methylated-beta-cyclodextrin. Eur. J. Pharm. Sci. 29(5): 340-347

Hazekamp A, Sijrier P, Verpoorte R, Bender J, van Bakel N (2005) Cannabis uit de apotheek is beter. Pharmaceutisch weekblad 12: 402-404

Hazekamp A, Giroud C, Peltenburg A, Verpoorte R (2005) Chromatographic and spectroscopic data of cannabinoids from *Cannabis sativa* L. J. Liq. Chrom. Rel. Technol. 28(15): 2361-2382

Hazekamp A, Choi YH, Verpoorte R (2004) Quantitative analysis of cannabinoids from *Cannabis sativa* using ¹H-NMR. Chem. Pharm. Bull. 52(6): 718-721

Hazekamp A, Simons R, Peltenburg-Looman A, Sengers M, van Zweden R, Verpoorte R (2004) Preparative isolation of cannabinoids from *Cannabis sativa* by centrifugal partition chromatography. J. Liq. Chrom. Rel. Technol. 27(15): 2421-2439

Hazekamp A, Verpoorte R, Panthong A (2001) Isolation of a bronchodilator flavonoid from the Thai medicinal plant *Clerodendrum petasites*. Journal of Ethnopharmacology 78: 45-49

Review papers

Hazekamp A (2017) An Indian perspective on cannabis for treatment of pain. International Journal of Ayurveda and Pharmaceutical Chemistry 7(3): 22-51

Kowal MA, **Hazekamp A**, Grotenhermen F (2016) Review on clinical studies with cannabis and cannabinoids 2010-2014. Cannabinoids 11(special issue): 1-18

Hazekamp A, Keizer D, Höner-Snoeken K (2011) [Medicinal cannabis for neurological disorders] [publication in Dutch]. Journal of Neurology and Neurosurgery 112: 132-140

Hazekamp A, Grotenhermen F (2010) Review on clinical studies with cannabis and cannabinoids 2005-2009. Cannabinoids 5(special issue): 1-21

Book chapters

Klumpers LE & **Hazekamp A**. The therapeutic potential of cannabis and the endocannabinoid system. In Principles and Practice of Botanicals as an Integrative Therapy; Hume EL, Orr K, Eds.; Taylor and Francis Group, Abingdon, UK, 2017 [in press].

Hazekamp A & Pappas G. Self-medication with cannabis. In Handbook of Cannabis; Pertwee, R, Ed.; Oxford University Press: Oxford, 2014, chapter 17

Hazekamp A et al. Chemistry of Cannabis. In Comprehensive Natural Products II Chemistry and Biology; Mander, L., Lui, H.-W, Eds.; Elsevier: Oxford, 2010; [Vol. No.3], pp 1033-1084

Published as co-author

Kowal MA, **Hazekamp A**, Grotenhermen F (2016) Review on clinical studies with cannabis and cannabinoids 2010-2014. *Cannabinoids* 2016;11(special issue):1-18

Kowal MA, van Steenberg H, Colzato LS, **Hazekamp A**, van der Wee NJ, Manai M, Durieux J, Hommel B (2015) Dose-dependent effects of cannabis on the neural correlates of error monitoring in frequent cannabis users. *Eur Neuropsychopharmacol.* (in press)

Kowal MA, **Hazekamp A**, Colzato LS, van Steenberg H, van der Wee NJ, Durieux J, Manai M, Hommel B (2015) Cannabis and creativity: highly potent cannabis impairs divergent thinking in regular cannabis users. *Psychopharmacology (Berl)* 232(6): 1123-1134

Solowij N, Broyd SJ, van Hell HH, **Hazekamp A** (2014) A protocol for the delivery of cannabidiol (CBD) and combined CBD and Δ^9 -tetrahydrocannabinol (THC) by vaporization. *BMC Pharmacology and Toxicology* 15: 58-65

Erkelens JL, **Hazekamp A** (2014) That which we call Indica, by any other name would smell as sweet. *Cannabinoids* 9(1): 9-15

Romano LL, **Hazekamp A** (2013) Cannabis Oil: chemical evaluation of an upcoming cannabis-based medicine. *Cannabinoids* 1(1): 1-11

Fischedick JT, **Hazekamp A**, Erkelens T, Choi YH, Verpoorte R (2010) Metabolic fingerprinting of Cannabis sativa L., cannabinoids and terpenoids for chemotaxonomic and drug standardization purposes. *Phytochemistry* 71 (17-18): 2058-2073

Fischedick JT, Glas R, **Hazekamp A**, Verpoorte R (2010) A qualitative and quantitative HPTLC densitometry method for the analysis of cannabinoids in Cannabis sativa L. *Phytochem Anal.* 20(5): 421-426

Zuurman L, Roy C, Schoemaker RC, **Hazekamp A**, den Hartigh J, Bender JCME, Verpoorte R, Piquier JL, Cohen AF, van Gerven JMA (2008) Effect of intrapulmonary THC administration in humans. *Journal of Psychopharmacology* 7: 707-716

Monnet-Tschudi F, **Hazekamp A**, Perret N, Zurich MG, Mangin P, Giroud C, Honegger P (2007) Delta-9- tetrahydrocannabinol accumulation, metabolism and cell-type specific adverse effects in aggregating brain cell cultures. *Toxicol. Applied Pharmacol.* 228: 8-16

Bastola K, **Hazekamp A**, Verpoorte R (2007) Synthesis and spectroscopic characterization of cannabinolic acid. *Planta Medica* 73: 273-275

Giroud C, Augsburg M, Favrat B, Menetrey A, Pin MA, Rothuizen LE, Appenzeller M, Buclin T, Mathieu S, Castella V, **Hazekamp A**, Mangin P. (2006) [Effects of oral cannabis and dronabinol on driving capacity] *French. Ann. Pharm. Fr.* 64(3): 161-172

Choi YH, **Hazekamp A**, Peltenburg-Looman AMG, Frédéricich M, Erkelens C, Lefeber AWM, Verpoorte R (2004) NMR assignments of the major cannabinoids and cannabiflavonoids isolated from flowers of *Cannabis sativa*. *Phytochem. Anal.* 15: 345-354

Choi YH, Kim HK, **Hazekamp A**, Erkelens C, Lefeber AWM, Verpoorte R (2004) Metabolomic differentiation of *Cannabis sativa* cultivars using ¹H-NMR spectroscopy and principal component analysis. *J. Nat. Prod.* 67: 953-957

Zuurman L, Roy C, **Hazekamp A**, Schoemaker R, den Hartigh J, Bender JCME, Piquier JL, Cohen AF, van Gerven JMA (2004) Effect of THC administration in humans: methodology study for further pharmacodynamic studies with cannabinoid agonist or antagonist. *Br. J. Clin. Pharmacol.* (59(5): 625

Choi YH, Kim HK, **Hazekamp A**, Erkelens C, Lefeber AWM, Verpoorte R (2004) Metabolomic differentiation of *Cannabis sativa* cultivars using ¹H NMR spectroscopy and principal component analysis. *Journal of Natural Products* 67(6): 953-957

Choi YH, Choi HK, **Hazekamp A**, Bermejo P, Schilder Y, Erkelens C, Verpoorte R (2003) Quantitative analysis of bilobalide and ginkgolides from *Ginkgo biloba* leaves and *Ginkgo* products using (1)H-NMR. *Chemical and Pharmaceutical Bulletin* 51(2):158-61

Ingkaninan K, **Hazekamp A**, de Best CM, Irth H, Tjaden UR, van der Heijden R, van der Greef J, Verpoorte R (2000) The application of HPLC with on-line coupled UV/MS-biochemical detection for isolation of an acetylcholinesterase inhibitor from *Narcissus* 'Sir Winston Churchill'. *Journal of Natural Products* 63(6): 803-806

Ingkaninan K, **Hazekamp A**, Hoek AC, Balconi S, Verpoorte R (2000) Application of centrifugal partition chromatography in a general separation and de-replication procedure for plant extracts. *Journal of Liquid Chromatography* 23(14): 2195-2208

Presentations (selection)

- | | |
|-----------------|--|
| Nov 2016 | Swiss Task Force for Cannabinoids in Medicine, STCM – Meeting 2016
Bern, Switzerland; oral presentation
The Dutch cannabis program: 15 years of patient-inspired research |
| Sep 2016 | Global Medical Cannabis Summit
Dublin, Ireland; oral presentation
The Dutch cannabis program: 15 years of patient-inspired research |
| Jun 2016 | International Cannabinoid Research Society (ICRS) annual meeting
Bukovina, Poland; oral presentation
The Sativa-Indica dilemma |
| Sep 2015 | Int. Association for Cannabis as Medicine (IACM) biannual meeting
Sestri Levante, Italy; Oral presentation
An overview of Bedrocan R&D - patient-inspired research |
| Mar 2015 | Medical Cannabis and Cannabinoids: policy, science and medical practice |

Symposium, Prague, Czech Republic; Ora presentation:
Cannabis - the art and science of vaporizing

- Sept 2013** **Int. Association for Cannabis as Medicine (IACM) biannual meeting**
Cologne, Germany; Oral presentation:
Studies, Surveys and Statistics: do we know what patients want?
- Aug 2013** **Int. Pharmaceutical Students Foundation, World congress 2013**
Utrecht, The Netherlands; Oral presentation:
Cannabis – on its way to modern medicine
- Jan 2013** **Swiss Task Force for Cannabinoids in Medicine, STCM – Meeting 2013**
Bern, Switzerland; Oral presentation:
The Dutch medicinal cannabis program
- Aug 2012** **International Association for the Study of Pain, 14th World Congress**
Satellite Symposium on Cannabinoids and Pain, Milan, Italy
Oral presentation:
Clinical use of cannabis and cannabinoids for treatment of pain
- Sep 2011** **Int. Association for Cannabis as Medicine (IACM) biannual meeting**
Bonn, Germany; Oral presentation
Clinical developments within the Dutch medicinal cannabis program
- May 2009** **Oregon House Committee on Medicinal Cannabis, scheduled hearing**
Oregon, USA; Invited presentation
Oral testimony on the current scientific status of medicinal cannabis use
- Apr 2008** **Patients out of time, 4th biannual meeting**
Asilomar, California, USA; Oral presentation
The use of medicinal cannabis tea
- Oct 2007** **Int. Association for Cannabis as Medicine (IACM) biannual meeting**
Cologne, Germany; Oral presentation
Experiences with medicinal cannabis tea in the Netherlands.
- Sep 2007** **Symposium on the evaluation of 5 years medicinal cannabis use in The Netherlands**
University Medical Center, Groningen, The Netherlands; Oral presentation
Review of administration forms of medicinal cannabis and cannabinoids
- Sep 2005** **Int. Association for Cannabis as Medicine (IACM) biannual meeting**
Leiden, The Netherlands; Oral presentation
Validation of the Volcano vaporizer for clinical administration of THC.
- Mar 2004** **Symposium on Plants in Health and Culture**
Leiden University, The Netherlands; Oral presentation
The use of Cannabis in modern medicine.
- Mar 2004** **Research Institute for Industrial Crops (ISCI)**
Bologna, Italy; Poster presentation
Isolation and use of cannabinoids for medicinal purpose.

- Dec 2003** **VSM pharmaceuticals Inc. annual symposium**
Alkmaar, The Netherlands; Oral presentation
Development of a homeopathic preparation of Cannabis.
- Oct 2003** **Int. Association for Cannabis as Medicine (IACM) biannual meeting**
Cologne, Germany; Poster presentation
Isolation of pure cannabinoids from Cannabis sativa plant material.
- Feb 2002** **Dutch-Belgian phytochemistry (LOF) symposium, 26th annual meeting**
Leiden, The Netherlands; Poster presentation
Cannabinoids from Cannabis sativa extracts; large scale purification and
receptor binding studies.