



THE 6<sup>TH</sup> INTERNATIONAL CONFERENCE ON MATHEMATICS AND NATURAL SCIENCES

**CMNS 2016**

**ON THE ROAD TOWARDS SUSTAINABLE DEVELOPMENT**

**BOOK OF ABSTRACTS**

**2-3 NOVEMBER 2016**  
**INSTITUT TEKNOLOGI BANDUNG**  
**BANDUNG, INDONESIA**

**ORGANIZED BY:**

**FACULTY OF MATHEMATICS AND NATURAL SCIENCES**  
**SCHOOL OF LIFE SCIENCES AND TECHNOLOGY**  
**SCHOOL OF PHARMACY**

**100**

**YEARS (1920-2020)**  
ITB AND HIGHER EDUCATION  
IN INDONESIA

**INVITED SPEAKER**  
**Wednesday, 2 November 2016**

Code	Place	Time	Invited Speakers
INV-01	WH	15:15-15:45	Veinardi Suendo
			Institut Teknologi Bandung, Indonesia
			"Local Structure Investigation of tetraphenylporphyrin: Ab initio calculations of its dimer and spectroscopic approaches"
INV-02	EH1	15:15-15:45	Lucky Puspitarini
			Institut Teknologi Bandung, Indonesia
			"Extracting Diffuse Interstellar Bands from Cool Star Spectra"
INV-03	EH2	15:15-15:45	Marlia Singgih
			Institut Teknologi Bandung, Indonesia
			"Role of Monascus and Neurosporain Pharmacy: Their Metabolites as Active Ingredients and Excipients"
INV-04	EH2	15:15-15:45	I Made Agus Gelgel Wirasuta
			Universitas Udayana, Indonesia
			"Herbal Fingerprint for authentication and quantification: an Increasing Indonesian Herbal Medicine tandardization"
INV-05	EH3	15:15-15:45	Guntur Fibriansyah
			Duke-NUS Medical School, Singapore
			"The Development of Therapeutic Antibodies against Dengue"
INV-06	EH4	15:15-15:45	Tirto Prakoso Brodjonegoro
			Institut Teknologi Bandung, Indonesia
			"Hydrothermal Carbonization of Seaweed for Biochar Production"
INV-07	EH5	15:15-15:45	Yogi Ahmad Erlangga
			Nazarbayev University, Kazakhstan
			"Multilevel Krylov Methods: Analysis and Applications"
INV-08	CC	15:15-15:45	Nandang Mufti
			Universitas Negeri Malang, Indonesia
			"Functionalization of Magnetite Photocatalyst Nanocomposite as Wastewater Treatment and Renewable Energy Materials"
INV-09	RFMIPA	15:15-15:45	Acep Purqon
			Institut Teknologi Bandung, Indonesia
			"Urban Physics and Its Implementation in Predicting Economic Growth Related to High Speed Train Development"
INV-10	BSCA1	15:15-15:45	Alexander A. Iskandar
			Institut Teknologi Bandung, Indonesia
			"Nano Plasmonics for Optical Sensing"

[INV-04]

## Herbal Fingerprint for Authentication and Quantification: an Increasing Indonesian Herbal Medicine Standardization

I Made Agus Gelgel Wirasuta

Universitas Udayana, Indonesia

### Abstract

The global market of herbal medicines has increased 7% annually. Their total market in 2008 was 200 million USD and it will increase to 50 billion USD in 2050. The WHO recommend an implementation the phytochemicals fingerprint to ensure and standardize the herbal remedies. The chemical content of herbal medicine is influenced by several factors, such as: species-varieties, cultivation, geography and climate of a place to grow, harvest, post-harvest processing methods, and production processing. The Good Agriculture and Collection Practices (GACP) guide to control the cultivation factors of medicinal plants. The current Good Manufacture Practices (cGMP) and good laboratory practices (GLP) govern to ensure the repeatability of the efficacy of the herbal medicine product. The spectrophotometric instrument, such as raman, FTIR; the chromatographic method implements to provide the phytochemical fingerprint. This method identifies and measure the bio- or chemical –marker. The biomarker is the chemical constituents, which were detected and identified while the pre and clinical trial. The biomarker represents the claimed substance, which responsible to their pharmacological effect. Many traditional herbal medicine based on the empirical experiment, so there is no scientific information of their biomarker. In this case the phytochemical chromatographic fingerprint could be used as a tool to control the substances. Providing the fingerprint of the JAMU herbal medicine will increase their quality and potency to compete in the global herbal medicine market.

The De

Dengue virus (DENV) is a mosquito-borne pathogen that causes dengue fever/dengue shock syndrome, hemorrhagic fever/dengue shock syndrome, and dengue fever. DENV consists of four serotypes: DENV-1, DENV-2, DENV-3, and DENV-4. DENV-2 is the most common cause of dengue fever/dengue shock syndrome. DENV-2 is a cross-reactive antigen with the virus, which is dependent on the hemagglutinin protein. DENV-2 serotypes, some of which are human and monkey therapeutics. Some of them recognize and bind to single domain involving DI of DENV-2 recognize virus change in morphology change its structure more effectively show disease-overcome by membrane receptor on cell DENV and the development of

# CERTIFICATE



FACULTY OF MATHEMATICS AND NATURAL SCIENCES  
SCHOOL OF LIFE SCIENCES AND TECHNOLOGY  
SCHOOL OF PHARMACY

Bandung, 2-3 November 2016



THE 6<sup>TH</sup> INTERNATIONAL CONFERENCE ON MATHEMATICS AND NATURAL SCIENCES  
**ON THE ROAD TOWARDS SUSTAINABLE DEVELOPMENT**

This is to certify that

**Dr.rer.nat. I Made Agus Gelgel W., M.Si. Apt.**

has participated in the 6<sup>th</sup> International Conference On Mathematics and Natural Sciences

as

**Invited Speaker**

Dr. Dessy Natalia

Chairperson  
ICMNS 2016



Prof. Edy Tri Baskoro, M.Sc., Ph.D.

Dean, Faculty of Mathematics  
and Natural Sciences  
Institut Teknologi Bandung



Dr. I Nyoman Pugeg Aryantha

Dean School of Life Sciences  
and Technology  
Institut Teknologi Bandung



Prof. Dr. Daryono H. Tjahjond Apt.

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Nr. : 4861/I1.C01/LL/2016

7 October 2016

Ref. : Invitation of the 6<sup>th</sup> International Conference on  
Mathematics and Natural Sciences (ICMNS)

Prof. Dr. I Made Agus Gelgel Wirasuta  
Universitas Udayana  
Bali  
Indonesia

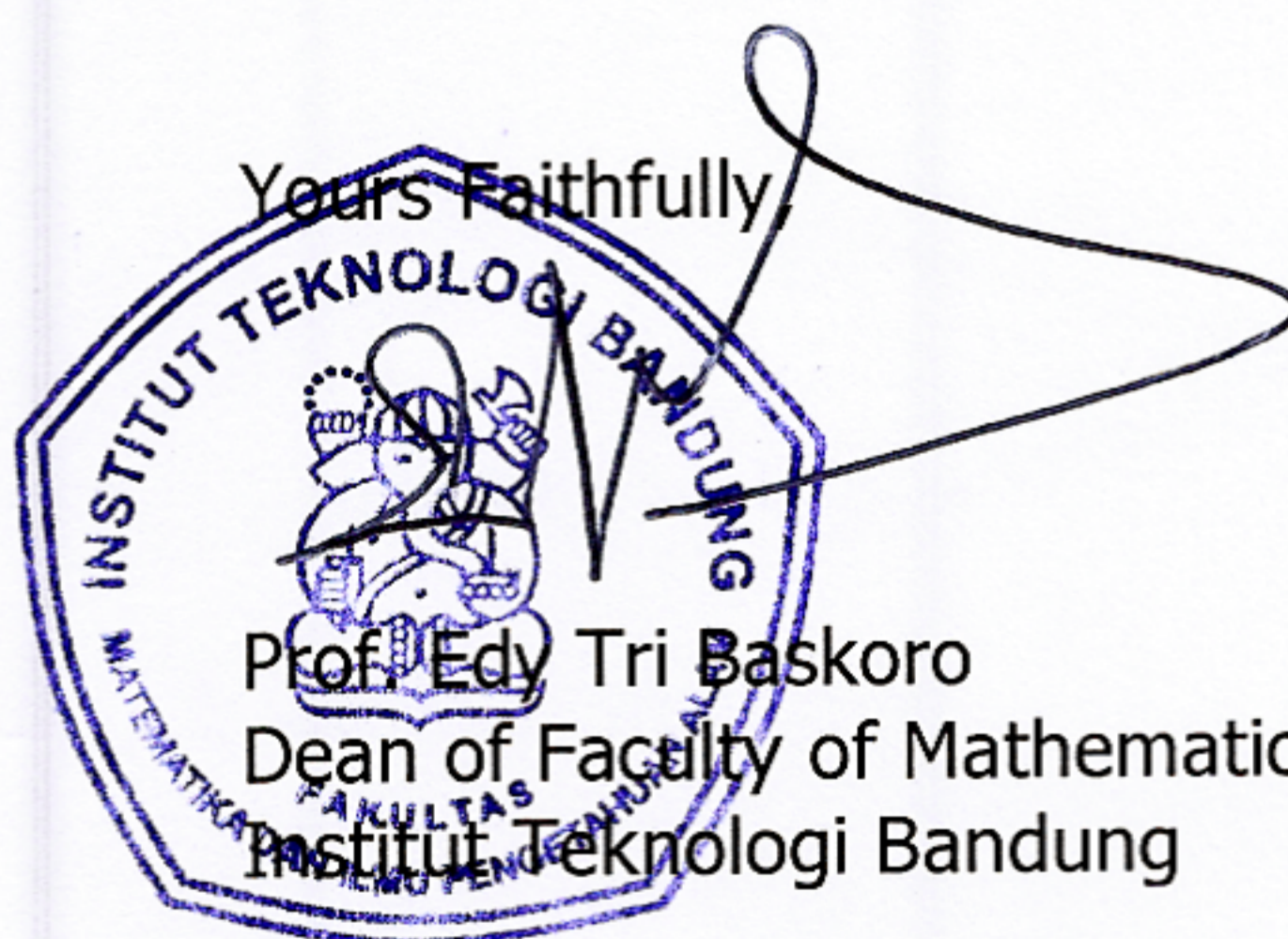
Dear Prof. Dr. I Made Agus Gelgel Wirasuta,

We would kindly like to invite you to the 6<sup>th</sup> ICMNS which will be held on Nov 2-3 2016 at Institut Teknologi Bandung, Bandung, Indonesia. This conference aims to disseminate recent research results in the field of sciences and mathematics and to promote multi- and inter-disciplinary researches in sciences and their applications. We would be very honoured if you could come and share your frontier knowledge and experience in the 6<sup>th</sup> ICMNS. We believe that your contribution to this field is very beneficial for inspiring scientists and triggering the advancement of science, and in turn for future sustainable development of humanity.

We are very happy to cover expenses associated with transportation, and accommodation (2 nights on 1-3 November 2016).

We are very honoured if you could accept invitation to join us for this event. On behalf of the Faculty of Mathematics and Natural Sciences and the Organizing Committee, we are looking forward to meeting you in Bandung.

Yours Faithfully



Prof. Edy Tri Baskoro  
Dean of Faculty of Mathematics and Natural Sciences  
Institut Teknologi Bandung

# herbal standardization

*by* Gelgel Wirasuta

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SUBMISSION ID	757045145	CHARACTER COUNT	1550

# Herbal Fingerprint for authentication and quantification: an Increasing Indonesian Herbal Medicine Standardization

I Made Agus Gelgel Wirasuta

1

Pharmacy Department, Faculty of Mathematic and Natural Sciences - Udayana University

## Abstract

The global market of herbal medicines has increased 7% annually. Their total market in 2008 was 200 million USD and it will increase to 50 billion USD in 2050. The WHO recommend an implementation the phytochemicals fingerprint to ensure and standardize the herbal remedies.

The chemical content of herbal medicine is influenced by several factors, such as: species-varieties, cultivation, geography and climate of a place to grow, harvest, post-harvest processing methods, and production processing. The Good Agriculture and Collection Practices (GACP) guide to control the cultivation factors of medicinal plants. The current Good Manufacture Practices (cGMP) and good laboratory practices (GLP) govern to ensure the repeatability of the efficacy of the herbal medicine product.

The spectrophotometric instrument, such as raman, FTIR; the chromatographic method implement to provide the phytochemical fingerprint. This method identify and measure the bio- or chemical – marker. The biomarker is the chemical constituents, which were detected and identified while the pre and clinical trial. The biomarker represent the claimed substance, which responsible to their pharmacological effect. Many traditional herbal medicine based on the empirical experiment, so there is no scientific information of their biomarker. In this case the phytochemical chromatographic fingerprint could be used as a tool to control the substances. Providing the fingerprint of the JAMU herbal medicine will increase their quality and potency to compete in the global herbal medicine market.

# herbal standardization

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Wirasuta, I Made Agus Gelgel, Ni Made Amelia Ratnata Dewi, Kadek Duwi Cahyadi, Luh Putu Mirah Kusuma Dewi, Ni Made Widi Astuti, and I Nyoman Kadjeng Widjaja. "Studying Systematic Errors on Estimation Decision, Detection, and Quantification Limit on Micro-TLC", Chromatographia, 2013.

Publication

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# herbal standardization For Future

*by* Gelgel Wirasuta

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FILE	MICROSOFT_POWERPOINT_-_ICMN_-HERBAL_STANDARIZATION.PDF (1.97M)		
TIME SUBMITTED	27-JAN-2017 05:57AM	WORD COUNT	365
SUBMISSION ID	763125868	CHARACTER COUNT	2449

## 2 HPTLC Fingerprint: Authentication of Phytochemicals for Improving Herbal Drug Standardization

Diterbitkan: Made Agus Geigel Wirasut, M.Si, Apt  
Pharmacy Department-Faculty Mathematic and Natural Science  
Udayana University - Jimbaran - Bali - Indonesia

### Increased use of herbal products: opportunities and threats

<ul style="list-style-type: none"> <li>▶ Opportunities</li> <li>▶ Increased acceptability of health professional to use HM - CAM</li> <li>▶ Increased awareness of prevention strategies</li> <li>▶ Synergy (HM/CAM vs Modern Medicine)</li> <li>▶ Increasing clinical evidence for efficacy</li> <li>▶ Consumer choice</li> </ul>	<ul style="list-style-type: none"> <li>▶ Threats</li> <li>▶ Dissonant claims</li> <li>▶ Poor-quality materials</li> <li>▶ Lack of sufficient evidence base</li> <li>▶ Concerns over safety</li> <li>▶ Legislative and commercial pressures</li> <li>▶ Threats to conservation</li> </ul>
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P. K. Mukherjee and P. J. Houghton, 2009. The worldwide phenomenon of increased use of herbal products: opportunities and threats, in: Evaluation of Herbal Medicinal Products Perspectives on quality, safety and efficacy, P. K. Mukherjee and P. J. Houghton (Ed.), London, Pharmaceutical Press

### OUTLINE

1. HMPs Trends
2. Standardization Herbal Medicine
3. Developing HMPs with quality, safety and efficacy
4. TLC/HPTLC Herbal medicine standardization
5. Finger Print HPTLC - Standardization Indonesian Herbal Medicine

### Standardization Herbal Medicine

- ▶ Standardization is a system that ensures a predefined amount of quantity, quality & the specific effect of ingredients in each dose
- ▶ The development of authentic analytical methods which can reliably profile the phytochemical composition, including quantitative analyses of marker/bioactive compounds and other major constituents, is a major challenge to scientists
- ▶ Fingerprinting of herbal medicines is utilized for the authenticity and quality control of herbal medicines and herbal preparations

Choudhary, N. and D. S. Sekhon (2011). An overview of advances in the standardization of herbal drugs. Pharm 2010 Res 2 (1): 66-72

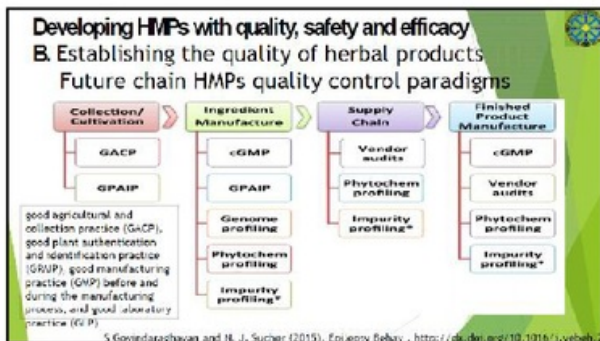
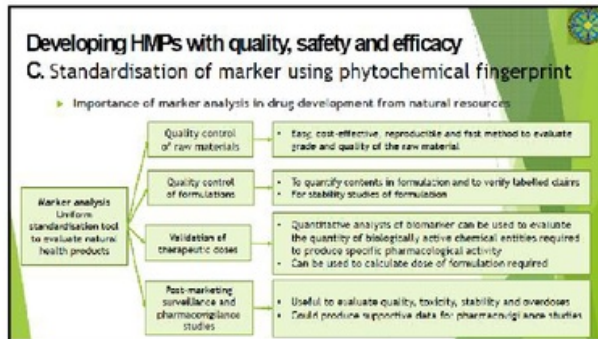
### Increased use of herbal products: opportunities and threats

### Developing HMPs with quality, safety and efficacy

#### A Development of biologically active plant products

##### > Natural Product Drug Discovery

<h6>▶ The Traditional Way</h6> <pre> Scientifics (e.g. DNA) → DNA → Gene → Amino acids → Peptides → Polypeptides → Proteins → Active compounds → Clinical trials → New drugs             </pre> <p>with a pipeline: Active compounds → Clinical trials → New drugs</p> <p>with a pipeline: Active compounds → Clinical trials → New drugs</p> <p>with a pipeline: Active compounds → Clinical trials → New drugs</p>	<h6>▶ Modern Processes</h6> <pre> Scientifics (e.g. DNA) → DNA → Gene → Amino acids → Peptides → Polypeptides → Proteins → Active compounds → Clinical trials → New drugs             </pre> <p>with a pipeline: Active compounds → Clinical trials → New drugs</p> <p>with a pipeline: Active compounds → Clinical trials → New drugs</p> <p>with a pipeline: Active compounds → Clinical trials → New drugs</p>
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### Why use HPTLC-TLC Scanner?

- ▶ Output Visual - e file
  - ▶ Direct visualization under white lamp or UV to obtain TLC-image
  - ▶ Combined with TLC-scanner to obtain densitogram, in-situ UV spectra
  - ▶ Data base of RfK profile
- ▶ Multiple Detection
  - ▶ pre/ post-derivative
  - ▶ Bio-assay
- ▶ Disposable plates
- ▶ Batch analyses
- ▶ Cost-efficiency
- ▶ Flexible
- ▶ cGMP-compliance

### Instrumentals are needed for HPTLC

The image shows four categories of HPTLC instruments: Sample Applicator, Eluting Plat, Immersion Plat, and Detection Plat. Each category contains several photographs of the respective equipment used in the process.

### TLC vs HPTLC

TLC or HPTLC

- ▶ Pharmacopoeias see differences primarily in the plate yet assume similar results

The chromatogram displays two peaks. The first peak is labeled 'TLC' and the second is labeled 'HPTLC'. Below the chromatogram is a densitogram showing the intensity profile of the peaks.

### Basic Validation Process

The flowchart illustrates the Basic Validation Process. At the center is 'VALIDATION METHOD', which leads to 'VALIDATION PROTOCOL', which in turn leads to 'ANALYTICAL GOAL'. Surrounding these central elements are several validation parameters: Stability, Optimization, Method selection, Specificity, Precision, and Robustness. Arrows indicate the flow and relationships between these components.

### Schematic Procedure of HPTLC-Technique

The flowchart details the Schematic Procedure of HPTLC-Technique. The steps are: Selection of chromatographic layer, Layer pre-washing, Layer pre-conditioning, Application of sample and standard, Samples and standard preparation, Optimization of mobile phase, Chromatographic development, Scanning and documentation of chromatoplate, and Detection of spots. Arrows indicate the sequential flow of the process.

Fig. 1.3 Schematic procedure for HPTLC method development

### TLC- Method Standardization

- ▶ Preparation and Plat handling
- ▶ Sample spotting
- ▶ Chamber saturation and humidity control
- ▶ Developing / eluting distance
- ▶ Staining / Derivative
- ▶ Documentation (TLC image / chromatogram)
- ▶ Evaluation

**1**  
A Standardized Approach to Modern High-Performance Thin-Layer Chromatography (HPTLC). Reich, E., SCHMID, A. (2004). J. Planar Chromatogr. 17, 439-443

**Chapter 7**  
**HPTLC Fingerprint Analysis: A Quality Control for Authentication of Herbal Phytochemicals**

Nasir Khan, M.Z. Mohd, M.A. Khan, and Prithvivar Jha

**Authentication of the Species Prone to Confusion**

Fig. 7.1 HPTLC fingerprints of Chinese and American growing

**Sambiloto (King Bitter, *Andrographis paniculata* (Burm. F.))**

- ▶ Major active compound (marker) andrografolid (Rosidah et al., 2012; Saranya et al., 2010).
- ▶ Pharmacological effect of andrografolid :
  - ▶ antipyretic, Anti inflammation, anti allergy, anti diabetes, Immune-stimulant, hepatic- protective, antioxidant.
  - ▶ Our focus research anti hyperlipidaemia.

**Monitoring the Dynamic Change Due to Interaction of Mixed Herbal Drugs during Extraction**

Fig. 7.2 HPTLC fingerprints of *Andrographis paniculata* under various heating conditions and peak heating effects. Chromatograms in 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

**HPTLC-Fingerprint of crude extract Sambiloto**

**Finger Print HPTLC - Standardization Indonesian Herbal Medicine**

PENGEMBANGAN STANDARISASI OBAT HERBAL INDONESIA DENGAN METODE FITOKHIMIA HPTLC-FINGERPRINT

USLAN PENELITIAN ENGLISH PERUBAHAN ENGLISH

**...cont.**

**Peak Pattern Identification**

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Journal of Traditional and Complementary Medicine xxx (2016) 1–8

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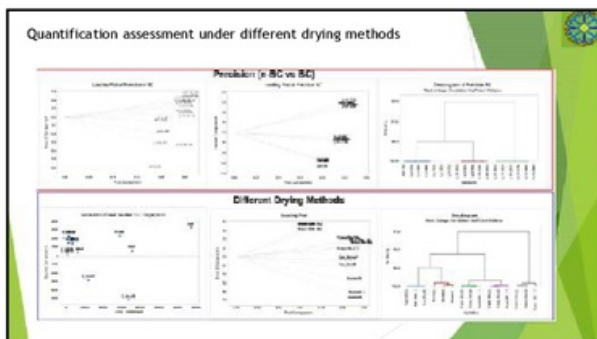
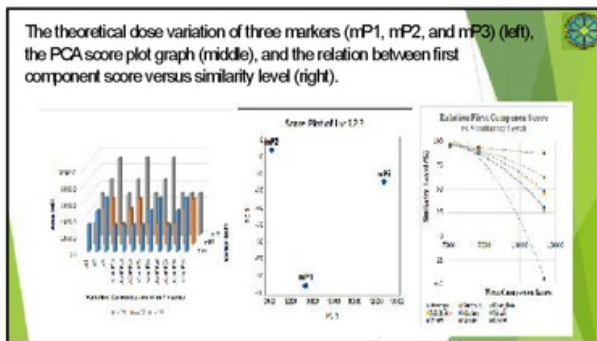
**Authentication of *Piper betle* L. folium and quantification of their antifungal-activity**

I Made Agus Gelgel Wirasata <sup>a,\*</sup>, I Gusti Ayu Made Srinadi <sup>b</sup>, Ida Bagus Gede Dwidarmasana <sup>c</sup>, Ni Luth Putri Putri Ardyaniti <sup>d</sup>, I Gusti Ayu Arya Trisnadewi <sup>e</sup>, Ni Luth Putri Vidya Paramita <sup>f</sup>

<sup>a</sup> Pharmacy Department, Faculty of Medicine and Natural Science, Udayana University, Indonesia; <sup>b</sup> Mathematics Department, Faculty of Mathematics and Natural Science, Udayana University, Indonesia; <sup>c</sup> Computer Science Department, Faculty of Mathematics and Natural Science, Udayana University, Indonesia

### Conclusion

- ▶ TLC/HPTLC a robust method is suitable for first-advantage HM standardization



# herbal standardization For Future

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