

INTISARI

APLIKASI SPEKTROMETER FOTOAKUSTIK LASER CO₂ UNTUK DETEKSI GAS AMONIA (NH₃) PADA GAS HEMBUS PENDERITA GANGGUAN LIVER

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Penelitian tentang konsentrasi gas amonia pada relawan penderita liver dan relawan sehat menggunakan teknik spektroskopi fotoakustik laser CO₂ konfigurasi intrakavitasi telah dilakukan. Masing-masing relawan tersebut berjumlah 15 orang dengan rentang usia 20 sampai 65 tahun. Sebelum dilakukan pengukuran konsentrasi gas dari relawan, daya laser CO₂ dioptimasi sehingga diperoleh daya tertinggi sebesar 19,90 watt. Pemayaran garis laser CO₂, pemayaran garis serapan etilen, aseton dan amonia, penentuan kurva resonansi dan faktor kualitas, serta pengukuran sinyal latar dan sinyal derau dilakukan sebagai karakterisasi fotoakustik laser CO₂. Faktor kualitas yang didapat dari hasil karakterisasi pada garis 10P14, 10P20 dan 10P12 masing-masing menunjukkan nilai sebesar $(19,41 \pm 1,13)$, $(15,71 \pm 0,75)$ dan $(9,67 \pm 0,28)$. Batas deteksi terendah pengukuran gas etilen, aseton dan amonia adalah sebesar $(0,58 \pm 0,06)$ ppb, $(1,35 \pm 0,11)$ ppb dan $(0,39 \pm 0,04)$ ppb. Metode pengambilan sampel gas hembus nafas relawan dilakukan secara *offline* dan *noninvasif*, yaitu dengan cara relawan menghembuskan nafas melewati *scrubber* kemudian hembusan nafas tersebut disimpan ke dalam *sample bag*. Sampel tersebut kemudian diukur dengan spektroskopi fotoakustik laser CO₂ dan hasilnya diolah menggunakan analisis multikomponen. Hasil menunjukkan bahwa konsentrasi rata-rata gas amonia yang diperoleh dari relawan penderita liver dan relawan sehat berturut-turut adalah sebesar $(3,27 \pm 0,75)$ ppm dan $(1,43 \pm 0,24)$ ppm. Konsentrasi gas amonia tertinggi dan terendah pada penderita liver adalah 4,77 ppm dan 1,99 ppm. Sementara itu, konsentrasi gas amonia tertinggi dan terendah pada relawan sehat adalah 1,89 ppm dan 1,02 ppm.

Kata kunci : spektroskopi fotoakustik laser CO₂, amonia, gangguan liver, analisis multikomponen.

ABSTRACT

APPLICATION OF THE CO₂ LASER PHOTOACOUSTIC SPECTROMETER IN DETECTING AMMONIA GAS (NH₃) OF LIVER DISEASE PATIENT'S BREATH

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Research on the concentration of ammonia gas in the volunteers of liver disease patients and healthy persons using CO₂ laser photoacoustic spectroscopy technique with intracavity configuration has been done. Each of these volunteers amounted to 15 persons with an age ranging from 20 to 65 years. Prior to the measurement of gas concentration from volunteers, CO₂ laser power was optimized so that the highest power of 19.90 watts was obtained. CO₂ laser line scanning; ethylene, acetone and ammonia absorption line scanning, determination of resonance curves and quality factors, and measurement of background and noise signals were performed as a photoacoustic characterization of the CO₂ laser. The quality factors obtained from the characterization results on the 10P14, 10P20 and 10P12 lines are (19.41 ± 1.13) ; (15.71 ± 0.75) and (9.67 ± 0.28) , respectively. The lowest detection limits of ethylene, acetone and ammonia measurements are (0.58 ± 0.06) ppb; (1.35 ± 0.11) ppb and (0.39 ± 0.04) ppb, respectively. The method of collecting breath gas samples of the volunteers was done offline and noninvasively, i.e. the volunteer breathed through scrubber then the breath was stored into sample bag. The sample was then measured by a CO₂ laser photoacoustic spectroscopy technique and the result was processed using multicomponent analysis. The results show that the average concentration of ammonia gas obtained from the volunteers of liver disease patients and healthy persons is (3.27 ± 0.75) ppm and (1.43 ± 0.24) ppm. The highest and the lowest ammonia gas concentration of liver disease patients are 4.77 ppm and 1.99 ppm. Meanwhile, the highest and the lowest ammonia gas concentration of healthy volunteers are 1.89 ppm and 1.02 ppm.

Key words: CO₂ laser photoacoustic spectroscopy, ammonia, liver disease, multicomponent analysis.