LAPORAN AKHIR

PENELITIAN UNGGULAN PERGURUAN TINGGI (PEMULA)

PENGEMBANGAN APLIKASI SENSOR BIOLISTRIK UNTUK MENDETEKSI LEMAK BABI PADA LEMAK PANGAN

Tahun ke 1 dari rencana 2 tahun

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ABSTRAK

Teknik deteksi cemaran babi yang obyektif dan handal sangat dibutuhkan. Dokumentasi, evaluasi, dan uji laboratorium bagi monitoring cemaran babi memerlukan waktu yang relatif lama. Sifat biolistrik bahan pangan, digunakan menilai kualitas pangan secara cepat dan non-destruktif. Hasil penelitian menunjukkan frekuensi sinyal listrik berpengaruh sangat signifikan terhadap konduktansi lemak. Pada Campuran lemak sapi dan lemak babi, Konduktansi sampel meningkat sampai tingkat tertentu frekuensi dan kemudian menurun sebagai fungsi frekuensi. Impedansi sampel cenderung meningkat seiring dengan meningkatnya frekuensi. Pada campuran lemak sapi dan lemak babi, lemak bertindak sebagai insulator pada frekuensi rendah yang berperilaku seperti sebuah kapasitor.

ABSTRACT

Lard contamination detection technique is objective and reliable is needed. Documentation, evaluation, and laboratory testing for contamination monitoring lard require a relatively long time. Bio-electrical properties of food materials, used rapidly assess the quality of food and nondestructive. The results showed the frequency of the electrical signals very significant effect on the conductance of fat. In Mixed beef tallow and lard, the conductance of the sample frequency increases to a certain level and then decreases as a function of frequency. Impedance of the sample tends to increase with increasing frequency. In a mixture of beef tallow and lard, fat acts as an insulator at low frequencies that behaves like a capacitor

RINGKASAN

Perkembangan metode deteksi cemaran babi, berdasar teknologi sensor dikelompokkan menjadi: metode konvensional berbasis non sensor meliputi *gas chromatography* (GC), *gas liquid chromatography* (GLC), *high performent liquid chromatography* (HPLC), *differential scanning calorimetry* (DSC); dan lain sebagainya. Metode berbasis sensor tak langsung, *polymerase chain reaction* (PCR); dan metode berbasis sensor tanpa pelabelan, meliputi *electronic nose* (E-Nose) dan *fourier transform infrared spectroscopy* (FTIR). Teknik-teknik konvensional berbasis non sensor perlu waktu persiapan sampel, bahan kimia, dan biaya. Teknik sensor tak langsung dan sensor tanpa pelabelan mempercepat persiapan sampel dan analisis, namun biaya investasi alat analisis mahal. Karena itu, perlu dikembangkan teknik analisis cepat, menggunakan alat relatif sederhana dan murah dibanding teknik sebelumnya. Peluang itu terbuka dengan penggunaan sifat bioelektrik bahan.

Perbedaan komposisi bahan berpengaruh pada perbedaan sifat bioelektrik, seperti konduktansi, impedansi, kapasitansi, dan konstanta dielektrik. Sifat bioelektrik juga dipengaruhi frekuensi dan suhu pengukuran. Sifat bioelektrik bahan pangan digunakan menilai kualitas dan kemurnian bahan secara cepat, non destruktif, mengarah *in-situ* berdasar energi elektromagnetik, teknik ultrasonik, dan resonansi (Castro-Giráldez, Fito, Toldrá, and Fito, 2010). Teknik bioelektrik dikembangkan untuk deteksi kerusakan daging sapi (Damez *et al.*, 2008) dan uji pencampuran lemak pangan (Lizhi, Toyoda, Ihara, 2008). Berdasar hal ini, sifat bioelektrik dijadikan dasar deteksi cemaran lemak babi pada lemak pangan. Komposisi asam lemak pangan menjadi salah satu dasar pembeda lemak babi dengan lemak lain, dan campuran diantaranya.

Sifat bioelektrik bahan pangan, telah digunakan menilai kualitas dan kemurnian bahan secara cepat, non destruktif, mengarah *in-situ* berdasar energi elektromagnetik, teknik ultrasonik, dan resonansi (Castro-Giráldez, Fito, Toldrá, and Fito, 2010). Teknik deteksi berbasis bioelektrik dikembangkan mendeteksi kerusakan daging sapi (Damez *et al.*, 2008), campuran lemak pangan (Lizhi, Toyoda, Ihara, 2008). Sebagai hasil awal, pengukuran konduktansi bahan berpotensi untuk mendeteksi lemak babi (Sucipto, Irzaman, Tun Tedja , dan Fauzi, 2011). Sifat biolektrik (konduktansi, impedansi, kapasitansi, dan konstanta dielektrik) sangat ditentukan komposisi bahan dan frekuensi spesifik pengukuran.

Perkembangan teknik preprosesing data dan machine learning dalam chemometric banyak digunakan untuk mempercepat proses klasifikasi. Hal ini membantu proses sensor non-destruktif bahan pangan. Belum ada penelitian deteksi lemak babi pada lemak pangan berbasis sifat bioelektrik dan chemometric. Berdasar hal ini, maka kombinasi sifat bioelektrik bahan pangan dan teknik chemometric akan dijadikan basis dalam rancang bangun teknik deteksi cepat cemaran lemak babi pada berbagai lemak pangan.

Penelitian ini penting, karena membuka peluang proses deteksi cemaran lemak babi menjadi lebih cepat, akurat, dan sederhana, serta relatif lebih murah dibanding teknik yang dipakai sebelumnya. Ini akan berkontribusi nyata dalam pengembangan ipteks penunjang pengawasan produksi, distribusi, dan sertifikasi produk halal yang sangat diperlukan konsumen.

Hasil penelitian menunjukkan frekuensi sinyal listrik berpengaruh sangat signifikan terhadap konduktansi lemak. Pada Campuran lemak sapi dan lemak babi, Konduktansi sampel meningkat sampai tingkat tertentu frekuensi dan kemudian menurun sebagai fungsi frekuensi. Impedansi sampel cenderung meningkat seiring dengan meningkatnya frekuensi. Pada campuran lemak sapi dan lemak babi, lemak bertindak sebagai insulator pada frekuensi rendah yang berperilaku seperti sebuah kapasitor.

SUMMARY

The development of lard contamination detection method, based on sensor technology are classified into: non-conventional methods based sensors include gas chromatography (GC), gas liquid chromatography (GLC), high performent liquid chromatography (HPLC), differential scanning calorimetry (DSC). Indirect sensor-based method, polymerase chain reaction (PCR), and sensor-based methods without labeling, includes electronic nose (E-Nose) and Fourier transform infrared spectroscopy (FTIR). Conventional techniques based on non sensors need to sample preparation time, chemicals, and costs. Indirect methods of sensor and sensor without labeling accelerate sample preparation and analysis, but the cost of an expensive investment analysis tools. Therefore, it is necessary to develop rapid analytical technique, using a relatively simple and inexpensive compared to previous techniques. The opportunities open to the use of bioelectric properties of materials

Differences composition effect on bioelectric properties, such as conductance, impedance, capacitance, and dielectric constant. Bioelectric properties are also influenced by the frequency and temperature measurements. Bioelectric properties of food materials used assess the quality and purity of the ingredients in a fast, non-destructive, in-situ lead based electromagnetic energy, ultrasonic techniques, and resonance (Castro-Giraldez, Fito, Toldrá, and Fito, 2010). Techniques developed for the detection of damage bioelectrical beef (Damez et al., 2008) and test mixing fat food (Lizhi, Toyoda, Ihara, 2008). On this basis, bioelectric properties form the basis of the detection of lard contamination in food fats. The fatty acid composition of food to be one of the basic differentiator pork fat with other fats, and mixtures of them.

The development of techniques of data preprocessing and machine learning in chemometric widely used to speed up the classification process. It supports the process of non-destructive sensors foodstuffs. Research lard detection based on fatty foods and chemometric bioelectric properties have not been developed. The combination of bioelectric properties of foodstuffs and chemometric techniques will be used as a basis for engineering design rapid detection of lard contamination in various food fats.

This study is important, because it opens opportunities lard contaminant detection process becomes more rapid, accurate, and simple, and relatively inexpensive compared to

previously used techniques. The results of the study will contribute in supporting the development of science and technology supervision of production, distribution, and certification of halal products indispensable consumers.

The results showed the frequency of the electrical signals very significant effect on the conductance of fat. In Mixed beef tallow and lard, the conductance of the sample frequency increases to a certain level and then decreases as a function of frequency. Impedance of the sample tends to increase with increasing frequency. In a mixture of beef tallow and lard, fat acts as an insulator at low frequencies that behaves like a capacitor.

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