Wednesday 26 October 2022		
	PCH-North	PCH-South
	Session Chair: Steve Cui	
8:40-9:20	P5 Prof. Dr. David J. Jenkins, Canada, Hydrocolloids, Glycemic Index for Human and Planetary Health	
9:20-10:00	P6 Prof. Dr. Yong-Cheng Shi, USA, Comparison of Gum Arabic, Starch Octenylsuccinate and Corn Fiber Gum as Emulsifiers	
10:00-10:35	K6 A/Prof. Dr. Ying Wu, USA, Application of Yellow Mustard Mucilage in Encapsulation of Essential Oils and Polyphenols using Spray Drying	
10:35-10:55	Break	
	Session Chair: Ying Wu	**Session Chair: Yongfeng Ai**
10:55-11:15	C45- Physicochemical properties of edible films formed by self-stratification of zein and hydroxy propyl methyl cellulose Go to abstract	C50 - Plant-based burgers versus beef burgers - how does food structure alter lipid digestion? Go to abstract
11:15-11:35	C46 - Preparation of ginger-derived nanoparticles for the stabilization of oil-in-water Pickering emulsions Go to abstract	C51 - Adipose tissue mimetics based on thixotropic ethylcellulose oleogels of oil glycerolysis products Go to abstract
11:35-11:55	C47 - Oleosome Interfacial Engineering to Enhance Functionality in Food Go to abstract	C52 - Textural restoration of broiler breast fillets with spaghetti meat myopathy, using two alginate systems Go to abstract
11:55-12:15	C48 - Effects of extraction pH and ball milling on physicochemical and functional properties of hempseed protein (Cannabis L. Sativa) Go to abstract	C53 - Using zein as a cohesive and viscoelastic agent in plant-based food analogues Go to abstract
12:15-12:35	C49-Impact of free calcium and magnesium incorporation to the heat-stability of a model UHT milk with dairy and soy protein Go to abstract	C54 - Effects of ph and functionalization on molecular configuration and rheology of salmon gelatin suspensions .Go to abstract
12:35	Adjourn and Lunch	

C45 - Physicochemical properties of edible films formed by self-stratification of zein and hydroxy propyl methyl cellulose

Yuyang Zhang, Loong-Tak Lim, Iris Joye

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Self-stratification during film-forming is an innovative and effective method for forming multi-layer films in a one-step formulation. The phenomenon overcomes the drawbacks of preparing multi-layer film systems by applying different layers consecutively. The incompatibility of polymers in the coat-forming solution is a prerequisite to induce phase separation that drives the self-stratification process. To produce a homogeneous solution, two incompatible polymers are dissolved in a common solvent or in a mixture of several solvents, and then phase separation can occur as the solvent evaporates. In the present study, two incompatible polymers, i.e., zein and hydroxy propyl methyl cellulose (HPMC) were dissolved in 70% (w/w) aqueous ethanol at 5% (w/w) total polymer concentration at different ratios (0:5, 1:4, 2:3, 1:1, 3:2 zein: HPMC). The solutions were cast and dried at 20 ℃ and 75% relative humidity to obtain films of various morphology and physiochemical properties. The cross-section of pure HPMC film, as revealed in scanning electron microscopy (SEM), displayed a uniform and smooth morphologies. With the addition of zein, submicron zein particles were formed in the film. The average size of the particles increased from 497 nm to 1222 nm as zein content increased from 20% to 60%. The spherical particles were homogeneously distributed in the film. Attenuated total reflectance-Fourier transform infrared spectroscopy showed the characteristic absorbance peaks of zein and HPMC, with no new absorbance peak nor frequency shift in the composite films. The addition of zein did not cause significant changes ($p > 0.05$) in the average film thickness, which ranged between 22.40 μm (HPMC) and 23.30 μm (2:3 zein: HPMC). Pure HPMC film presented the highest water vapor permeability (1.89 10-5 g·mm/m2·h·kPa), which decreased to from 1.7910-5 to 1.4510-5 g·mm/m2·h·k·Pa as zein content increased from 20% to 60%. The opacity of HPMC film was 1.61 mm-1, which increased significantly ($p < 0.05$) as zein content increased. The pure HPMC films showed the lowest value of (0.113), which increased significantly ($p < 0.05$) with increasing zein content. The tensile stress decreased significantly ($p < 0.05$) from 62.35 to 33.65 MPa, while the elongation at break decreased from 14.88% to 1.88%, for HPMC and 3:2 zein: HPMC films, respectively. Overall, SEM analysis confirmed the existence of type-III self-stratification during the formation of the composite films, and intermolecular interaction was not detected between zein and HPMC after phase separation during the drying process.

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C46 -Preparation of ginger-derived nanoparticles for the stabilization of oil-in-water Pickering emulsions

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The present study reported the preparation of ginger-derived nanoparticles (GNPs) as a Pickering emulsifier for the first time. The rhizome of ginger (Zingiber officinale) was washed thoroughly with tap water at room temperature. After final washing, the ginger rhizome was juiced in a blender, followed by passing through a 100-mesh and a 400-mesh nylon press cloth. After resting overnight, the upper liquid was centrifuged for 15 min (5000 r/min) to remove larger ginger fibers. The obtained supernatant was placed in deionized (DI) water for dialysis for 24 h (MWCO 8,000~14,000 Da). The GNPs suspensions after dialysis were concentrated to 0.48% wt by a rotary evaporator and were stored at 4 ℃. For proximate analysis and physicochemical characterization, a part of the GNPs suspensions was further freeze-dried and stored in a bag and sealed. By characterizing of the suspensions of ginger-derived nanoparticles, a zeta-potential of -32.37±0.42 mV, polydispersion index of 0.230±0.069, and average particle size of 298.07±17.69 nm (25 ℃ , pH=7.5) were obtained for GNPs. The GNPs had a water contact angle of 73.8°. The morphology and structural characteristics of GNPs were investigated by the transmission electron microscope (TEM), Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), and thermal analysis, respectively. The oil-in-water Pickering emulsions stabilized by the GNPs suspensions were prepared. Optical microscopy indicated that microstructures and drop sizes of the Pickering emulsions depended on the concentration of GNPs and oil fraction. Rheological measurements indicated that a higher concentration of GNPs (0.06% wt to 0.48% wt, oil fraction=0.50) increased viscosity and storage modulus. Visual inspection demonstrated that increasing oil fraction (from 0.20 to 0.64) induced decreasing creaming index. Pickering emulsions stabilized by the GNPs showed similar stability at different pH values (from 2.5 to 8.5). Pickering emulsions stabilized by GNPs showed a high degree of stability over 30 d of storage. In conclusion, ginger-derived nanoparticles are a potentially excellent candidate as one of the oil-in-water Pickering emulsifiers

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C53 - Using zein as a cohesive and viscoelastic agent in plant-based food analogues

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Recent awareness related to health concerns and environmental sustainability issues has led to changes in consumer preference toward plant-based proteins and the related market has been booming with growing investments and new plant-based alternatives. However, improvements still need to be made in the quality of products (e.g., texture, flavor, and color) to match those of meat and cheese products. Specifically, the lack of viscoelastic-cohesive network formation in commercial plant proteins (e.g., soy and pea) hampers the alternatives. While wheat gluten or hydrocolloids, such as methylcellulose and xanthan gum, have been used to overcome this drawback, these ingredients are not desirable to many processors and consumers who want them to be either clean label or gluten-free. Here, we show that corn protein zein, which is known for its unique ability to create viscoelastic fibrils and network formation similar to wheat gluten upon proper conditioning, provides such a viscoelastic network in foods that confers cohesiveness and a tender chewiness to plant protein-based analogue formulations. Soy, pea, chickpea, pumpkin seed, and rice proteins were tested with and without the addition of zein to determine both the functionality of those blends and the compatibility of zein with those proteins. Among all, pea and chickpea proteins had relatively good functionality with their high complex modulus showing strength of the blends (i.e., cohesiveness), low phase angle values indicating elasticity (i.e., viscoelasticity), and high extensional viscosity (i.e., resistance to extension under large deformation conditions). The addition of zein to these blends further improved their rheological properties by forming interconnected well-dispersed web-like networks as shown by scanning electron and confocal microscopy, thus conferring viscoelastic and cohesive structure. Then, we introduced a new method to functionalize zein at room temperature without the necessity of a treatment above its glass transition temperature. Sole addition or a combination of arginine and calcium hydroxide treatments not only further enhanced the viscoelastic properties of model pea protein-zein formulation but also further strengthened the viscoelastic zein fibrils holding the structure together through a dispersed network. Secondary structure composition analysis by FT-IR showed the importance of β-sheet content in enhancing the material viscoelastic properties, arginine and calcium hydroxide-incorporated blends presenting the highest β-sheet content. Furthermore, the textural properties of formulations were adjusted by varying calcium hydroxide concentrations in the formulations (1-7%) to match those of commercial meat and cheese products. By changing the concentration, the formulation still preserved its well-dispersed zein networks (by SEM and confocal) without any change in its protein molecular chemistry (by FT-IR). Most notably, the textural properties of the formulated blends could be matched to those of tested commercial products (1%-tilapia fish, 3%-chicken nugget and mozzarella cheese, 5%-tuna fish and Colby cheese, 7%-burger patties). Overall, zein combined with other ingredients (calcium hydroxide and rice starch) can be the primary, and even superior, agent providing cohesiveness and viscoelasticity to plant-based protein formulations. Practical outcomes are formulations of new plant-based meat and cheese analogues that match the textural properties of existing animal-based commercial products.
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C48 - Effects of extraction pH and ball milling on physicochemical and functional properties of hempseed protein (Cannabis L. Sativa)

Sharath Julakanti[1], Jing Zhao[2], Fitzroy Bullock[1], Rabia Syed[1] and Ying Wu[1],

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Hemp (Cannabis Sativa L.) is an annual crop cultivated mainly for its use as medicinal, food, oil and fiber sources. Hempseeds contain about 30% of protein, 30% of oil and 25% of fiber. The protein fraction contains all the essential amino acids and offers enough concentration of each amino acid for infant/children consumption as suggested by FAO/WHO. The objective of this study is to obtain high protein concentrates with controlled use of mechanochemical process such as ball milling in combination with extraction pH. Defatted hempseed meal was ballmilled and protein was extracted using isoelectric precipitation at pH 8, 9 and 10. The obtained protein was examined for changes in color, composition, emulsion stability, zeta-potential and droplet size, surface tension, surface hydrophobicity, solubility and water and oil holding capacity compared against the protein extracted without ball milling. The extraction pH and ball milling have introduced a significant change in yield and protein functional properties such as surface activity, solubility, hydrophobicity, zeta potential, droplet size, emulsion stability, water holding capacity and oil holding capacity. Ball milling has improved the yield, solubility, emulsion stability, droplet size and zeta potential. Low pH extraction preserved the native state of protein which was reflected in better surface activity due to higher amphiphilic protein content. According to the surface activity data, the amount of amphiphilic protein decreased with increasing extraction pH. At pH 5 and lower, ball milling significantly improved the solubility of proteins extracted at pH 8. As the extraction pH increased, the water holding capacity was increased due to higher extent of protein denaturation and oil holding capacity was reduced due to decrease in particle size. The current study can be used to optimize the functional properties of the hempseed protein according to the method of extraction. This study shows that optimization of extraction parameters can also help increase the yield by using mechanochemical extraction methods like ball milling. Depending on the designated use of hemp seed protein, the extraction process can be designed to target the most profitable functional properties.

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C49 - Impact of free calcium and magnesium incorporation to the heat-stability of a model UHT milk with dairy and soy protein

Wei Wang, Martin Chen

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The stability of high protein ready-to-drink (RTD) milk during heat-treatment is usually a big challenge, especially when mineral salts, such as calcium and magnesium, are fortified in the formulation for nutritional purposes. In this study, we investigated the impact of calcium and magnesium chloride at concentrations of 0, 2, 3.5, 5 and 6.5 mM on physic-chemical properties of a model formulation after heating. The UHT milk model combines milk protein concentrate and soy protein isolate (MPC-SPI) in the formulation, which can be usually found on commercial UHT milks with high protein concentration in the market.

After homogenization and pasteurization, the model milk was dosed with different levels of CaCl2 or MgCl2, respectively, before heat-treatment using the liquid rheometer. The viscosity of the model milk with different levels of salt was measured with a temperature ramp between 20 to 80 degrees Celsius. Increasing of either magnesium or calcium concentration resulted in a more significant increase in viscosity and the milk's medium particle size (D50) after heating, with MgCl2 showing slightly less effectiveness than CaCl2 at higher concentration. More importantly, the change in viscosity and particle size appears to follow a non-linear relationship with the increased mineral level, where a dramatic change in viscosity and particle size was found at 5mM or even higher mineral concentration. LUMsizer analysis showed that the de-stabilization pattern of the sample with high salt concentration was significantly different from their low salt concentration counterparts. This was further verified by the microscope observation of their protein aggregation degree after heating. This study could lay a solid foundation for future nutritional UHT milk development for industrial application

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C45 -Physicochemical properties of edible films formed by self-stratification of zein and hydroxy propyl methyl cellulose

Yuyang Zhang, Loong-Tak Lim, Iris Joye

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Self-stratification during film-forming is an innovative and effective method for forming multi-layer films in a one-step formulation. The phenomenon overcomes the drawbacks of preparing multi-layer film systems by applying different layers consecutively. The incompatibility of polymers in the coat-forming solution is a prerequisite to induce phase separation that drives the self-stratification process. To produce a homogeneous solution, two incompatible polymers are dissolved in a common solvent or in a mixture of several solvents, and then phase separation can occur as the solvent evaporates. In the present study, two incompatible polymers, i.e., zein and hydroxy propyl methyl cellulose (HPMC) were dissolved in 70% (w/w) aqueous ethanol at 5% (w/w) total polymer concentration at different ratios (0:5, 1:4, 2:3, 1:1, 3:2 zein: HPMC). The solutions were cast and dried at 20 ℃ and 75% relative humidity to obtain films of various morphology and physiochemical properties. The cross-section of pure HPMC film, as revealed in scanning electron microscopy (SEM), displayed a uniform and smooth morphologies. With the addition of zein, submicron zein particles were formed in the film. The average size of the particles increased from 497 nm to 1222 nm as zein content increased from 20% to 60%. The spherical particles were homogeneously distributed in the film. Attenuated total reflectance-Fourier transform infrared spectroscopy showed the characteristic absorbance peaks of zein and HPMC, with no new absorbance peak nor frequency shift in the composite films. The addition of zein did not cause significant changes ($p > 0.05$) in the average film thickness, which ranged between 22.40 μm (HPMC) and 23.30 μm (2:3 zein: HPMC). Pure HPMC film presented the highest water vapor permeability (1.89 10-5 g·mm/m2·h·kPa), which decreased to from 1.7910-5 to 1.4510-5 g·mm/m2·h·k·Pa as zein content increased from 20% to 60%. The opacity of HPMC film was 1.61 mm-1, which increased significantly ($p < 0.05$) as zein content increased. The pure HPMC films showed the lowest value of (0.113), which increased significantly ($p < 0.05$) with increasing zein content. The tensile stress decreased significantly ($p < 0.05$) from 62.35 to 33.65 MPa, while the elongation at break decreased from 14.88% to 1.88%, for HPMC and 3:2 zein: HPMC films, respectively. Overall, SEM analysis confirmed the existence of type-III self-stratification during the formation of the composite films, and intermolecular interaction was not detected between zein and HPMC after phase separation during the drying process.

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C50 - Plant-based burgers versus beef burgers - how does food structure alter lipid digestion?

Zhitong Zhou[1], Pedram Nasr[1], Arianna Sultani[1], H. Douglas Goff[1], Maria G. Corradini[1,2], Iris J. Joye[1], Michael A. Rogers[1],*

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Plant-based, ultra-processed burger compared to traditional comminuted beef burger share similar physicochemical and organoleptic characteristics, yet a knowledge gap exists in understanding the lipemic responses following consumption. This study characterizes the structural differences between plant-based and traditional beef burgers and determines how structure alters the in-vitro fatty acid bioaccessibility during simulated digestion using the robotic digestive system, the TNO Intestinal Model-1 (TIM-1). Plant-based burger comprised of formulated ingredients have no intact whole food structure, while in comminuted beef, myofibrils entrap intramyocellular lipids or the perimysium connective tissues enclose lipids as intramuscular adipocytes. Plant-based and beef burgers have distinctly different food structures, resulting in a significantly higher FFA bioaccessibility for the plant-based burger (28.2 ± 4.80%) than the beef burger (8.73 ± 0.52%). The FFA release profiles are sigmoidal and fit a three-parameter shifted logistical model as a function of digestive time. Based on the cumulative FFA bioaccessibility (%) in combined jejunal and ileal compartments, the rate of lipolysis (k, min-1) is significantly higher for plant-based burger (0.022, 95% confidence interval (CI) [0.019, 0.026]) than beef burger (0.015, 95% CI [0.010, 0.019]). In contrast, the induction times (tc, min) that indicate the time for releasing half of the total FFA for plant-based beef (166, 95% CI [155, 177]) and beef (202, 95% CI [165, 239]) are not significantly different attributed to the scattering of data points, especially for beef burgers due to the inevitable variance between comminuted patties; however, the plant-based burger has a significantly shorter induction time than beef when constructing the confidence level of 90%. With an emphasis on food structure, this research provides insights into how the physical structure plays a dominant role in modulating the kinetics of lipid digestion, FFA bioaccessibility and potential bioavailability.

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C51 - Adipose tissue mimetics based on thixotropic ethylcellulose oleogels of oil glycerolysis products

Yasamin Soleimanian, Saeed M. Ghazani, Alejandro G. Marangoni

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Enzymatic glycerolysis is a viable technique to structure a variety of oils by converting native triacylglycerols into partial glycerides without changing the overall fatty acid composition. Here we report on the use of specific oil glycerolysis products (GP) as the oil phase of ethyl-cellulose (EC) oleogels. EC oleogels were prepared using a variety of oils including shea olein, rice bran, peanut, cottonseed, palm olein, and high oleic canola oil and EC with different molecular weights (20 cP, and 45 cP) at 5% w/w level. The thermal profile for the GP EC oleogels resembled that of the neat glycerolysis products, however, the melting peaks were shifted to higher temperatures, likely due to interactions between the partial glycerides and the EC backbone. Oleogel formulations behaved as non-Newtonian pseudoplastic fluids, but some also displayed a thixotropic character, as indicated by the reduction of viscosity with an increase in share rate, and a time-dependence in the viscosity recovery after shear. The rheological (Small deformation oscillatory rheology) and mechanical (Texture Profile Analysis) properties of the EC oleogels were compared to those of whole pork and beef adipose tissue to map and compare thermal softening behavior and absolute rheological characteristics. The thermal softening behavior of some of the EC oleogels was very similar to those of native adipose tissue and showed the potential for EC oleogels of oil glycerolysis products to be used as adipose tissue mimetics in the new generation of plant-based meat analogues.

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C52 - Textural restoration of broiler breast fillets with spaghetti meat myopathy, using two alginate systems

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The effect of single salt-sensitive alginate (called 'A') and a two-component salt-tolerant alginate system ('B') used at a 0.5% or 1.0% level, were evaluated in normal breast (NB) chicken fillets and Spaghetti Meat (SM), an emerging myopathy exhibiting loose, detached fiber-like muscle fibers mainly in the cranial part of the chicken fillet. Minced raw and cooked SM samples showed higher cooking loss ($P < 0.05$) and lower penetration force compared to NB meat. Both alginate systems significantly raised penetration force in raw samples and decreased cooking loss ($P < 0.05$). Adding 1% of 'A' or 0.5% 'B' to SM, without salt, resulted in a similar penetration force as the cooked NB meat, while 1% 'B' with salt resulted in a higher penetration force. Excluding salt from SM samples while adding alginate ‘A’ or ‘B’ improved texture profiles, but not to the same level as using NB without additives. Overall, salt, together with alginate 'B', improved the texture of SM to that of normal meat without myopathy.

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C47 - Oleosome Interfacial Engineering to Enhance Functionality in Food

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In eukaryotes, oleosomes are naturally emulsified oil droplets, covered and stabilized by a unique protein/ phospholipid membrane. This makes them natural oil-in-water suspensions. After extraction, oleosomes have a low suspension stability even during storage at fridge temperature. The charge properties of the oleosomes' surface can be a major factor contributing to the stability of the oleosomes. So, changing pH can have a large effect on the stability of oleosomes. During storage of oleosomes, the pH of the suspension drops below the isoelectric point (pI) of the oleosome proteins (~6.2), that makes oleosomes start aggregating. This severely limits their potential applications in foods.

In this study, we attempted and succeeded in depositing natural surface-active components such as lecithin, and polysaccharides (xanthan and gellan) on the oleosome surface to create a multilamellar structure surrounding the oil droplet to provide steric and electrostatic barriers against flocculation and enhance mechanical strength. Multilamellar "structured" oleosomes, or coated oil-bodies, showed an enhanced stability and improved mechanical properties. These structured oleosomes could then be incorporated in spreads, cream, and processed cheese at acidic pHs.

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C54 -Effects of ph and functionalization on molecular configuration and rheology of salmon gelatin suspensions.

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Gelatin methacrylol (GelMA) hydrogels potential for tissue engineering has been well established. However, information regarding GelMA, specially from salmon origin, SGelMA, molecular configuration and how pH affect this configuration is scarce, despite being an important for fabrication purposes. The aim of this work was to characterize SGelMA at various pHs by rheology and molecular configuration and to compare this data with porcine gelatin methacryloyl (PGelMA). Results showed degree of functionalization and pH affecting gelatin molecular structure and rheological properties. In addition, SGelMA molecular structure was more sensitive to changes in pH, showing differences in gelification temperatures and triple helix formation than PGelMA. This suggest that SGelMA showed wider tunebility potential as biomaterial for biofabrication.

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Preparation of ginger-derived nanoparticles for the stabilization of oil-in-water Pickering emulsions

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The present study reported the preparation of ginger-derived nanoparticles (GNPs) as a Pickering emulsifier for the first time. The rhizome of ginger (Zingiber officinale) was washed thoroughly with tap water at room temperature. After final washing, the ginger rhizome was juiced in a blender, followed by passing through a 100-mesh and a 400-mesh nylon press cloth. After resting overnight, the upper liquid was centrifuged for 15 min (5000 r/min) to remove larger ginger fibers. The obtained supernatant was placed in deionized (DI) water for dialysis for 24 h (MWCO 8,000~14,000 Da). The GNPs suspensions after dialysis were concentrated to 0.48% wt by a rotary evaporator and were stored at 4 ℃. For proximate analysis and physicochemical characterization, a part of the GNPs suspensions was further freeze-dried and stored in a bag and sealed. By characterizing of the suspensions of ginger-derived nanoparticles, a zeta-potential of -32.37±0.42 mV, polydispersion index of 0.230±0.069, and average particle size of 298.07±17.69 nm (25 ℃ , pH=7.5) were obtained for GNPs. The GNPs had a water contact angle of 73.8°. The morphology and structural characteristics of GNPs were investigated by the transmission electron microscope (TEM), Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), and thermal analysis, respectively. The oil-in-water Pickering emulsions stabilized by the GNPs suspensions were prepared. Optical microscopy indicated that microstructures and drop sizes of the Pickering emulsions depended on the concentration of GNPs and oil fraction. Rheological measurements indicated that a higher concentration of GNPs (0.06% wt to 0.48% wt, oil fraction=0.50) increased viscosity and storage modulus. Visual inspection demonstrated that increasing oil fraction (from 0.20 to 0.64) induced decreasing creaming index. Pickering emulsions stabilized by the GNPs showed similar stability at different pH values (from 2.5 to 8.5). Pickering emulsions stabilized by GNPs showed a high degree of stability over 30 d of storage. In conclusion, ginger-derived nanoparticles are a potentially excellent candidate as one of the oil-in-water Pickering emulsifiers.

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